International Journal of Computer Applications Technology and Research
Volume 10–Issue 06, 132-135, 2021, ISSN:-2319–8656

An Analysis on Human Resource Development Culture and Climate of Chemical Based Public Sector Enterprises in Kerala, India

Balakrishnan.A
Research scholar in Management
Srinivas University, Mangalore
Karnataka, India

Dr. KVM Varambally
Former Director of Manipal institute of Management
and
Research Guide, Department of Management
Srinivas University
Mangalore, Karnataka, India

Abstract: The impact of Globalization creates a competitive horizon with new markets, new products, new mindsets, new competencies, and new ways of thinking about business. As an outcome of this, the market places become more complex, uncertain, competitive, and transformational. In this era, the major challenge faced by any organization is to maintain a peaceful as well positive culture and climate inside the organization. The human resource development climate of an organization plays a significant role in ensuring the competency, motivation, and development of its employees. Here the term climate denotes the quality of the internal environment. It influences morale and the attitudes of the individual toward his work and his environment. Culture refers to the deep structure of organizations, which is rooted in the values, beliefs, and assumptions held by organizational members. The study was aimed to analyze the Human Resource Development culture and climate of chemical-based public sector enterprises in Kerala. The results indicated that the Human Resource Development climate in an organization is average and the perception of employees regarding Human Resource Development culture and climate does not differs significantly based on age, job approval status, and qualification. But it differs significantly based on gender and experiences.

Keywords: Globalization, Human resource development, Human Resource Development Culture, chemical-based, public sector.

1. INTRODUCTION

The success of any organization depends upon skillful employees and efficient management. Providing the right type of climate in an organization helps the employees to showcase their full potential and to use the opportunities effectively to achieve the goals of the organization and thereby ensuring optimization of human resources. Under globalization, all boundaries have vanished and the world is now growing independently. Organizations started planning to think globally and act locally. As a result without any barriers, the exchange of knowledge, technology, ideas, information, literature, and culture is shared. Above all one of the major challenges for any organization in this era is to maintain a peaceful as well positive culture and climate inside the organization. It is supposed that the organization's best way to tackle these challenges will be for those that can acquire and utilize valuable recourses and cultivate a positive culture and neutrally maintain the climate. In the world of cutthroat competition, the only actions will survive.

Kerala, God's own country had exposed many things in front of the world such as unrivaled scenic beauty, delectable cuisine, vivid architectural styles, and cottage, etc. From the centuries back, traditional industries like mat-weaving handloom, bamboo products, coir products, etc. were popular in different parts of Travancore, Cochin, and Malabar. To utilize these cultures, serious attempts that were started only by the middle of the 19th century, those are an example of Human resources utilization. An organization that has a better Human Resource Development climate will perform more effectively than an organization that does not have them. The success of any organization is determined by the skill and motivation of its members. While this has always been true, recent changes focus on ways in which Human Recourse Development activities can be used to ensure organizations have what they need to meet challenges. The competence, motivation, and development of employees depend mainly on the human resource development climate of an organization. The appropriate climate can be created through effective HR development systems and leadership styles on the part of management.

In 2016, Desimone. R.I., Werner.J.M.&Harris.D.M. point out that the human resource development climate is both a means to an end as well as an end in itself. In 1973 Pritchard and Mara sick define The Human Recourse Development climate as a relatively sustainable quality of an organization's internal environment, distinguishing it from other organizations that are.

1. Results from the behavior and practice of members of the organization especially in top management.
2. Is perceived by members of the organization,
3. Serves as a basis for interpreting the situation,
4. Acts as a source of pressure for directing activity.

Human resource development climate can be grouped as general climate, HR culture (OCTAPACE), and HR mechanisms. As far as the general climate is concerned, the following factors play an enabling role in improving the human resources development climate:

1. Top Management Style and Philosophy
2. Personnel Policies

3. Positive Attitudes Towards Development

4. The commitment of Line Managers

The HRD (OCTAPACE) culture items deal with the extent to which Openness, Confrontation, Trust, Autonomy, Pro-activity, Authenticity, Collaboration, and Experimentation are valued and promoted in the organization. The primary responsibility of the Human Resources Manager is to acquire a thorough understanding of the culture, plans, and policies of the organization. Important HRD mechanisms, which constitute part of the HRD climate and are considered for the present study are the following.

1. Performance Appraisal

2. Career Planning

3. Grievance Mechanism

4. Feedback and Counseling

5. Training and Development

6. Employee Welfare for quality work-life

7. Job rotation

8. Rewards

9. Recruitment and Selection.

In the changing world of globalization, HRD is inevitable for acquiring higher competencies and sharpened skills. A newer approach to accomplish the organizational goals will be benefited by the end-user i.e., the customer. Although Kerala has a progressive face in many areas of social development, it is a sad predicament that the industrial sectors in the state are yet to shed their conservative approaches and go out to take up new challenges and opportunities. The contribution of the present status and the unwillingness of the authorities to bring on changes either structural or functional in the industrial development scenario would be highly damaging to the interests of the young generation in general and the present employees in particular. The findings of the study should help the concerned authorities to provide the lacking of HRD elements that can increase the service output and efficiency.

Public enterprises have more social obligations than other organizations. These organizations spending on HRD activities did not convert into the desired output. Additional HRD activities are needed to increase the effectiveness and efficiency of the employees of chemical-based state-owned enterprises in Kerala. This study is proposed to be made to analyze the problems and prospects of the HRD system in the Chemical-based state public sector in Kerala, India.

2. OBJECTIVES

1. To study the HRD culture and climate prevailing in chemical bases public enterprises in Kerala.

2. To analyze the problems and prospects of the HRD system in chemical-based state-level public enterprises in Kerala.

3. To understand the strength and weaknesses of the HRD activities in these organizations.

4. To evolve appropriate strategies and suggest measures to improve the efficiency of the employees in these organizations.

3. LITERATURE REVIEW

Iqbal (2007) says human productivity is crucial for the growth and survival of organizations. Wilson.J.P.(2005) supported the idea and investigated that performance management is not a technique or a single step process, but rather a collection of processes that include employee knowledge of what their managers expect of them, motivation to perform well, mentoring, and performance evaluation to identify areas where improvements are required. Nurmi (2001) conducted a study on "An Investigation of Evaluation of Human Resource Development: A Case Study in the Finish Pulp and Paper Industry". This unpublished dissertation focused on the evaluation of industrial Human Resource Development (HRD). The study analysed the conceptual background of Human Resource Development (HRD). Bhardwaj, and Mishra (2002), conducted a study on private sector organizations which is one of India's largest multi-business companies. Thus, on the whole, the existence of a good HRD climate in the organization is covered under the study. Managers, in general, had a positive attitude toward the organization's HRD policies and procedures. They were pleased with top management's developmental policies, as well as the current HRD climate in the firm. Mufeed (2006) conducted a comprehensive study about the perception of medical staff towards HRD climate in the said hospital. The result of the study shows the existing HRD climate in the hospitals to a large extent is significantly poor. The study also shows that HRD in organizations uses various instruments like performance appraisal, training, promotion, rewards, organizational development, counseling, etc., to create a climate conducive to achieve organizational efficiency and effectiveness. The review of the literature highlights the important role played by HRD Climate in the successful performance of organizations.

4. METHODOLOGY

The investigator used normative survey methods for the present study. Employees of Kerala's chemical-based Public Sector Enterprises were included in the study as population constituents. When all three chemical-based public sector units (PSUs) in Kerala were combined, the total population was 2104 people. The researcher individually contacted 600 employees from three chemical-based PSUs.The tools and techniques used for the present study are the Human Resource Development Climate (HRDC) Questionnaire ,Personal Interviews and Secondary data.The Secondary sources were used for the study includes the following

1. Office records of administration & HRD Departments of the concerned companies.

2. Economic review of state planning Economic Board, Kerala.

3. “A Review of Public Enterprises in Kerala” for the years 2013-14 to 2017-18 published by Bureau of Public Enterprises, Government of Kerala, Trivandrum.

4. Books and Magazines published by Chemical based PSUs in Kerala

5. Standing Orders of the companies.

6. Annual reports of chemical based state level public sector enterprises in Kerala.

All the respondents were approached individually and personal interviews were conducted to elicit relevant data from these personnel clearing the apprehensions. The researcher received 444 completed surveys, with a response rate of 74%. After rejecting 42 questions for various reasons such as incompleteness, insufficient information, and errors, a total of 402 completed questionnaires were chosen for the study. The Employees Details both Managerial Staff and Workers of study are shown in Table 1.

Table 1

Employees Details both Managerial Staff and Workers

Organization	Managerial Staff	Workers	Total	Total Number of employees
Minerals & Metals,Chavara	68	148	216	1064
Titanium Products Trivandrum	48	98	146	664
The Cochin Chemicals	18	64	82	376

5. FINDINGS AND DISCUSSIONS

The major goal was to research the culture and atmosphere of HRD in Kerala's chemical-based industries. The HRD climate is found to be significantly associated with all of the parameters. However, a strong link was discovered with the HRD process. All of the sub-dimensions are significantly associated with HRD (OCTAPACE) culture. In the responses related to the General Climate, the two elements i.e. Top Management Style and Philosophy and Personnel policies scored unfavorable conditions which show the weakness of HRD activity. This demonstrates that the HRD system is the most important contributor to the whole HRD atmosphere in Kerala's chemical-based public sector firms.

The study's second aim was to examine the difficulties and potential of the HRD system in Kerala's chemical-based public firms. (1). General climate, (2). HRD (OCTAPACE) culture, and (3). HRD mechanisms. In the responses related to HRD (OCTAPACE) culture, all the eight elements i.e. Openness, Confrontation, Trust, Authenticity, Pro-Activity, Autonomy, Collaboration, and Experimentation scored favorable conditions which show the strength of HRD activity. In the responses related to HRD Mechanisms, the elements i.e., Career Planning, Employee Welfare, and Quality Work-Life, and Rewards scored an unfavorable condition which shows the weakness of HRD activity. Based on data analysis, the factors contributing to favorable dimensions of HRD culture were as Educated, experienced, and skilled workforce, Positive and motivating attitude of supervisors and executive staff. Dedicated and committed line managers, Dedicated and committed line managers, Positive attitude of some trade unions of the employees, and Freedom to let people work independently with responsibility.

The factors contributing to the weakness of HRD activities were found to be as Non-conformity of actions with the declaration of the top management, Lack of clear cut and adequately defined policy on human resources, Incompetency of concerned persons who are responsible for the development of human resources, Inadequate utilization of HRD instruments and system, Inadequate delegation of power and autonomy to the concerned implementing officers at various levels and Behavioral issues which are varying from person to person occupied at the key position of management.

The research study's third goal was to identify the strengths and weaknesses of HRD operations in these firms." The findings demonstrated that the general elements of HRD climate, such as General Climate, HRD (OCTAPACE) culture, and HRD Mechanisms, were in good condition, indicating that HRD climate is strong. In the responses related to HRD mechanisms, the elements i.e., Performance Appraisal, Grievances Mechanism, Feedback and Counseling, Training, Recruitment & Selection, and Job Rotation scored favorable conditions which show the strength of HRD activity.

The last objective of the present study was to evolve appropriate strategies and suggest measures to improve the efficiency of the employees in these organizations. The measures to improve the efficiency of the employees of chemical-based state PSUs in Kerala are found from the analysis were, conducted Awareness programs regarding economic and technological changes for all employees of chemical-based state PSUs in Kerala, Worker participation in management should be permitted which will help to improve a healthy organizational culture, To improve welfare activities, one officer should be there. This may lead to getting more concentration in welfare activities in these organizations, For positive and rational performance appraisal a clear and comprehensive, parameters based, sketch of evaluation must be defined to make the results of perception more scientific, To make the HRD system practices more acceptable and result-oriented, the Government should fully assist the Public Sector Units for promoting needs-based training and development by providing financial support and technical expertise.

6. CONCLUSION

A good HRD atmosphere is promoted by an organisation that has superior learning, training, and development system, as well as a reward and recognition system and an information system. The quality of the human system and the processes that underpin the enterprise's products and services will be determined by the attitudes, knowledge, and capabilities of the enterprise's personnel, as well as its contractors and suppliers. Currently, state public enterprises have emerged as a vital instrument or public policy for meeting the development objectives in Kerala.

The present study was also an attempt to contribute to a better understanding of the HRD climate prevailing in chemical-based state-level public enterprises in Kerala and make a comparative analysis to understand whether they have some degree of HRD climate or not. Based on the overall analysis it can be concluded that the favorable HRD climate was prevalent in the organizations surveyed. Thus, the extent of the HRD climate prevailing in both organizations seems to be different. For organizational and employee performance it is important to focus on various aspects of the HRD climate prevalent in the organization

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International Journal of Computer Applications Technology and Research
Volume 10–Issue 06, 136-141, 2021, ISSN:-2319–8656

Automatic Voltage Regulator (AVR) Optimization Based on PID Using the Hybrid Grey Wolf Optimization - Genetic Algorithm (HGWGA) Method

Anas Setiawan
Electrical Engineering Department
Brawijaya University
Malang, Indonesia

Panca Mudjirahardjo
Electrical Engineering Department
Brawijaya University
Malang, Indonesia

Wijono
Electrical Engineering Department
Brawijaya University
Malang, Indonesia

Abstract: In the generator set (genset), the voltage stability system is affected by the excitation system controlled by control circuit called AVR (Automatic Voltage Regulator). One of the important components in the AVR system is the algorithm of the controller. The application of the PID control method has been widely used in the design of AVR controllers. This study applies the GWO-GA (Grey Wolf Optimization - Genetic Algorithm) hybrid method on PID parameters setting. The best transient automatic voltage regulator (AVR) response results were obtained when using the hybrid genetic algorithm - grey wolf optimization (HGAGW) method with a fitness score of 4.3039, the Grey wolf optimization (GWO) method with a fitness score of 4.5059, and the genetic algorithm (GA) method with a fitness score of 6.0214.

Keywords: Generator set**,** AVR, PID**,** hybrid GWO-GA

1. PRELIMINARY

Consumption of electrical energy has become a primary need for all lines of community life. Starting from households to industry, it is highly dependent on the availability of electrical energy in the industrial world, the use of electrical energy can increase productivity and efficiency in the production system. The electricity consumption increase in Indonesia is influenced by increasing population and economic growth [1].

Indonesia is one of the electricity deficit countries. It can be seen from the data published by PLN, which states that the level of electrification in Indonesia is 88.3% in 2015 [2]. So that at the end of 2015, PLN made a construction program for electricity generation of 35,000 MW with an electrification target of 97.4% in 2019. Electrification in Indonesia still could not run optimally, one of the causes is Indonesia's geographical location consisting of islands. Due to the level of availability of electrical energy in Indonesia which is still deficit to the level of its needs, the use of generator set (genset) is still used as an alternative as a reserve of electrical energy sources for many consumers.

In the generator set (genset), the voltage stability system is influenced by the excitation system controlled by a control circuit called the AVR (automatic voltage regulator). One of the important components in the AVR system is an algorithm of the controller. The algorithm of a controller has a closed loop-based control method. The controller algorithm functions to process the signal from the sensor then processed into an output score to regulate the excitation flow on the exciter. The use of the control method in the AVR system has the purpose of dealing with the problem of voltage stability at nonlinear load and can also optimize the score of time responses [3].

The control of Proportional Integral Derivative (PID) method has been widely implemented in industrial systems such as chemical processes, biomedical processes, thermal processes, and many others. The advantages of the PID control method are to use and has relatively stable performance (Busra, 2019). Based on this, the use of the PID control method has been widely used in the design of the AVR controller. The optimization of PID control methods is carried out through the tuning parameters of KP, KI, and KD. The PID parameter assistance method carried out conventionally using the Ziegler-Nichols method does not provide optimum performance on the plan [4]. Many studies have been conducted to find optimum tuning methods using Artificial Intelligence (AI).

Several studies have been conducted in determining PID parameters, including using the Artificial Intelligent (AI) method. One of the studies that have been done is the use of the Grey Wolf Optimization (GWO) method based on the controller on the AVR system (Automatic Voltage Regulator) [4]. Based on studies conducted using the GWO method obtained transient response which had an overshoot of 1,1301 V and settling time of 0.7739 S. In other studies entitled The AVR system controller design using the PID-based Grey Wolf Optimization (GWO) method was obtained by the results of the Transient Step Response with an overshoot score of 1.1301V and settling time of 0.7739 S [5].

Based on the discussion above, researchers will use the GWO-GA hybrid method (Grey Wolf Optimization - Genetic Algorithm) in PID parameters settings in the hope of improving the transient response from the system.

2. THEORETICAL BASIS

Automatic Voltage Regulator (AVR) generally consists of four main components, namely amplifiers, exciter, synchronous generators, and sensors. In every generator set (genset) there is an AVR as one of the components of the compulsion. The main objective of the Automatic Voltage Regulator (AVR) in the generator set (generator) system is as a manipulator so that the output voltage on the Synchronous generator terminal is maintained and stable at a certain score.

The PID control method is widely used in the AVR control system because it has a simple structure and has a stable performance of disturbances [6].

2.1. PID Controller on the AVR system

The stability of power parameters (voltage and frequency) in synchronous generators is a very important thing. Where it depends on the performance of the Automatic Voltage Regulator (AVR) which functions to regulate the voltage of the synchronous generator to be maintained. Until now, the PID controller is still widely used in the Automatic Voltage Regulator (AVR) system due to it is easy to use and cheap [7].

PID Controller (Proportional, Integral, Derivative) is a controller that able to improve the level of accuracy of a plant system that has the characteristics of feedback on the system. PID controller calculates and minimizes the error or difference score between the process output of the input or set point given to the system.

A. Proportional Controller

Proportional / gain controllers act as amplifiers that able to change the output of the system proportionally without providing a dynamic effect on the controlling performance. There are two types of proportional controllers, namely analog and digital. The equation from analog and digital proportional controllers is stated in the equation:

$$P_{out} = K_c . E(t) \quad \text{.....(1)}$$

$$P_{out} = K_c . E_N \quad \text{.....(2)}$$

Where:

P_{out} = Output of the proportional controller

K_c = Constants Gain

$E(t)$ = Error recognized in continuous time

E_N = Error recognized in discrete

Settings with using proportional controllers able to improve the transient response from the system, especially rise time. This controller is also able to fix settle time from the system.

B. Integral Controller

Integral controller is a controller that serves to improve a product response from the system so that this controller able to minimize the error system. There are two types of integral controller, namely analog and digital. The equation from analog and digital integral controllers is stated in the equation:

$$I_{out} = K_i \int_0^t E(\tau) d\tau \quad \text{.....(3)}$$

$$I_{out} = \frac{K_c \Delta t}{T_i} \sum_{i=1}^{N} E_i \quad \text{.....(4)}$$

Where:

I_{out} = Output of the integral controller

K_i = Constants Integral

$E(\tau)$ = Error recognized in continuous time

τ = Variable of integration

T_i = Integral time

Δt = Sampling Period

E = Error recognized in discrete

C. Derivative Controller

Derivative controllers are controllers that mainly function to correct the transient response from the system. There are two types of derivative controllers, namely analog and digital. The derivative controller equation can be stated in the following equation:

$$D_{out} = K_d . \frac{d}{dt} E(t) \quad \text{.....(5)}$$

$$D_{out} = \frac{K_c T_d}{\Delta t} (E_N - E_{N-1}) \quad \text{.....(6)}$$

Where:

D_{out} = Output of the derivative controller

K_d = Constants Derivative

$E(t)$ = Error recognized in continuous time

P_{out} = Output of the derivative controller

T_d = derivative time

Δt = Sampling time

E_N, E_{N-1} = Error recognized in discrete

2.2. Genetic Algorithm

The genetic algorithm provides the option to determine the score of parameters by duplicating genetic reproduction methods, new chromosome formation, gene migration processes, and natural selection as happens in living organisms. Generally, genetic algorithms can be illustrated through the diagram in Figure 1

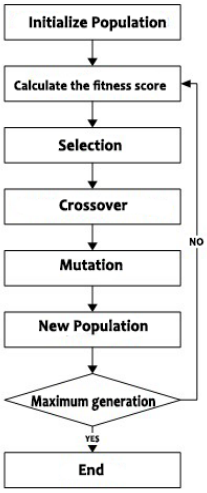

Figure 1. General Structure Diagram Of Genetic Algorithms

2.3. Grey Wolf Optimizer (GWO)

The Grey Wolf Optimizer algorithm is an algorithm inspired by the behavior of wolf hunting in nature. Grey wolf is considered a peak predator, which means that the grey wolf is at the top of the food chain. Grey wolf also has a high socially dominant hierarchy. The leaders who are the first level will be referred to as alpha, the second level is beta, third level is delta, while the last level is omega. In addition to the social hierarchy of wolves, hunting in groups is another interesting behavior of grey wolves.

The social hierarchy of the grey wolf method is categorized based on the fitness score. The distribution of social hierarchies from grey wolves is divided into four as shown in Figure 2.

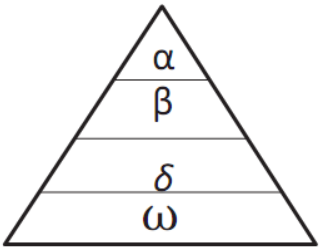

Figure 2. Social Hierarchy of Grey Wolf

3. METHOD

3.1. Automatic Voltage Regulator (AVR) Modeling System

An automatic voltage regulator (AVR) system is formed by four main components, namely amplifier, exciter, generator, and sensor. Each of the components has the transfer function shown in Figure 3.

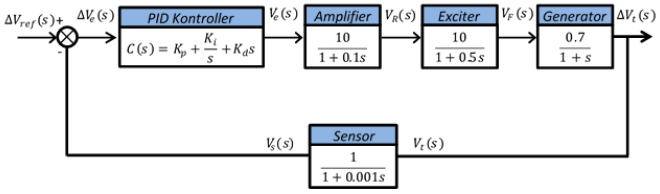

Figure 3. AVR system diagram block with PID controller

3.2. PID Controller Design

In this study, researchers used a PID controller as a control method that functions to improve the quality of the Automatic Voltage Regulator (AVR) response in maintaining the stability of the generator output voltage. The parameters of the PID control method in the form of KP, KI, and KD scores are determined using the Genetic Algorithm (GA) algorithm, Grey Wolf Optimization (GWO) and Hybrid Grey Wolf Optimization - Genetic Algorithm (GWO-GA). The PID-based Automatic Voltage Regulator (AVR) system diagram block with an Installation of the Artificial Intelligent (AI) method is shown in Figure 4.

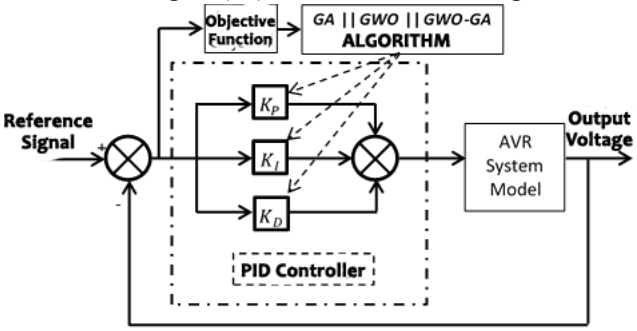

Figure 4. PID-based AVR system diagram block using the installation of Artificial Intelligent (AI) method

3.3. Objective Function Design

The objective function has a very important role in the Artificial Intelligent (AI) method. The objective function works to evaluate the performance of a solution generated from the Artificial Intelligent (AI) method.

In this study, researchers used ITAE - Modified as the objective function. The objective function of ITAE - Modified is the development of the objective function of ITAE (Integral of Time Multiplied by Absolute Error). The equation of the objective function of ITAE and ITAE - Modified is shown in the equation below:

$$ITAE = \int_0^{\tau} t|e(t)|dt \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$ITAE - Modified = \int_0^{\tau} t|e(t)|dt + w_1.O_v + w_2.e_{ss} + w_3.t_s + w_4.t_r \quad \ldots\ldots\ldots\ldots (8)$$

Where:

$w_1 = Multiplier\ Constants\ O_v$
$w_2 = Multiplier\ Constants\ e_{ss}$
$w_3 = Multiplier\ Constants\ t_s$
$w_4 = Multiplier\ Constants\ t_r$
$O_v = Overshoot$
$e_{ss} = Error\ Steady\ State$
$t_s = Time\ Settling$
$t_r = Time\ Rise$

In the objective function of ITAE - Modified there is a modification of variables addition from the original function of ITAE. The addition of parameter variables used includes overshoot, state steady error, time settling, and time rise. In the ITAE - modified using the equation of w_1, w_2, w_3 and w_4. Determination of the multiplier constant score based on the priority level of the variable to be optimized. In this study, the score of the multiplier factor constant is determined as:

$w_1 = 1.5$
$w_2 = 15$
$w_3 = 7$
$w_4 = 1$

Based on the determination score of the multiplier factor shown above, it is obtained an objective function as follows:

$$ITAE - Modified = \int_0^{\tau} t|e(t)|dt + 1{,}5xO_v + 15xe_{ss} + 7xt_s + 1xt_r \ldots\ldots\ldots\ldots\ldots (9)$$

3.4. Genetic Algorithm (GA) Design

One method of Artificial Intelligent (AI) was used in this study, namely Genetic Algorithm (GA) in the PID parameters settings process. The Genetic Algorithm (GA) method is a stochastic algorithm implemented from the biological evolutionary process. The Genetic Algorithm (GA) method has three main operators, namely reproduction, crossover, and mutations. The flowchart design of the Genetic Algorithm method is shown in Figure 5.

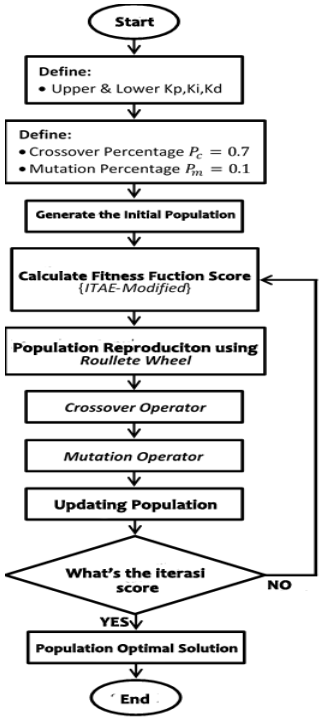

Figure 4.4 Genetic Algorithm (GA) Flow Method Diagram

3.5. Grey Wolf Optimization Design (GWO)

This study uses one of the Artificial Intelligent (AI) methods, namely Grey Wolf Optimization (GWO) in the process of tuning PID parameters. The method of Grey Wolf Optimization (GWO) is a swarm intelligence-based meta-heuristic method based on the behavior of a group of grey wolves in hunting prey. The step in the GWO technique is based on social hierarchy, tracking, siege, and attacking prey. GWO has a group of hunting (optimization) with three settlements namely Alpha, Beta, and Delta with Alpha settlement is the best solution. The flowchart of the design of the Grey Wolf Optimization (GWO) method is shown in Figure 6.

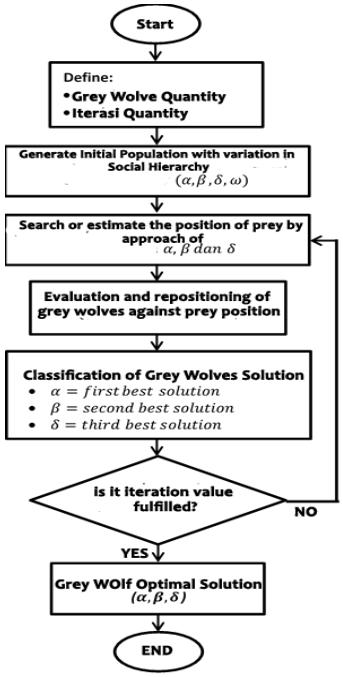

Figure 6. Grey Wolf Optimization (GWO) Flow Method Diagram

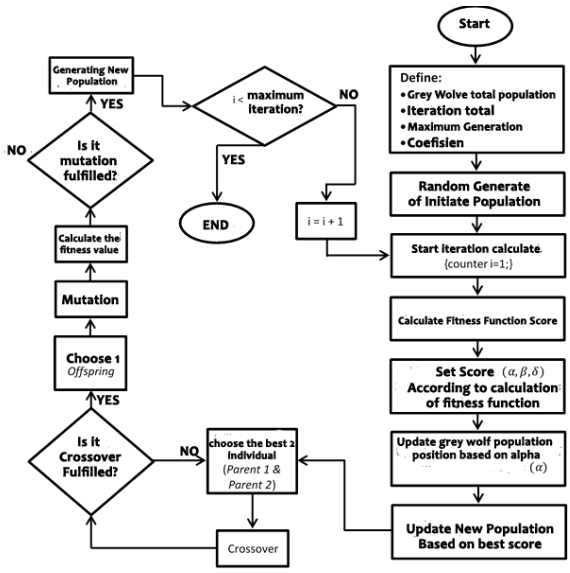

Figure 7. Hybrid Grey Wolfs Optimization – Genetic Algorithm (HGWGA) Flow Method Diagram

3.6. Grey Wolf - Genetic Algorithm (HGWGA) Design

The HGWGA method combines the GWO and GA methods. The hybrid process of both methods is carried out serially. In this case, the first process is done by using the Grey Wolf Optimization (GWO) method first, then continued using the Genetic Algorithm (GA) method. The flowchart method of hybrid grey wolf optimization - genetic algorithm (HGWGA) is shown in Figure 7.

Table 1. Test result summary of GA, GWO dan GA-GWO on PID Based Automatic Voltage Regulator (AVR) system

	PID Parameter			Rise Time (s)	Settling Time (s)	Maximum Overshoot (%)	Peak (PU)	Peak Time (s)	Fitness	Elapsed Time (s)
	Kp	Ki	Kd							
Genetic Algorithm (GA)	0.6477	0.4592	0.2476	0.3149	0.4756	1.5813	1.0158	0.6283	6.0214	30.7106
Grey Wolf Optimization (GWO)	0.6278	0.4316	0.2458	0.3238	0.4986	0.4516	1.0045	0.6239	4.5059	39.5309
Hybrid GA-GWO	0.6030	0.3808	0.2242	0.3497	0.5447	0.0909	1.0009	0.6884	4.3039	42.7498

4. RESULT AND DISCUSSION

Based on the results of the Automatic Voltage Regulator (AVR) test-based controller by using the Genetic Algorithm method, Grey Wolf Optimization and Hybrid Genetic Algorithm - Grey Wolf Optimization that has been carried out has different characteristics. The summary of the test results of the three methods is shown in Table 1.

Based on the test results of the three methods shown in Table 1 can be seen that the best fitness score is obtained when using the Hybrid Genetic Algorithm - Grey Wolf Optimization method with a score of 4,3039. It can be concluded that by using the Hybrid GA-GWO method obtained the best transient response compared to the GA and GWO method. This refers to the lowest fitness score achieved by each method. The disadvantage of the GA-GWO hybrid method is to have a higher execution time (Elapsed Time) compared to the GA and GWO methods. It is because there are additional crossover and mutation functions in the process of Hybrid GA-GWO that result in additional execution time.

4.1. Automatic Voltage Regulator (AVR) Loading Test

The automatic voltage regulator (AVR) loading test is needed to determine the transient response of the system to reach the set point score when there is a disturbance due to the effect of loading. In addition, it is also to determine the comparison of the control response to the Artificial Intelligent (AI) method implemented in the AVR control system. The automatic voltage regulator (AVR) loading test is carried out by providing a disturbance signal to the system. The disturbance signal is given at the system output point and the controller output point. The diagram block of the automatic voltage regulator (AVR) loading test is shown in Figure 8.

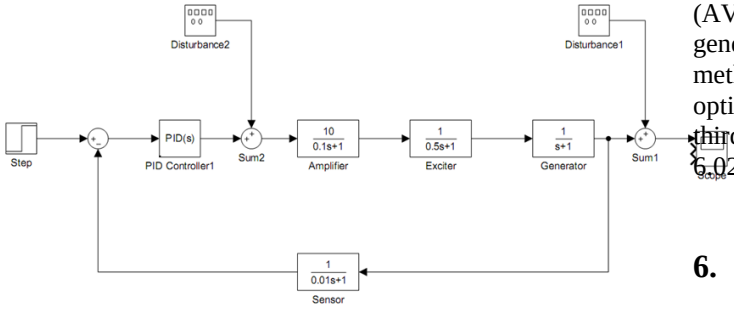

Figure 8. The diagram block of the automatic voltage regulator (AVR) loading test

The results of the load / disturbance test (disturbance 1) are carried out by providing a disturbance signal at the output position of the AVR system (Sum1). The score of the interference signal in this test is 0.25 PU. The test results for disturbance are shown in Figure 9.

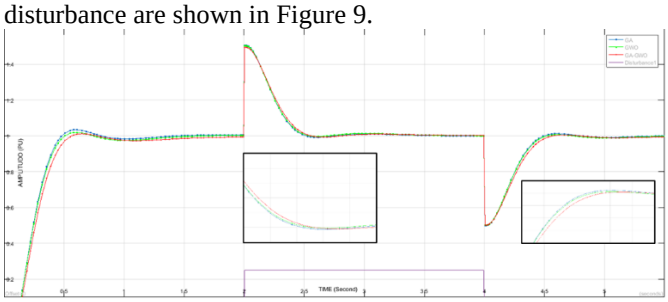

Figure 9. Results Test of Disturbance 1 with a Score of 0.25 PU

The test result for disturbance 2 is carried out with providing a disturbance signal at the output position of the PID controller (Sum2). The score of the interference signal in this test is 0.25 PU. The test results for disturbance are shown in Figure 10.

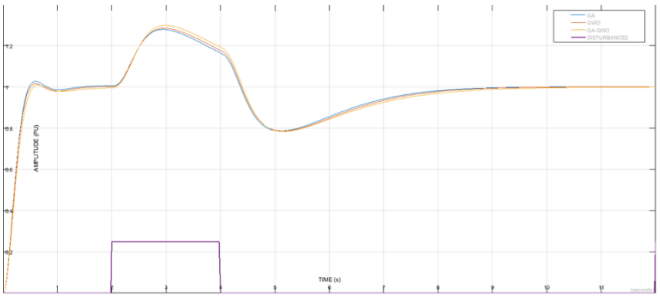

Figure 10. Results Test of Disturbance 2 with a Score of 0.25 PU

5. CONCLUSION

Based on the results and discussion of automatic voltage regulator (AVR) optimization based on PID controllers using the Hybrid Genetic Algorithm - Grey Wolf Optimization method, the best automatic voltage regulator (AVR) transient response is obtained when using the hybrid genetic algorithm - grey wolf optimization (HGAGW) method with fitness score of 4.3039. The second is grey wolf optimization (GWO) with a fitness score of 4.5059. The third is a genetic algorithm (GA) with a fitness score of 6.0214.

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International Journal of Computer Applications Technology and Research
Volume 10–Issue 06, 142-148, 2021, ISSN:-2319–8656

An Initial Study of Tree-Adjoining Grammar Formalism for Parsing Manipuri Language

Yumnam Nirmal
Department of Computer Science and Engineering
Tezpur University
Assam 784028, India
ynirmal@tezu.ernet.in

Utpal Sharma
Department of Computer Science and Engineering
Tezpur University
Assam 784028, India
utpal@tezu.ernet.in

Abstract: We present an initial study into the representation of tree-adjoining grammar formalism for parsing Manipuri language. Being a low resource and computationally less researched language, it is difficult to achieve a natural language parser for Manipuri. Treebanks, which are the main requirement for inducing data-driven parsers, are not available for Manipuri. In this paper, we present an extensive analysis of the Manipuri language structure and formulate a lexicalized tree-adjoining grammar. A generalized structure of Manipuri phrases, clauses and the structure of basic and derived sentences have been presented. The sentence types covered in our analysis are that of simple, compound and complex sentences. Using the tree-adjoining grammar we have formulated, one can implement a Manipuri parser whose results can be of immense help in creating a Treebank for Manipuri.

Keywords: Parsing; Tree-adjoining grammar; Tibeto-Burman; Manipuri

1. INTRODUCTION

Computational representation of language syntax is a crucial step in achieving parsing of natural languages. It involves representation of natural language syntax into computational formalism such as context-free grammar (CFG), tree-adjoining grammar (TAG) and dependency grammar (DG). We can use these computational grammar formalisms along with parsing algorithms to successfully induce a parser.

Tree-adjoining grammar is a formalism introduced by Joshi et al. [1] for describing linguistic structure of natural languages. It is a tree generating and more powerful formalism as opposed to string generating formalisms such as a context-free grammar. A TAG comprises a finite set of elementary trees which are further divided into initial trees (α) and auxiliary trees (β). Initial trees have internal nodes labeled with non-terminals, and the leaf nodes are either labeled with terminals or non-terminals with substitution marker (↓). Auxiliary trees, on the other hand, are constrained with such a condition that it should have a non-terminal leaf node (marked with ✻) exactly same as the root node. Trees corresponding to sentences of a language are generated through a process called 'adjunction'. Adjunction operation inserts an auxiliary tree at a corresponding node of an elementary tree or a derived tree. An advantage of TAG formalism is its ability to handle localized dependencies such as wh-dependency, filler gap and predicate arguments, which are difficult to achieve with CFG.

We explore the use of tree-adjoining grammar (TAG) formalism for representing the syntax of Manipuri language. We use lexicalized approach to tree-adjoining grammar [2] for our work. Lexicalization allows each and every elementary tree to be associated with a lexical item (word), known as anchors (indicated by ◇) of the tree.

2. LITERATURE REVIEW

Computational tools for Manipuri are non-existent and its resources are hardly available making it a low resource language that can help achieve parsing of the language. Currently, Treebanks are non-existent for this language that could have otherwise helped in developing data-driven parsers. Additionally, developing a significantly sized Treebank for Manipuri is constrained with a huge amount of time and manpower. This is not viable within a short period of time and the limited resources available.

There has been plenty of work done on parsing of different languages, by utilizing either rule-based or data-driven approaches. These works could not be adapted to Manipuri, as different languages exhibit different behavior in terms of syntax and structure. Though, there exist similarities across languages, it becomes extremely necessary to model the syntax of an individual language, so that its detailed linguistic properties could be captured properly. As an example, English follows subject-verb-object (SVO) pattern, while Manipuri being a Tibeto-Burman language [3] follows subject-object-verb (SOV) pattern. At the phrase level, in English, a determiner always precedes a head noun, whereas in Manipuri, a determiner always succeeds a head noun.

Manipuri also differs from Indian languages such as Hindi and Bangla that belongs to the Indo-Aryan language family. As an example, quantifiers (Qtf) and adjectives (Adj) precede a head noun (N) in Hindi. Whereas, in the case of Manipuri, quantifiers always follow a head noun, while adjectives can either precede or succeed a head noun. These have been illustrated in examples 1 and 2.

Example 1. (a) Manipuri: ꯑꯉꯥꯡ ꯃꯌꯥꯝ
əŋaŋ\N mjam\Qtf
child many

(b) Hindi: बहुत बच्चे
bəhut\Qtf bəcce\N
many children

Example 2. (a) Manipuri: ꯑꯊꯣꯠꯄ ꯑꯉꯥꯡꯕ ꯂꯩ
ət^{h}otpə\Adj əŋaŋbə\Adj ləi\N
soft red flower

Or, ꯂꯩ ꯑꯊꯣꯠꯄ ꯑꯉꯥꯡꯕ
ləi\N ət^{h}otpə\Adj əŋaŋbə\Adj
flower soft red

(b) Hindi: नरम लाल फुल
nəɹəm\Adj lal\Adj p^{h}ul\N
soft red flower
* फुल नरम लाल
p^{h}ul\N nəɹəm\Adj lal\Adj
flower soft red

There has been no work reported on TAG of Manipuri, other than a preliminary work by Singh and Sharma [4]. The work covers only a few instances of Manipuri phrases and sentences, and does not cover derived sentences. It also lacks generalization in terms of sentence structure. Additionally, domain of locality in relation to word classes, which is a main advantage of using TAG formalism, has not been analyzed in this work.

Another notable works reported on CFG based parsing of Manipuri is that of Nirmal and Sharma [5, 6]. Sarangthem and Singh [7] also reported a work focused on developing an abstract data structure for Manipuri noun phrases.

3. ELEMENTARY TREES FOR BASIC MANIPURI SENTENCES

We construct elementary trees for basic structures of Manipuri language by extensively analyzing the language structure. The trees have been derived by studying the existing Manipuri linguistic literature and our native knowledge of the language.

3.1 Noun Phrase

Noun phrases (NP) in Manipuri minimally consists a head as the obligatory constituent and can have adjectives, determiners, quantifiers, or locative nouns (NLoc) as its optional constituents [8, 9]. Within an NP, these optional constituents can occur together, but determiners and quantifiers generally do not occur together. The head can be either a noun or a pronoun (Pr) in its pure form without any suffixes, but not verbal nouns (Vn) [7]. Determiners and quantifiers always succeed the head, while adjectives either precede or succeed the head. Adjectives, while constituting an NP along with other optional constituents, always occur as an immediate neighbor of the head. The remaining optional constituents can immediately follow the head, only if adjectives precede the head. Otherwise, adjectives immediately follow the head and other optional constituents follow the adjectives.

Initial trees (*αN)* and (*αPR*) in Fig. 1 represent NPs consisting of either a noun or a pronoun without any optional constituent, while (*αNdet*) and (*αPRdet*) represent NPs constituting a head followed by a determiner. Similarly, (*αNqtf*) and (*αPRqtf*) represent NPs constituting a head followed by a quantifier.

In example 3, we illustrate a sentence consisting two NPs. The first NP "ꯅꯤꯄꯤꯃꯆꯥ ꯑꯗꯨ" (nipiməca ədu) consists of a head noun succeeded by a determiner, while the second NP "ꯆꯍꯤ ꯱꯴" (cəhi təɹaməɹi) has a quantifier succeeding a head noun. These two NPs can be represented using the initial trees (*αNdet*) and (*αNqtf*) shown in Fig. 1.

Example 3. ꯅꯤꯄꯤꯃꯆꯥ ꯑꯗꯨ ꯆꯍꯤ ꯱꯴ ꯆꯪꯂꯦ꯫
[nipiməca\N ədu\Det]NP [cəhi\N təɹaməɹi\Qtf]NP cəŋle\V
The girl is approaching 14 years.

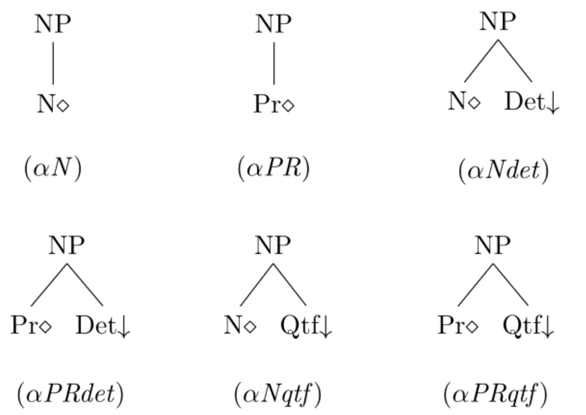


Figure 1. Initial trees for noun phrases

The constitution of quantifiers and determiners along with a pronoun as head in an NP is illustrated in examples 4 and 5 respectively.

Example 4. ꯅꯈꯣꯏ ꯑꯅꯤꯃꯛ ꯑꯃꯅ-ꯑꯃꯕꯨ ꯉꯝꯅꯗ꯭ꯔꯦ꯫
[nək^{h}oj\Pr ənimək\Qtf]NP əmənə-əməbu\Pr ŋmnədre\V
You two are not able to win over each other.

Example 5. ꯃꯤꯁꯛ ꯑꯁꯤꯗ ꯑꯉꯥꯡ ꯑꯁꯤ ꯁꯤꯟꯅꯔꯃꯂꯒꯦ꯫
[misk\Pr əsidə\Det]NP [əŋaŋ\N əsi\Det]NP sinnərəmləge\V
I will hand over the baby to this man.

Manipuri is a post-positional language as opposed to preposition. The post-positions are generally directional and indicate temporal dimensions within a syntactic relation [3]. A post-position, always succeeds the head within an NP, or either succeeds an NP. In Manipuri, post-positions occur as locative nouns (NLoc) and with case markers suffixed to them. Structures of such NPs have been represented with elementary trees (*αNnloc*) and (*βnpNLOC*) as shown in Fig. 2. We have marked the NP node in (*αNnloc*) with null adjoining (NA)[1] as it is not allowed to be adjoined by (*βnpNLOC*). Adjoining using (*βnpNLOC*) is allowed only to NPs of type (*αN*), (*αPR*), (*αNdet*), (*αPRdet*), (*αNqtf*) and (*αPRqtf*).

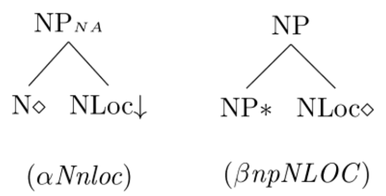


Figure 2. Elementary trees for NPs formed with locative nouns

In example 6, the NP "ꯎꯄꯨ ꯃꯊꯛꯇ" (upu mət^{h}ktə) constitutes a head noun followed by a locative noun, whereas in example 7, the NP "ꯊꯥ ꯑꯁꯤꯒꯤ ꯃꯅꯨꯡꯗ" (t^{h}a əsigi mənuŋdə) constitutes an existing NP followed by a locative noun.

Example 6. ꯎꯄꯨ ꯃꯊꯛꯇ ꯂꯩꯔꯤꯛ ꯂꯩꯍꯧꯕꯅꯤ꯫
[upu\N mət^{h}ktə\NLoc]NP ləiɹik ləihəubəni
The book is over the cupboard.

[1] A node where adjoining is disallowed is said to have a null adjoining (NA) constraint.

Example 7. ꯊꯥ ꯑꯁꯤꯒꯤ ꯃꯅꯨꯡꯗ ꯁꯦꯟꯗꯣꯏ ꯑꯗꯨ ꯄꯤꯊꯣꯛꯄꯤꯌꯨ
[[tʰa asigi]NP mənuŋdə\NLoc]NP sendoj ədu pitʰokpiyu
Please clear the interest within this month.

3.2 Auxiliary Trees for Modifying Noun and Pronoun

Auxiliary trees allow recursion as well as provide a way to introduce modifiers for a word class. We can use these feature of TAG to successfully modify noun and pronoun word classes.

Within an NP in Manipuri, adjectives either precede or succeed the head (noun or pronoun) which is being modified. These can be achieved using auxiliary trees (*βADJn*), (*βnADJ*), (*βprADJ*) and (*βADJpr*) shown in Fig. 3.

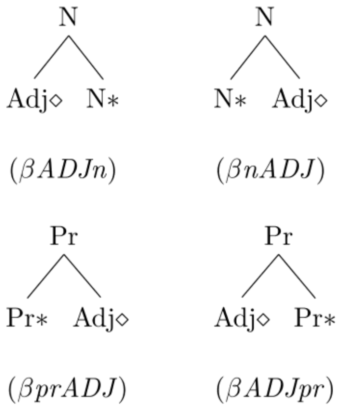


Figure 3. Auxiliary trees for modifying noun and pronoun using adjectives

As an example, the head noun in NP "ꯅꯤꯄꯤꯃꯆꯥ ꯑꯗꯨ" (nipiməca ədu) of example 3 can be modified with the adjective "ꯑꯄꯤꯛꯄ" (əpikpə) by using the auxiliary tree (*βADJn*), as shown in Fig. 4.

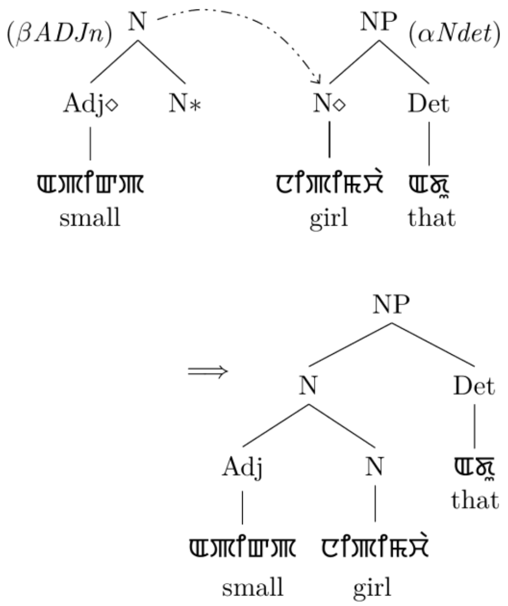


Figure 4. An example of noun modification with adjective in Manipuri

3.3 Elementary Trees for Basic Sentences

Manipuri belong to the family of Tibeto-Burman languages [10] and follow subject-object-verb (SOV) order and generally has verb as the final constituent of a sentence [3]. Using sub-categorization information of verbs, we classify the basic sentence structure of Manipuri into three tree families as shown in Fig. 5. The verbs can be of type intransitive, monotransitive and ditransitive. In our further discussions, we denote subject, direct object and indirect object using NP_0, NP_1 and NP_2 respectively.

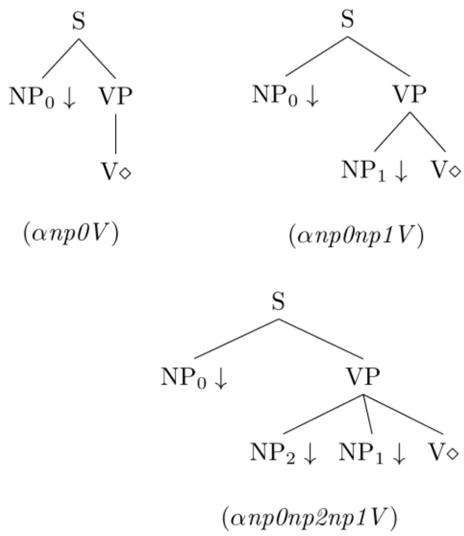


Figure 5. Initial trees for basic Manipuri sentences

Sentences with intransitive verbs in Manipuri lack an object and have only the subject followed by a verb [3]. We represent such sentences with the initial tree (*αnp0V*) shown in Fig. 5. We illustrate such a sentence with example 8. The parse tree for this sentence can be formed by substituting (*αNdet*), for NP "ꯎꯄꯥꯜ ꯑꯁꯤ" (upal əsi), in (*αnp0V*), as shown in Fig. 6.

Example 8. ꯎꯄꯥꯜ ꯑꯁꯤ ꯋꯥꯡꯉꯤ
[upal\N əsi\NLoc]NP_0 waŋŋi\V
The tree is tall.

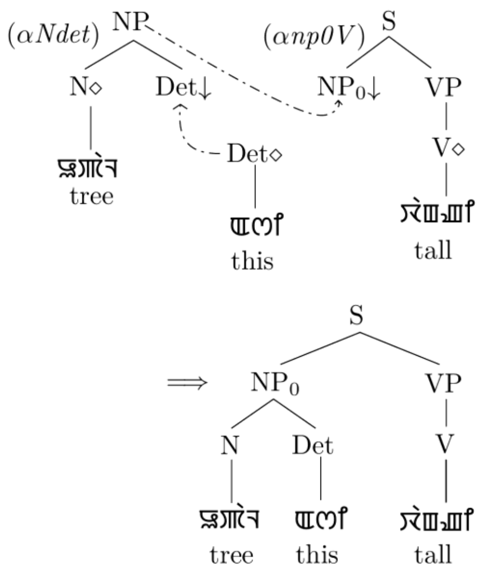


Figure 6. Parse tree formation for example 8

A monotransitive verb takes a subject and an object as its arguments. And, sentences formed with such verbs do not contain a complement [3]. This type of sentences can be represented using the initial tree (*αnp0np1V*) shown in Fig. 5. One such sentence can be seen in example 3 and its respective parse tree is shown in Figure 7. This tree can be obtained by substituting (*αNdet*) and (*αNqtf*) in (*αnp0np1V*).

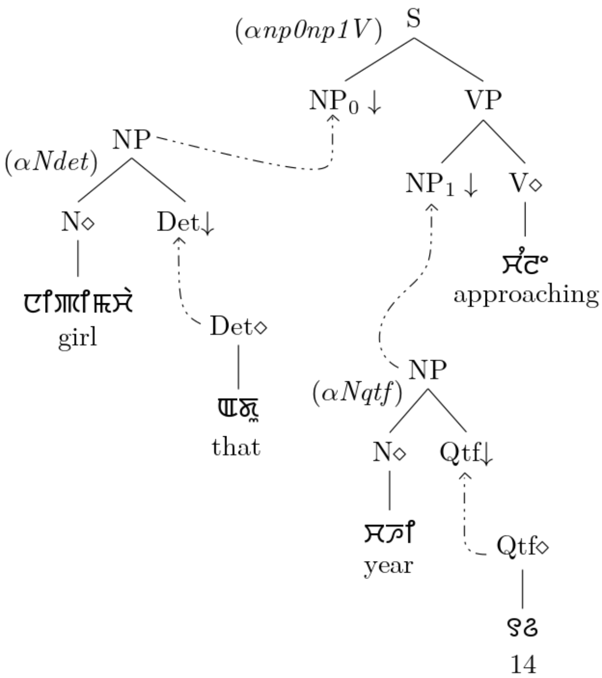


Figure 7. Parse tree formation for example 3

Manipuri sentences with ditransitive verbs contain a subject and two objects: a direct and an indirect object [3, 11]. In general, the direct object normally succeeds the indirect object, but an interchange in their positions is also possible [3]. We represent such sentences using the initial tree (*αnp0np2np1V*) shown in Fig. 5. One such sentence is example 9 and its respective parse tree is shown in Fig. 9.

Example 9. ꯃꯈꯣꯏ ꯑꯅꯤꯅ ꯇꯣꯝꯕꯗ ꯈꯨꯗꯣꯜ ꯑꯃ ꯄꯤ

[məkʰoj ənina]NP_0 [tombədə]NP_2 [kʰudol əmə]NP_1 pi\V

The two of them give Tomba a gift.

3.4 Auxiliary Tree for Verb Modification

Adverbs, in Manipuri, always precede the verb that is being modified. Theoretically, there can be an infinite number of adverbs modifying a verb [9]. We achieve verb modification through the use of auxiliary tree (*βADVv*) shown in Fig. 8. As an example, the verb "ꯋꯥꯡꯉꯤ" (waŋŋi) in example 8 can be modified using the adverb "ꯌꯥꯝꯅ" (jamnə) as illustrated in Fig. 10.

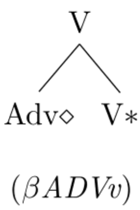


Figure 8. Auxiliary tree for verb modification

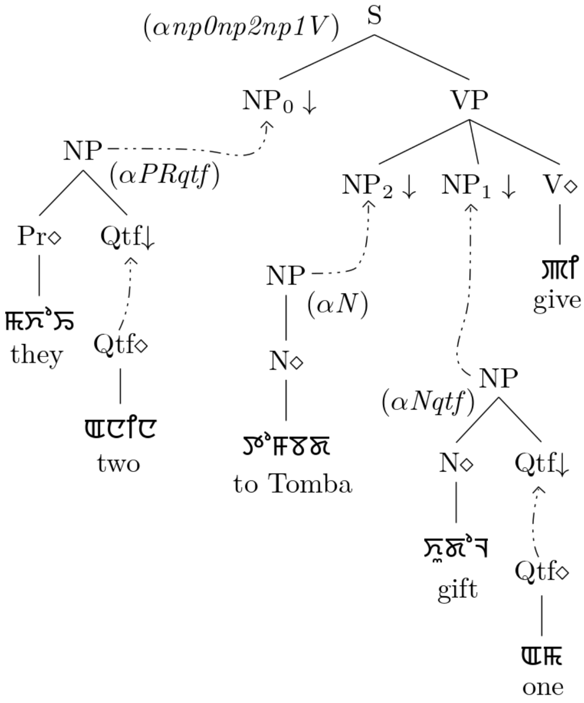


Figure 9. Parse tree formation for example 9

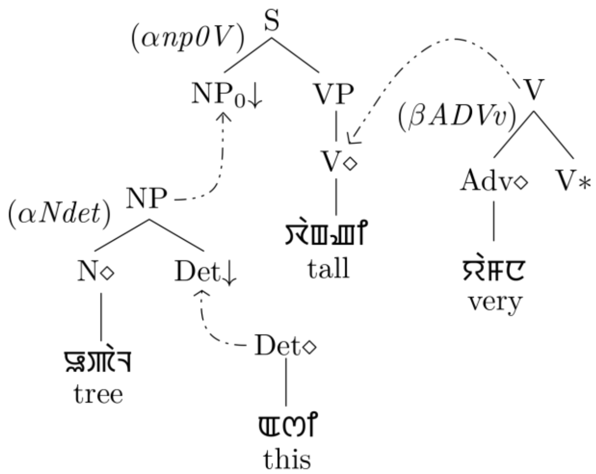


Figure 10. Modification process of verb "ꯋꯥꯡꯉꯤ" (waŋŋi) in example 8 using the adverb "ꯌꯥꯝꯅ" (jamnə)

4. ELEMENTARY TREES FOR DERIVED MANIPURI SENTENCES

In Manipuri, sentences are generally derived using coordinate conjunctions or by the process of embedding.

Compound sentences are derived by concatenating two or more sentences using coordinate conjunctions (Conj). Auxiliary trees for compound sentences are represented using the initial tree (*αsCONJs*) shown in Fig. 11. Example 10 illustrates a compound sentence formed by conjoining two simple sentences using the coordinate conjunction (Conj) "ꯑꯗꯨꯒ" (əduga).

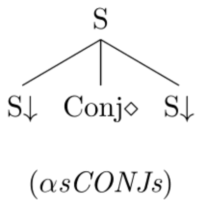


Figure 11. Initial tree for compound sentences

Example 10. ꯑꯍꯟꯕ ꯌꯨ-ꯂꯤꯛꯂꯤ ꯑꯃ ꯁꯠꯂꯤ ꯑꯗꯨꯒ ꯌꯥꯎꯝ ꯃꯔꯤ-ꯃꯉꯥ ꯊꯛꯆꯤꯜꯂꯤ

[əhənbə ju-likli əmə sətli]S ədugə\Conj [jəum məɹi-məŋa tʰəkcilli]S

A new wine bottle is pulled out and four-five mouthfuls are drunk.

Complex sentences in Manipuri are formed by embedding one or more sentence within another sentence [12]. Only one of the sentence acts as the main clause (ClMain) and the remaining become subordinate clauses (ClSub). Subordinate clauses always precede the main clause and are dependent on it [13]. A main clause, on the other hand, can stand alone and act as a complete sentence. Subordinate clauses can be further divided into *nominal*, *adverbial* and *sentential* clauses.

Nominal clauses are formed by nominalizing the verb of a sentence that is to be embedded using the nominalizer -ꯄ~-ꯕ (-pə~-bə) as a suffix of the verb [9]. The verb, thus nominalized, takes the form of a verbal noun and may also occur with a case marker suffixed to it. Nominal clause generally helps in clarifying the noun of the main clause that follows, thus taking the form of a relative clause. The noun of the main clause, thus clarified, becomes the head of the relative clause and is known as the relativized argument. We represent complex sentences consisting of nominal clauses with the initial trees (*αnpVNs*), (*αnpnpVNs*) and (*αnpnpnpVNs*), as shown in Fig. 12.

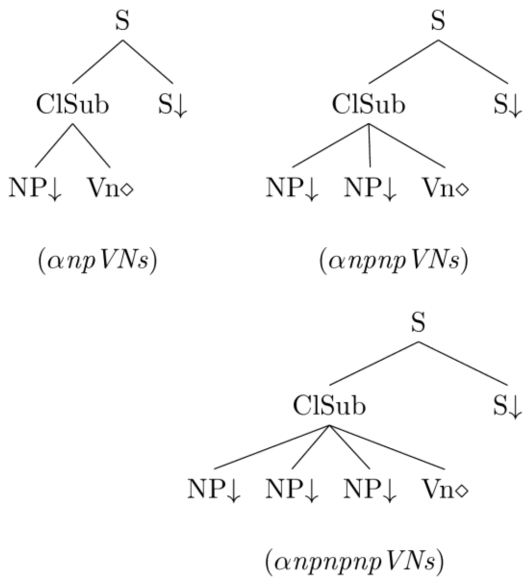


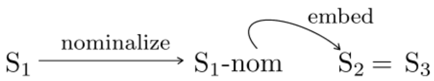
Figure 12. Initial trees for complex sentences with nominalized clauses

An illustration of complex sentence formation with nominal clause in Manipuri is shown in example 11. In the process, the verb "ꯇꯨꯝꯂꯤ" (tumli) of S_1 is nominalized as "ꯇꯨꯝꯂꯤꯕ" (tumlibə) and then the nominalized sentence S_1-nom is embedded into S_2 thus forming complex sentence S_3 . Here, S_1 takes the form of a subordinate clause and S_2 become the main clause. The parse tree for example 11(S3) and its formation is illustrated in Fig. 13.

Example 11.

S1: ꯍꯩꯅꯧ ꯃꯈꯣꯡꯗ ꯇꯨꯝꯂꯤ
həinəu məkʰoŋdə tumli
He/she is sleeping below the mango tree.

S2: ꯅꯤꯄ ꯑꯗꯨ ꯂꯤꯜꯅ ꯆꯤꯛꯂꯦ
nipa ədu lilnə cikle
The man has been bitten by a snake.



S3: ꯍꯩꯅꯧ ꯃꯈꯣꯡꯗ ꯇꯨꯝꯂꯤꯕ ꯅꯤꯄ ꯑꯗꯨ ꯂꯤꯜꯅ ꯆꯤꯛꯂꯦ

[həinəu məkʰoŋdə tumli-bə\Vn]ClSub [nipa ədu lilnə cikle]ClMain

The man sleeping below the mango tree is bitten by a snake.

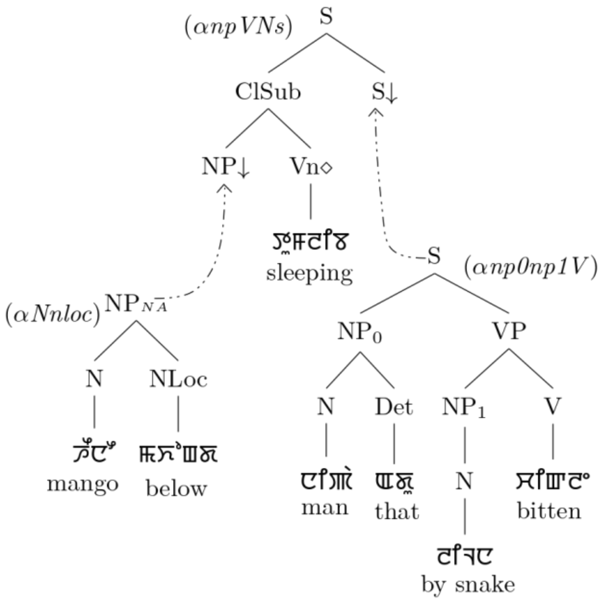


Figure 13. Parse tree formation for complex sentence S_3 in example 11

An *adverbial clause* behaves like an adverb and modifies the main clause. Clauses of this type are formed by adding the adverbial suffix -ꯅ (-nə)[2] to the verb of subordinating clause [13]. In order to accommodate the adverbial suffix, the aspectual markers of the verb may also be modified accordingly. We represent complex sentences consisting of adverbial clauses with the initial trees (*αnpVAs*), (*αnpnpVAs*) and (*αnpnpnpVAs*), as shown in Fig. 14.

An illustration of complex sentence formation with embedded adverbial clause can be seen in example 12. The complex sentence S_3 is derived by embedding the simple sentence S_1 in S_3. In the process, the verb "ꯊꯣꯀꯤ" (tʰoki) of sentence S_1

[2] We use Va to denote verbs ending with the adverbial suffix -ꯅ (-nə).

undergo morphological change by replacing the aspectual marker "-ꯏ" (-i) with the suffix "-ꯇꯨꯅ" (-tunə), thus converting S_1 into an adverbial clause. The parse tree for example 12(S_3) and its formation is illustrated in Fig. 15.

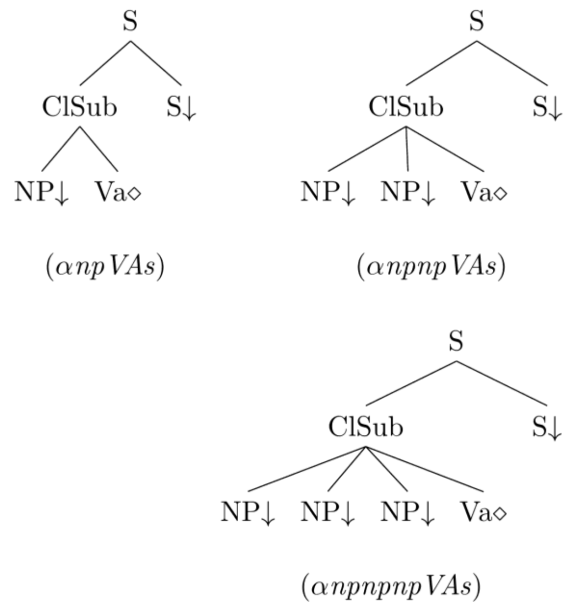


Figure 14. Initial trees for complex sentences with adverbial clauses

Example 12.

S1: ꯈꯣꯡꯅꯥꯡ ꯃꯈꯣꯡꯗ ꯊꯣꯛꯏ
kʰoŋnaŋ məkʰoŋdə tʰoki
He/she went below the ficus tree.

S2: ꯇꯣꯝꯕꯗꯨ ꯉꯥꯏꯍꯥꯛ ꯂꯦꯞꯂꯨꯏ
tombədu ŋaihak leplui
Tomba stand for some time.

S3: ꯈꯣꯡꯅꯥꯡ ꯃꯈꯣꯡꯗ ꯊꯣꯛꯇꯨꯅ ꯇꯣꯝꯕꯗꯨ ꯉꯥꯏꯍꯥꯛ ꯂꯦꯞꯂꯨꯏ
[kʰoŋnaŋ məkʰoŋdə tʰoktunə\Va]ClSub [tombədu ŋaihak leplui]ClMain
Tomba went below the ficus tree and stand there for some time.

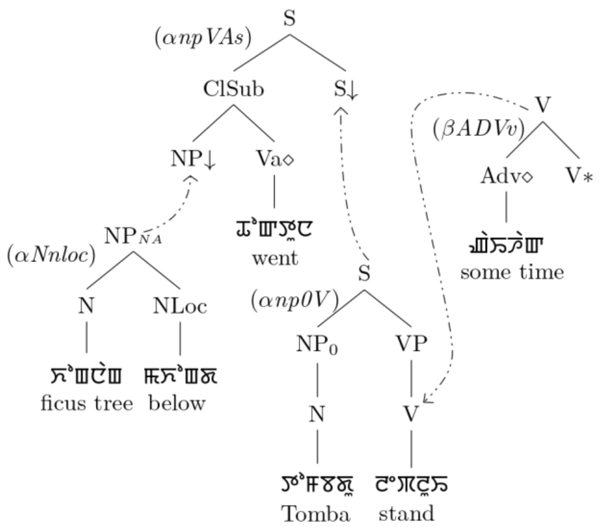


Figure 15. Parse tree formation for example 12(S_3)

Sentential clauses (SClause) are formed by adding complementizers such as "ꯍꯥꯏꯕ" (haibə) and "ꯍꯥꯏꯅ" (hainə) after the verb of the clause being subordinated [13]. They are also known as sentential complements (SCompl) since they form subordinate clauses with a full-fledged sentence [14]. We represent complex sentences formed with the help of sentential clauses using the initial tree (*αsSCOMPLs*) shown in Fig. 16.

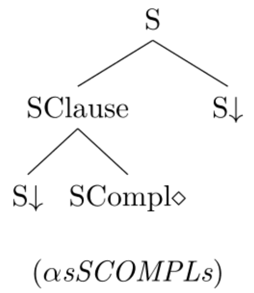


Figure 16. Initial trees for complex sentences with sentential clauses

Examples 13 and 14 are two complex sentences formed by using the sentential complementizers "ꯍꯥꯏꯕ" (haibə) and "ꯍꯥꯏꯅ" (hainə) respectively. The formations of parse trees for these two sentences are shown in Fig. 17 and Fig. 18 respectively.

Example 13. ꯅꯤꯄꯥ ꯑꯗꯨ ꯇꯨꯝꯂꯤ ꯍꯥꯏꯕ ꯑꯩ ꯈꯪꯉꯤ
[[nipa ədu tumli]S (haibə)SCompl]Sclause [əi kʰəŋŋi]S
I know that the man is sleeping.

Example 14. ꯅꯤꯄꯥ ꯑꯗꯨ ꯇꯨꯝꯂꯤ ꯍꯥꯏꯅ ꯑꯩꯅ ꯇꯥꯏ
[[nipa ədu tumli]S (hainə)Scompl]SClause [əina tai]S
I heard that the man is sleeping.

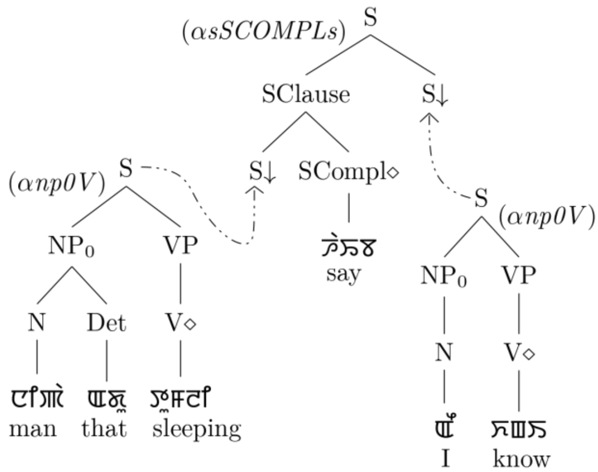


Figure 17. Parse tree formation for example 13

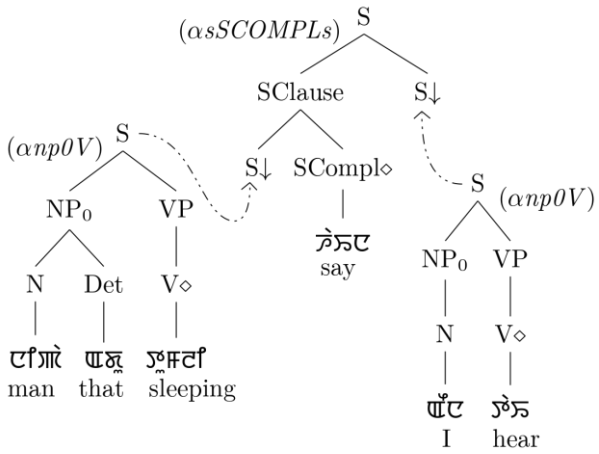


Figure 18. Parse tree formation for example 14

5. CONCLUSION

We introduced a TAG formalism for Manipuri language, which is low in resource and for which data-driven parsing is not viable due to non availability of Treebanks. We extensively analyzed the language structure and formulate the Manipuri TAG formalism. The grammar covers structures of Manipuri phrases, clauses, basic sentences, as well as derived sentences. Our grammar can be used for creating a Manipuri parser and would be extremely helpful for creating a Treebank for Manipuri.

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International Journal of Computer Applications Technology and Research
Volume 10–Issue 06, 149-155, 2021, ISSN:-2319–8656

Leaf Diseases Classification on Peanut Leaves Based on Texture and Colour Features

Brahma Ratih Rahayu F.
Department of Electrical Engineering, University of Brawijaya
Malang, Indonesia

Panca Mudjirahardjo
Department of Electrical Engineering, University of Brawijaya
Malang, Indonesia

Muhammad Aziz Muslim
Department of Electrical Engineering, University of Brawijaya
Malang, Indonesia

Abstract: Peanuts are a food crop commodity that Indonesians widely consume as a vegetable fat and protein source. However, the quality and quantity of peanut productivity may decline, one of which is due to plant diseases. Efforts that can be made to maintain peanut productivity are the application of technology to detect peanut plant diseases early; thus, disease control can be carried out earlier. This study presents a technology development application, particularly digital image processing, to identify disease features of infected peanut leaves based on GLCM texture features and colour features in the HSV colour space and classified using the SVM method. The development of the SVM method that is applied is the Multiclass SVM with the DAGSVM strategy, which can classify more than two classes. Based on the experimental results, it confirms that the combination of HSV colour features and GLCM texture features with an angular orientation of 0 degrees and classified by the Multiclass SVM method with polynomial kernels produces the highest accuracy, i.e. 99.1667% for leaf spot class, 97.5% for leaf rust class, 98.8333% for eyespot class, 100% for normal leaf class and 100% for other leaf class.

Keywords: Peanut, GLCM, HSV, Multiclass SVM, DAGSVM

1. INTRODUCTION

Peanut (Arachis Hypogae L.) is one of the most common crops consumed by Indonesians, which benefits as a source of vegetable fat and protein. In addition, the benefits of peanuts are that they hold high economic value, which can be relied on as a crop to increase farmers' income. In increasing peanut productivity, several factors affect the quality and quantity of the results achieved, specifically pests, changing weather conditions, and plant diseases. Plant disease is an important limitation in peanut cultivation in Indonesia [1]. Thus far, identifying plant diseases is only by observing the external appearance of the plant. One other way that can be done is a lab test, particularly by isolating the pathogen associated with the symptoms of the disease with the tissue planting method. Then the sample will be incubated for 2-3 days and subsequently will be observed using a microscope to determine the morphological and physiological characters [2]. Although morphological and physiological characters are required during the initial study, this method is considered less efficient since it takes a longer time.

In order to contribute to maintaining peanut productivity, the use of technology can certainly be an alternative to be applied to peanut cultivation, especially for the introduction and control of plant diseases. Technology application that can be implemented is digital image processing. The application of digital image processing is used to identify the features of the image of leaves affected by the disease; thus, it can help identify peanut plant diseases early.

Several image processing techniques are feature extraction and classification. In feature extraction and classification, appropriate methods are needed in identifying diseases in peanut plants. Feature extraction techniques can be analysed through colour, shape, and texture. The feature extraction technique chosen in retrieving the features of peanut leaf plant disease is texture and colour. The Gray Level Co-occurrence Matrix (GLCM) method is a method in texture feature extraction; this method was adopted because it has been proven to be an effective texture descriptor, simple method, easy to use, and has good accuracy and computation time [3]. In addition to texture feature extraction, colour feature extraction is also used in the HSV colour space. The HSV colour space was preferred because it consists of colours that can be captured by human vision. The classification technique used was the Support Vector Machine (SVM) method; this method can work well on high dimensional data sets. Only a selected number of data contributes to forming the model used in the classification [4]. The SVM method can only perform binary classification (two classes); thus, development was performed, i.e. the Multiclass SVM method.

Based on the description of the problem above, in identifying diseases in peanut plants, a combination of GLCM texture features and HSV colour features were used and classified using the Multiclass SVM method with the DAGSVM strategy.

2. LITERATURE REVIEW

Several previous studies regarding identifying plant diseases have weaknesses, such as identifying medicinal plant diseases using the LBP and FLBP methods, particularly in determining the grey pixel value threshold, which makes the presentation of its texture sensitive to noise [5]. Another study regarding the identification of soybean plant diseases based on texture features using the Gabor method shows that recognising disease features is highly dependent on delivering the correct value of the frequency and orientation parameters [6]. Research on disease identification through the combination of textural features with GLCM and colour features in the LAB colour space can provide an accuracy of up to 97% [7].

Research on the classification of rice plant diseases proves that the ANN classification provides an accuracy of 87.5% and the SVM classification provides an accuracy of 92.5%

[8]. Another study, particularly the classification of cucumber leaf disease using M-SVM with the OAA strategy, recognised the disease well. In the OAA method, for class N problems (N> 2), two classes of SVM were formed. The first SVM was trained and labelled the sample in the first class as positive, and in the rest of the class, it was labelled negative. The OAA strategy has a disadvantage, i.e. the complexity of training because each N is trained with all available samples [9]. Another study, classification of types and phases of various malaria parasites used the OAO strategy, with an accuracy rate of 85% to 95.55% [10]. The OAO strategy has a disadvantages, which is that it requires more time in testing. Research [11], regarding the classification of textile motive using the M-SVM method, the results showed that using the DAGSVM strategy gave a better results when compared to OAA and OAO strategies. DAGSVM is applied to classify the types of electrocardiogram signals, the results show that DAGSVM provides better accuracy when compared to the KNN and ANN methods. Multiclass SVM method with the DAGSVM strategy, which can provide good accuracy and faster computation time. [12].

3. METHOD

In this study, a scheme was developed, i.e. the extraction process for the image features of infected peanut leaves using the GLCM method to determine the texture and colour space features of HSV to determine the colour features of each disease and classified using the M-SVM method. The process stages of this research consisted of image input, preprocessing, segmentation, feature extraction, and classification. Figure 1 shows the research methodology carried out in this study.

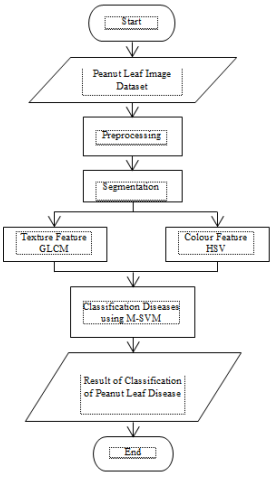

Figure 1. Research Method

3.1 Image Input

The image data used is the image of peanut leaves obtained from the image acquisition process. The image used is an image of RGB-level peanut leaves in .jpg format. The image resolution size is 4608x3465 pixels. The image of peanut leaves used consists of leaf spot class, leaf rust, eyespot, normal leaf, and other leaves.

3.2 Preprocessing

At this stage, the RGB input image was resized. The original RGB input image will be reset in resolution to 635x439 pixels. The resizing process aims to simplify the calculation process and reduce storage capacity and processing time.

3.3 Segmentation

Segmentation is the process of separating one object from another object or between objects and the background contained in an image. In this study, image segmentation was used to select the Region of Interest (ROI) on the leaf image of the peanut plant, which consists of several stages, i.e

1. Converting the image of peanut leaves in RGB format to a LAB image. The conversion of RGB images to LAB can be calculated using equation 1 [13].

$$L^* = 116 f\left(\frac{Y}{Y_n}\right) - 16$$
$$a^* = 500\left[f\left(\frac{X}{X_n}\right) - f\left(\frac{Y}{Y_n}\right)\right] \quad (1)$$
$$b^* = 200\left[f\left(\frac{Y}{Y_n}\right) - f\left(\frac{Z}{Z_n}\right)\right]$$

   In this matter, $f(q)$ is calculated as follow

$$f(q) = \begin{cases} q^{\frac{1}{3}}, \text{jika } q > 0{,}008856 \\ 7{,}787q + \frac{16}{116}, \text{for another} \end{cases}$$

2. Clustering using the K-means method on the a* and b* components of the LAB colour space. The K-means method works by partitioning N objects into K groups (clusters) in one group with the closest centroid. The calculation of the distance from each data to each centroid employs the Manhattan distance calculation, which can be calculated using equation 2 [14].

$$d_{ij} = \sum_{k=1}^{n} (x_{ik} - y_{jk}) \quad (2)$$

   Where *d* is the distance between *i* and *j*, *i* is cluster data center, *j* is attribute data, *k* is the symbol of each data, *n* is the amount of data, x_{ik} is the data in the centre of the *k* cluster, and y_{jk} is the data on each *k* data.

3. Filling the object with the resulting image from the K-means clustering process. The purpose of the object filling process is to fill the perforated objects.
4. Perform image subtraction, particularly reducing the image resulting from the K-means clustering and the resulting image from the filling object.
5. Perform a bwareaopen operation to remove objects with a small number of pixels; thus, the image segmentation results will be obtained.

3.4 Feature Extraction

Feature extraction is an important step in building classification and aims to extract relevant information that characterises each class. The purpose of feature extraction is to perform calculations and comparisons that can be used to classify the features of an image. Feature extraction has a significant role because the better the feature extraction, the higher the level of accuracy.

In this study, the feature extraction process was carried out to obtain the texture feature and colour feature of the image of the segmented peanut leaves. The texture feature used was the Gray Level Co-Occurance Matrix (GLCM) method. This method recognises texture features by calculating the spatial relationship between pixels in the image. The GLCM matrix is created by determining the relationship of pixels of various angular orientations and distances. Texture features extracted were angular second moment (ASM), contrast, inverse

difference moment (IDM), correlation, entropy, variance, sum average, sum entropy, sum variance, difference entropy, and difference variance [15].

Angular second moment (ASM) is a measure of the homogeneity of an image. ASM is calculated using equation 3.

$$ASM = \sum_{i=0}^{N_g}\sum_{j=0}^{N_g} P(i,j)^2 \quad (3)$$

Contrast is a measure of the varying intensity of the presence of an image or a measure of the spread of gray elements in an image. Contrast is calculated using equation 4.

$$Contrast = \sum_{i=1}^{N_g}\sum_{j=1}^{N_g} (i-j)^2 P(i,j) \quad (4)$$

Inverse Difference Moment is used to measure homogeneity. The homogeneity in question is the local homogeneity of the observed images. IDM is calculated using equation 5.

$$IDM = \sum_{i=0}^{N_g}\sum_{j=0}^{N_g} \frac{P(i,j)}{1+(i-j)^2} \quad (5)$$

Correlation is a measure of linear dependence or the value of the gray level in the image. Correlation calculates the correlation between one pixel and another pixel. Correlation is calculated using equation 6.

$$Correlation = \sum_{i=0}^{N_g}\sum_{j=0}^{N_g} \frac{(i\times j)P(i,j) - \mu_x\mu_y}{\sigma_x\sigma_y} \quad (6)$$

Entropy is used to measure gray level irregularity in the image. Entropy can be calculated using equation 7.

$$Entropy = -\sum_{i=1}^{N_g}\sum_{j=1}^{N_g} p(i,j)\log[p(i,j)] \quad (7)$$

Variance is used to measure the spread (related to the mean) of the gray level distribution. Variance is calculated using equation 8.

$$Variance = \sum_{i=1}^{N_g}\sum_{j=1}^{N_g} (i-\mu)^2 P(i,j) \quad (8)$$

Sum average is used to measure the average distribution of the number of gray levels in the image. Sum average is calculated using equation 9.

$$Sum\ Average = \sum_{i=2}^{2N_g} i p_{x+y}(i) \quad (9)$$

Sum entropy is used to measure noise related to the gray level distribution in the image. Sum entropy is calculated using equation 10.

$$Sum\ Entropy = -\sum_{i=2}^{2N_g} p_{x+y}(i)\log\{p_{x+y}(i)\} \quad (10)$$

Sum variance is used to measure the spread (concerning the mean) in distributing the amount of grayscale in the image. Sum variance is calculated using equation 11.

$$Sum\ Variance = \sum_{i=2}^{2N_g}\left(i - \left[\sum_{i=2}^{2N_g} i p_{x+y}(i)\right]\right)^2 \quad (11)$$

Difference entropy is used to measure noise associated with the distribution of differences in the gray level of the image. The entropy difference is calculated using equation 12.

$$Difference\ Entropy = -\sum_{i=0}^{N_{g-1}} p_{x-y}(i)\log\{p_{x-y}(i)\} \quad (12)$$

Difference variance is used to measure the spread (concerning the mean) in distributing the grayscale differences in the image. The difference variance is calculated using equation 13.

$$Difference\ Variance = \sum_{i=2}^{2N_g}\left(i - \left[\sum_{i=2}^{2N_g} i p_{x-y}(i)\right]\right) \quad (13)$$

N_g is the number of gray levels, *p(i,j)* is the shared probability distribution of the pixel pair with gray level *i* and gray level *j*. μ is the average of the pixel values and σ is the standard deviation.

In addition to textural characteristics, the colour features will also be extracted to assist in obtainin colour features in peanut plant diseases. The extracted colour feature is the mean in the HSV colour space. The conversion of RGB to HSV images can be calculated using equation 14 [16].

$$\begin{aligned} &r = \frac{R}{R+G+B}, \quad g = \frac{G}{R+G+B}, \quad b = \frac{B}{R+G+B} \\ &V = \max(r,g,b) \\ &H = \begin{cases} 0 & if\ S = 0 \\ \frac{60*(g-b)}{S*V} & if\ V = r \\ 60*\left[2+\frac{(b-r)}{S*V}\right] & if\ V = g \\ 60*\left[4+\frac{(r-g)}{S*V}\right] & if\ V = b \end{cases} \\ &S = \begin{cases} 0 & If\ V = 0 \\ V - \frac{\min(r,g,b)}{V} & If\ V > 0 \end{cases} \\ &H = H + 360 \quad If\ H < 0 \end{aligned} \quad (14)$$

Obtaining the mean HSV value from the image can be calculated using equation 15.

$$\begin{aligned} I_H &= \frac{H}{H+S+V} \\ I_S &= \frac{S}{H+S+V} \\ I_V &= \frac{V}{H+S+V} \end{aligned} \quad (15)$$

Where I is the intensity, while H, S, and V are Hue, Saturation, and Value, respectively.

3.5 Classification

Classification is the process of determining a model or function that describes or distinguishes a concept or data class to estimate an object's class. The purpose of classification is to recognise the image by classifying the characteristics it possesses. In the classification process, there are two phases, particularly the training phase and the testing phase. The training phase is part of the data that has been recognised by the data class to form a thinking model. As for the testing phase, the model that has been formed is tested with some other data to determine the model's accuracy.

The Support Vector Machine (SVM) method is chosen in this study to be used in the classification process. The SVM method is a supervised learning classification method to determine the best hyperplane used to separate two classes in the input space. The best hyperplane is the middle between the object and two classes, particularly the positive and negative classes. The approach to acquire the best hyperplane is to measure the hyperplane margin and determine its maximum point. Figure 2 shows an illustration of the optimal hyperplane that separates two data classes, a positive class, and a negative class.

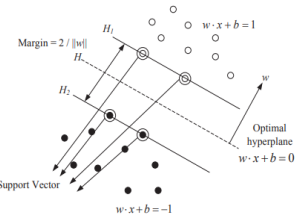

Figure 2. Illustration of a Support Vector Machine

The SVM method has a weakness of only able to classify two classes. Therefore this research will use the development of the SVM method, i.e. the Multiclass SVM method, with the strategy used is the Directed Acyclic Graph Support Vector Machine (DAGSVM), which can classify more than two data classes. In the DAGSVM method, training is carried out by building N(N-1)/2 binary SVM classification models the same as the one-against-one (OAO) method. Meanwhile, at the testing stage, it is only N-1 times. Figure 3 shows an illustration of the DAGSVM classification with five classes.

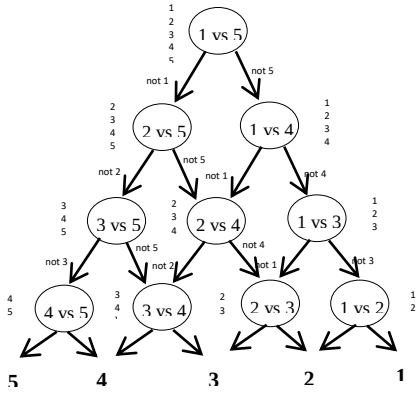

Figure 3. Illustration of DAGSVM for the 5 class classification

The DAGSVM method consists of N(N-1)/2 of two kinds of classifiers. Each classifier correspondence with two classes distributed in the N structure. In DAGSVM, there is a node in the top layer called the root node. The two nodes are in the second layer and forward, where the j layer has as many as i nodes. The total number of nodes depends on N(N-1)/2. Each node represents one decision function. Each node will classify the processed data into the next layer using the SVM algorithm. The result of the decision in the form of class is actually in the last layer [17].

4. Results and Discussion

In this research, a dataset of 402 images was used, which were collected through an image acquisition process using a Samsung J8 mobile camera, with details of 100 images of leaf spot class, 100 images of leaf rust class, 72 images of eyespot class, 100 images of normal leaf class, and 30 images of other leaf class. This image dataset will be inputted into the program, and then it will undergo the preprocessing stage, where the image will be resized to 635x439 pixels. This resized image will be used in the segmentation process to obtain the Region Of Interest (ROI) part, which is the diseased part of the peanut leaf image. Figure 4 shows the image from the segmentation process.

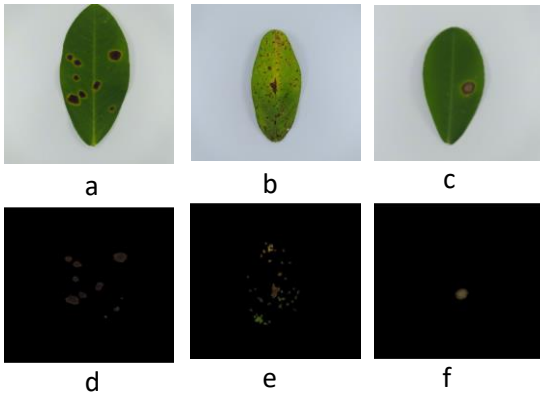

Figure 4. Original image of peanut leaves: (a) Leaf spots, (b) Leaf rust, (c) Eyespots, Segmentation results image (d) Leaf spots, (e) Leaf rust, (f) Eyespots

After the segmented image was obtained, the following process was feature extraction to obtain the texture and colour features of the peanut leaf image. In the feature extraction process, the segmented image will be converted into a grayscale image for the GLCM texture feature extraction process. It will be converted into the HSV colour space for the colour feature extraction process. The GLCM process will use distance as d = 1, and four angular orientations will be used, i.e. $0^0, 45^0, 90^0$ dan 135^0. The extracted texture features are ASM, contrast, IDM, correlation, entropy, variance, sum average, sum entropy, sum variance, difference entropy, and difference variance. As for the extraction of colour features, three features were extracted, namely the mean H, mean S, and mean V. Thus, in this study, there were 14 features used to obtain the features of the image of peanut leaves. Table 1 shows the results of the extraction of GLCM texture features and HSV colour features.

Table 1. Extraction Results of GLCM and HSV Features

Image	Features	Angle (degrees)			
		0	45	90	135
	ASM	0.8653	0.8558	0.8635	0.8565
	Contrast	0.0262	0.0362	0.0284	0.0355
	IDM	0.9871	0.9821	0.9860	0.9824
	Corelation	0.7627	0.6729	0.7424	0.6790
	Entropy	0.3222	0.3481	0.3279	0.3465
	Variance	1.1419	1.1422	1.1421	1.1434
	Sum average	2.1167	2.1169	2.1164	2.1169
	Sum entropy	0.3036	0.3226	0.3076	0.3215
	Sum	3.4818	3.4042	3.4636	3.4090

	variance				
	Difference entropy	0.1206	0.1551	0.1285	0.1529
	Difference variance	0.0262	0.0362	0.0284	0.0355
	Mean H	0.1410	0.1410	0.1410	0.1410
	Mean S	0.3843	0.3843	0.3843	0.3843
	Mean V	0.1711	0.1711	0.1711	0.1711
	ASM	0.2504	0.2324	0.2483	0.2222
	Contrast	0.1985	0.2312	0.1856	0.2549
	IDM	0.9121	0.8891	0.9117	0.8773
	Corelation	0.8194	0.7811	0.8306	0.7585
	Entropy	1.6007	1.6592	1.5943	1.6980
	Variance	4.9118	5.0088	4.8686	5.0146
	Sum average	4.2098	4.2747	4.1970	4.2747
	Sum entropy	1.4413	1.4889	1.4556	1.5110
	Sum variance	9.6642	9.6399	9.5180	9.4936
	Difference entropy	0.4926	0.5459	0.4808	0.5748
	Difference variance	0.1985	0.2312	0.1856	0.2549
	Mean H	0.0984	0.0984	0.0984	0.0984
	Mean S	0.4692	0.4692	0.4692	0.4692
	Mean V	0.2934	0.2934	0.2934	0.2934

The subsequent process is the classification to classify the five classes of leaf conditions used in this study. This classification process gains input from the extraction of GLCM texture features and HSV colour characteristics with 14 features. The sharing proportion of training data and test data used in the classification process is 70% for training data and 30% for test data, with 282 images as training data and 120 images as test data. The classification method used is Multiclass SVM with the DAGSVM strategy. The kernel used to test the DAGSVM method in this study compares the use of two types of kernels, namely linear kernels and polynomial kernels. For the performance evaluation of the classification model, the calculated parameter is accuracy. Accuracy is calculated using equation 16.

$$\text{Accuration} = \frac{TP + TN}{TP + TN + FP + FN} \times 100\% \qquad (16)$$

Where TP is True Positive, TN is True Negative, FP is False Positive, and FN is False Negative.

Table 2 shows the performance of the classification results using the multiclass SVM method with the DAGSVM strategy on the polynomial kernel with an angle of 0 degrees.

Table 2. Classification Performance for Polynomial Kernels, 0 degrees angle

No.	Diseases	TP	TN	FP	FN	Accuration (%)
1	Leaf Spot	29	90	0	1	99.1667
2	Leaf Rust	30	87	3	0	97.5000
3	Eyespot	19	99	0	2	98.3333
4	Normal Leaf	30	90	0	0	100
5	Other Leaf	9	111	0	0	100

Figure 5 shows a graph of the performance of the multiclass SVM classification results with the DAGSVM strategy using a polynomial kernel with an angles of 0, 45, 90, and 135 degrees.

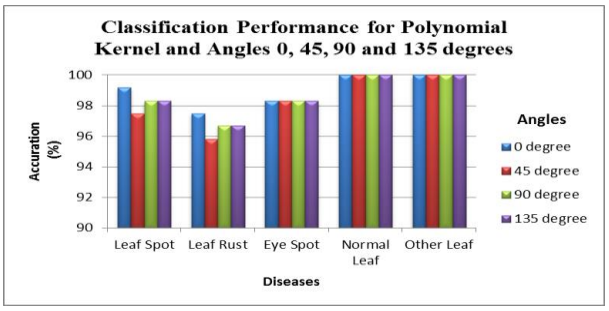

Figure 5.Graph of Classification Performance Results for Polynomial Kernel, Angles 0, 45, 90, and 135 degrees

Table 3 shows the performance of the classification results using the multiclass SVM method with the DAGSVM algorithm on a linear kernel with an angle of 0 degrees.

Table 3. Performance Classification for Linear Kernel, Angle 0 degrees

No.	Diseases	TP	TN	FP	FN	Accuration (%)
1	Leaf Spot	28	90	0	2	98.3333
2	Leaf Rust	30	85	5	0	95.8333
3	Eyespot	18	99	0	3	97.5000
4	Normal Leaf	30	90	0	0	100
5	Other Leaf	9	111	0	0	100

Figure 6 shows a graph of the performance of the SVM multiclass classification results with the DAGSVM strategy using a linear kernel with an angles of 0, 45, 90, and 135 degrees.

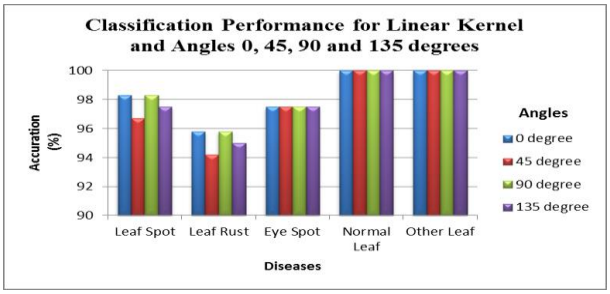

Figure 6. Graph of Classification Performance Results for Linear Kernel, Angles 0, 45, 90, and 135 degrees.

Table 4 shows the confusion matrix results from the results of the SVM multiclass classification system with the DAGSVM algorithm on a polynomial kernel with an angle of 0 degrees.

Table 4. Confusion Matrix Classification Results for Polynomial Kernel, Angle 0 degrees (%)

	Leaf Spot	Leaf Rust	Eyespot	Normal Leaf	Other Leaf
Leaf Spot	96.7	3.3	0	0	0
Leaf Rust	0	100	0	0	0
Eyespot	0	9.5	90.5	0	0
Normal Leaf	0	0	0	100	0
Other Leaf	0	0	0	0	100

Based on table 4, the results of the confusion matrix for kernel polynomial with an angle of 0 degrees indicate that the system is able to classify peanut leaf diseases appropriately, i.e. 96.7% as leaf spot class from 30 data, 100% as leaf rust class from 30 data, 90.5% as eyespot class from 21 data, 100% as normal leaf class from 30 data and 100% as other leaf class from 9 data.

Table 5 shows the confusion matrix results from the results of the SVM multiclass classification system with the DAGSVM algorithm on a linear kernel with an angle of 0 degrees.

Table 5. Confusion Matrix Classification Results for Linear Kernel, Angle 0 degrees (%)

	Leaf Spot	Leaf Rust	Eyespot	Normal Leaf	Other Leaf
Leaf Spot	93.3	6.7	0	0	0
Leaf Rust	0	100	0	0	0
Eyespot	0	14.3	85.7	0	0
Normal Leaf	0	0	0	100	0
Other Leaf	0	0	0	0	100

Based on table 5, the results of the confusion matrix for kernel linear with an angle of 0 degrees indicate that the system can classify peanut leaf disease accurately, i.e. 93.3% as leaf spot class from 30 data, 100% as leaf rust class from 30 data, 85.7% as eye spot class from 21 data, 100% as normal leaf class from 30 data and 100% as other leaf class from 9 data.

5. Conclusion

The disease detection system in peanut leaves has been designed successfully in this research. Based on the results of the research, the classification system of peanut leaf disease using polynomial kernels obtained the highest accuracy at pixel proximity (distance) of 1 and in the GLCM direction of 0 degrees with an accuracy value of 99.1667% for leaf spot class, 97.5% for leaf rust class, 98.8333% for eyespot class, 100% for normal leaf class and 100% for other leaf class. Whereas for the classification of peanut leaf disease with linear kernels, the highest accuracy was obtained at the pixel proximity (distance) of 1 and the GLCM 0 and 90 degrees with an accuracy value of 98.3333% for leaf spot class, 95.8333% for leaf rust class, 97.5% for eyespot class, 100% for normal leaf classes and 100% for other leaf classes. Based on the accuracy results obtained, the SVM multiclass classification model with the DAGSVM approach using a polynomial kernel provides the best accuracy results compared to the use of a linear kernel.

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International Journal of Computer Applications Technology and Research
Volume 10–Issue 06, 156-160, 2021, ISSN:-2319–8656

Design Passive Optical Network Using Multiclass Classification Neural Network

Firman Pratama Dewantara
Electrical Engineering Department,
Faculty of Engineering,
Brawijaya University.
Malang, East Java, Indonesia

Sholeh Hadi Pramono
Electrical Engineering Department,
Faculty of Engineering,
Brawijaya University.
Malang, East Java, Indonesia

Rahmadwati
Electrical Engineering Department,
Faculty of Engineering,
Brawijaya University.
Malang, East Java, Indonesia

Abstract: To require the order of last mile and the increasing demands of high quality of internet, the network architecture of FTTH (Fiber to the Home) has been chosen by numerous ISP (Internet Service Provider). Poor planning does not only increase the infrastructure costs, but it also increases maintenance costs. In this study, the authors focus on the design of passive optical network by using multiclass classification [9] in backpropagation neural network to shorten the FTTH network planning based on passive optical network design to determine final splitter type which refers to the feasibility of QoS (Quality of Service) and Cost Efficiency. Dataset in this study utilizes GIS (Geographic Information System) report with 33 sub-districts in Malang Regency in 2019 data layer. As a result, after 7300 epoch, the accuracy training was 99.99% and the splitter classification accuracy was 98.76%.

Keywords: PON; QGIS; multiclass-classification; quality-of-service

1. INTRODUCTION

Fiber optic (FO) is a current transmission medium that has the reliability of passing data with a large data capacity, has the characteristics of large bandwidth, high transmission speed in gigabit units and has low attenuation. Optical fiber has been widely used in various fields of technology, one of which is in the field of telecommunications networks [1].

With the rapid use of fiber optics in the telecommunications sector, internet penetration in Indonesia increased by 8.9% in 2019 compared to 2018. The data was released by the Indonesia Survey Center through APJII (Association of Indonesian Internet Service Providers) [2]. In addition, APJII also continues to improve the availability of access infrastructure by collaborating with network providers through a member-neutral FTTH program [3].

ISP (Internet Service Provider) as an internet network provider as well as a member of APJII has a pivotal role in increasing internet penetration and equity in Indonesia by carrying out the commitment of 5 cities in the first 5 years on the principle license period. This is in accordance with the statement of the chairman of APJII, Jamalul Izza, in discussing the RPM controversy (Draft Ministerial Regulation) regarding to the prohibition on the operation of internet access services outside the scope of its service area. This is also published in PERMENKOMINFO No.7 of 2015 [4]. The commitment of regional services has implications on the broad reach of ISPs in developing internet business.

To meet the increasing demand for last mile (end user) as well as the demands of internet service quality, the FTTH (Fiber to the Home) network architecture has been chosen by many ISPs. However, poor network planning can not only lead to very high infrastructure installation costs, but it can also increase high maintenance costs. This encourages researchers to perform optimizations using various methods. One of the FTTH architectures that is often studied is PON (Passive Optical Network).

PON is an optical fiber-based broadband access network architecture that uses optical passive devices, so it can be used in point-to-multipoint configurations and can increase access speeds from 155 Mbps to 2.4 Gbps and even up to 5 Gbps for GPON. The elements used in PON are passive optical elements such as passive splitters, fiber optic cables and splices so that this technology can simplify the network, simplify protocol synchronization between interconnection devices and reduce costs in terms of network construction [5].

To get quality of service (QOS) optimization, FTTH network planning must notice to several parameters including the total demand in the cluster, bandwidth requirements, OLT placement, splitter placement, and the cable length. The increasing number of ISP operators available in the certain areas can also provide effectiveness in determining the topology and use of the final infrastructure [6]. Apart from the above parameters, device specifications such as the power emitted on the OLT, the power sensitivity of the ONT, the spectral width of the laser are also needed to consider. Feasibility parameters such as rise time, SNR (Signal to Noise Ratio), and BER (Bit Error Rate) are the output of the feasibility parameters.

A related research previously conducted by Mateusz Zotkiewicsz in 2018 entitled "Classifiers Applied to Dimensioning of Splitters in PON Design" compares the PON classification using a neural network and a decision tree. The use of a neural network is better than using a decision tree [7]. Dataset is adapted from Kaltham Al Romaithi in 2020 entitled "Optimization of Multilayer Design for FTTH Networks Based on Geographical Information" [8]. We utilizes QGIS with OSM (Open

Street Map) as basic map to provide road and demand data which processed using geoAI/ grass, also using k-means to provide clustered demand and route line. Random OLT point determination is required to process the potential node middle splitter and final splitter and the various report attributes therein. The complete process of collecting dataset in QGIS is explained in section 2. Dataset in this study is generate from 33 sub-districts in Malang Regency in 2019 data layer. The purpose of this research is to shorten design of passive optical network to determine final splitter type which refers to the feasibility of optical transmission QoS (Quality of Service) and Cost Efficiency in FTTH planning.

2. METHOD

The concept of the method in this study is shown in Figure 1 below:

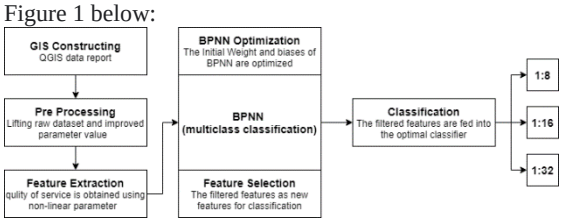

Figure 1. (Research Method)

2.1 Passive Optical Network

PON (Passive Optical Network) in this paper are used GPON parameters shown in Table 1 below:

ITU-T G.652		
652.D (Uplink)	0.4	dB/km
652.D (Downlink)	0.3	dB/km
Chormatic Dispersion (Tmat) SMF	12	ps/nm.km
Intermodal Dispersion (Tmod) MMF	0	ps/nm.km
Optical Interface		
Sensitifity Receiver	-27	dBm
Risetime Receiver	200	ps
Risetime Transmitter	150	ps
Passive Component		
Splitter 1:4 Loss	7.25	dB
Splitter 1:8 Loss	10.38	dB
Splitter 1:16 Loss	14.1	dB
Splitter 1:32 Loss	17.45	dB
Connector Loss	0.5	dB
Redaman Splicing	0.1	dB

Table 1. Passive Optical Specification

The parameters are used to calculate the feasibility of SNR and BER at each potential node, with minimum standard of SNR> 21.5 dB and BER> 1x10-9. The total loss parameter is calculated by using the general link budget in equation 1-12 to ensure the power received is not less than the minimum receiver sensitivity. The risetime budget in this study uses an NRZ type encoding that can carry a large bandwidth.

$$tsys = (t_{tx}^2 + t_{chromatic}^2 + t_{modal}^2 t_{rx}^2)^{1/2} \quad (1)$$

$$D_t = D(\lambda).\ S.\ L \quad (2)$$

$$D(\lambda) = \frac{S_0}{4}\left(\lambda - \frac{\lambda_0^4}{\lambda^3}\right) \quad (3)$$

$$t_{sys} < t_r \quad (4)$$

$$tr = \frac{0,7}{Br} \quad (5)$$

Quality-of-service also involves SNR and Q factor parameters.

$$\left(\frac{S}{N}\right) = \frac{Signal\ Power}{Shot\ Noise\ Power + Amplifier\ Noise\ Power} \quad (6)$$

$$Signal\ Power = 2\ (2P_{opt}\frac{\eta q}{\eta v})^2\ M^2 \quad (7)$$

Noise:

$$Noise\ Dark\ Current\ i_{ND}^2 = 2qi_D B. \quad (8)$$

$$Thermal\ Noise = \frac{4k\ T_{eff}\ B}{R_{eq}} \quad (9)$$

$$Shot\ Noise = 2q\ (2P_{opt}\frac{\eta q}{\eta v})^2\ B\ M^2\ F\ (M) \quad (10)$$

To calculate BER, Q factor needs to be calculated with the following equation:

$$(S/N)\ pk/rms = 20\ Log\ 2Q \quad (11)$$

$$BER = Pe(Q) = \frac{1}{\sqrt{2\pi}}\ .\frac{e}{Q}^{-\frac{Q^2}{2}} \quad (12)$$

2.2 Dataset

The data used in this research are the QGIS parameter reports which were processed to produce SNR and BER values. From 33 sub-districts, the data collected is 2727 clusters with various customer capacities for each cluster. From 2727 clusters, 41801 potential node final splitters were produced with a splitter ratio parameter of 1:8, 1:16, and 1:32.

Figure 2. *QGIS Design Network*

In addition to parameters of power transmission, bitrate and wavelength are required to design the QoS (Quality of Service) ODN (Optical Distribution Network). The transmission power scenario uses 1.5, 3, 5 dB, bitrate from 10-100 Mbps, wavelengths of 1490 (dual play), and 1550 (triple play). To build a classification model, we use three stages: 1) GIS constructing, 2) Design of QoS (Quality of Service), 3) Determine the passive optical network class label on ODN.

1) *Gis Constructing:* we make the use of hierarchical features and k-means algorithm provided by the GNI planner of QGIS. Experiments were carried out several times to produce an even distribution of demand in each cluster. After the clusters are generated, we repeated this step to produce several distribution variations in the same district. From the distribution of demand in each cluster, a potential node was generated in the form of a middle splitter and final splitter as well as a rough calculation of loss. Report parameters in GIS was selected to be used as the system training input.

2) *Design Quality of Service:* This stage adopts 1-12 equations and aims to produce training data matrices that are in accordance with the feasibility of Quality of Service. The amount of data used has as many as matrices (1048575, 83)

3) *Classification of Training:* To determine the training data, we calculate Design Quality of Service first, then select which index or parameter is suitable to be used as training data (eg: BER replaced by Q factor) because it has a very small value.

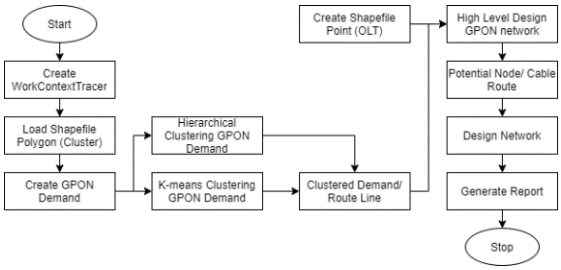

Figure 3. *GIS Constructing*

id	s	w	bdl	l	p	c	rdl	sdl	qdl	k	testing
1	0	1	0.57	4.7021815	0	57	0.2620012	781.91801	13.981398		1
3	0	1	0.69	10.791893	0	69	0.3080037	222.75678	7.4625193		1
5	0	1	0.97	9.8789222	0	97	0.2993688	188.06218	6.8567883		1
6	0	1	0.77	4.5565913	0	77	0.2612853	590.48283	12.149926		1
7	0	1	1.93	2.0275388	0	193	0.2522745	399.61709	9.9952125		1
9	0	1	1.45	7.5612436	0	145	0.2799795	189.53917	6.8836613		1
10	0	1	0.73	7.8732315	0	73	0.2823593	377.58645	9.7157919		1
11	0	1	1.64	6.2036849	0	164	0.2705465	211.33357	7.2686582		1
14	0	1	2.17	4.212662	0	217	0.2596765	209.83052	7.2427639		1
15	0	1	1.98	6.8887327	0	198	0.2751144	145.41756	6.0294602		1
19	0	1	2.4	2.8284628	0	240	0.2544077	262.93922	8.1077004		1
20	0	1	1.84	3.5206422	0	184	0.2567968	298.06378	8.6322619		1
21	0	1	1.97	2.0839265	0	197	0.2524022	354.66384	9.4162603		1
24	0	1	1.32	0.2227212	0	132	0.2500276	818.73646	14.306786		1
25	0	1	1.12	1.2998123	0	112	0.2509373	760.59836	13.789474		1
27	0	1	0.02	12.601642	0	2	0.3265453	5723.4139	37.826624		1
29	0	1	0.9	8.2265417	0	90	0.2851448	266.24904	8.1585697		1
30	0	1	0.64	6.9726996	0	64	0.2757016	487.3306	11.037783		1
31	0	1	1.91	5.4838524	0	191	0.2661905	200.28195	7.0760504		1
32	0	1	1.1	7.6674408	0	110	0.280781	235.21963	7.6684357		1

sf_train.drop(sf_train[sf_train.k <1].index,inplace=True)

(123001, 11)

Table 2. Dataset using dataframe.drop

2.3 Network Architecture

We used 3 layers of MLP (Multi-Layer Perceptron) in this study. In Figure 2, the input layer has eight nodes in the form of wavelength, bitrate, length, capacity, tx, risetime, SNR, and BER. Those eight layers in the hidden layer are for adding non-linear parameters into the model resulting in three output layer nodes as the final splitter multiclass classification [9] based on the quality-of-service feasibility value.

We did an experiment using several hidden layer models and a different number of neurons and got a fit model using a hidden layer 8,8. The architecture above was chosen because it produces minimal loss and results in a fairly effective training process compared to the combination of hidden layers and other neurons.

Algorithm for the proposed system:

1. Initiation of weights using small random numbers

2. Feed Forward

- Each input unit (x_i, i=1,.....,n) was passed to the hidden layer
- Each hidden layer (z_j, z=1,.....,p) added the weight of the input signal $Z\_in_{jk} = V_{0j} + \sum_{i=1}^{n} x_i v_{ij}$, by applying the activation function $Z_j = f(Z\_in_j)$
- For example, the activation function used is sigmoid y = $f(x) = \frac{1}{1+e^{-x}}$,, then this signal was sent to all output units.
- Each output unit (yk, k=1,.....m), added up the input and weight $Y\_in_k = w_{0j} + \sum_{k=1}^{p} z_j v_{jk}$ by applying the activation function Yj = f (Y_ink)

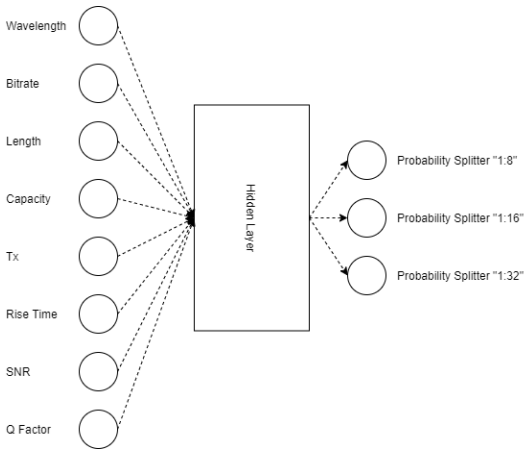

Figure 4. Neural Network Architecture

3. Backpropagation

- Each output unit (y_k, k=1,.....,m) received the training input by calculating the error $\delta_k=(t_k - y_k)\, f'(y\_in_k)$
- Calculating the correction for weight and bias $\Delta w_{jk} = \alpha\delta_k x_j$, $\Delta w_{0k} = \alpha\delta_k$
- Each hidden layer (z_j, z=1,.....p) added up the input delta $\delta\_in_j = \sum_{k=1}^{m} \delta_k w_{jk}$ and calculated the error $\delta_j = \delta\_in_j f(x\_in_j)$
- Calculating weight and bias correction $\Delta v_{ij} = \alpha\delta_j x_i$

4. Fixing the weight and bias

- Each output unit (y_k, k=1,.....,m) updated the weight and bias (j=0,1,.....,p)
- w_{jk} (new) = w_{jk} (old) + Δw_{jk}
- Each hidden layer unit (z_j, z=1,.....,p) updated the weight and bias (i=0,1,.....,n)
- v_{ij} (new) = v_{ij} (old) + Δv_{ij}

5. Training stopped

2.4 Implementation

We conducted an experiment using several hidden layers and hyperparameter model. The input feature will be streamed to all hidden layer neurons where each feature will be multiplied by weight and added bias at the same time, as well as the output from the hidden layer to the output layer. After the feature reach the output layer, the classification loss will be calculated using Categorical Cross-Entropy (CCE) loss. The target for multi-class classification is a one-hot vector, meaning has one on a single position and 0's everywhere else [10] [11].

$$\text{Loss CCE} = -\sum_x p(x) \,.\log q(x) \qquad (13)$$

p(x) = Probability of class x in the "target" matrix

q(x) = Probability of class x in the "predict" matrix

The training process uses Early Stopping parameters with Patient (Number of epochs with no improvement after which training will be stopped) [12] after the 1000th epoch and Model Checkpoint monitoring Val accuracy mode 'max' to avoid overfitting during training. Training stopped at the 7300th epoch of the 20,000 epochs specified. MLP used 5 neurons in the hidden layer with the sigmoid activation function and three neurons in the output layer with the SoftMax activation function [10] [11]. The author also conducted an experiment using hyperparameter [citation]. This experiment aims to find a neural network model that produces the best accuracy.

es = EarlyStopping (monitor = 'val_loss', mode = 'min', verbose = 1, patience = 1000)

mc = ModelCheckpoint ('best_model.h5', monitor = 'val_accuracy', mode = 'max', verbose = 1, save_best_only = True)

3. RESULT AND DISCUSSION

3.1 Training Result

After 7300 epochs, we evaluate the model using the test data. The training accuracy is around 99.99% and the testing accuracy is around 98.76%.

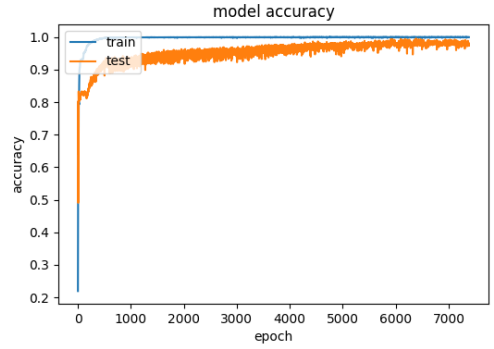

Figure 5. Training and Testing Accuracy Result

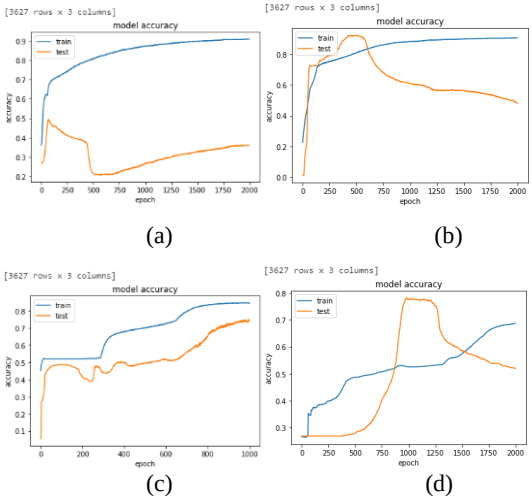

Figure 6. Overfit (a) relu 8 batch-size 64, adam 0.00001 (b) relu 7 batch-size 64, adam 0.00001 (c) 4 relu, 8 sigmoid, batch-size 16, sgd 0.0001 (d) 7 relu, 5sigmoid, 32, 0.000001

Epoch 07299: val_accuracy did not improve from 0.99559

Epoch 7300/20000

116/116 [==============================] - 0s 1ms/step - loss: 5.2663e-04 - accuracy: 0.9997 - val_loss: 0.1006 - val_accuracy: 0.9876

3.2 One-hot Encoding

The target for multi-class classification is a one-hot vector, meaning has 1 on a single position and 0's everywhere else [13].

Layer (type)	Output Shape	Param #
input_23 (InputLayer)	[(None, 8)]	0
dense_44 (Dense)	(None, 5)	45
dense_45 (Dense)	(None, 3)	18

Figure 7. Neural Network Model

	1:8	1:16	1:32
8226.0	1.000000	1.181006e-08	2.144990e-29
3990.0	1.000000	1.302063e-08	2.111058e-29
4013.0	1.000000	1.302063e-08	2.111058e-29
5186.0	1.000000	2.197091e-08	4.575406e-29
5209.0	1.000000	2.197091e-08	4.575406e-29
2016.0	1.000000	8.022938e-10	3.542995e-31
2030.0	1.000000	8.022938e-10	3.542995e-31
2884.0	1.000000	1.227288e-09	6.593431e-31
2898.0	1.000000	1.227288e-09	6.593431e-31

Figure 8. Multiclass Classification Result (One-hot Encoding)

Some classifications resulted in inaccurate predictions of final splitter ratios. However, the classification results produced the optimum final splitter in FTTH network planning by prioritizing the cost efficiency factor without eliminating the QoS factor.

3893.0	0.013101	9.868993e-01	1.065835e-16
5089.0	0.003422	9.965783e-01	2.124624e-16

Figure 9. Cost Efficiency Result

3.3 Loss CCE

On the section 2.4, it has been explained that the implementation of training used *Categorical-CrossEntropy*. loss CCE is calculated using equation *13* [13]:

Sample (id 3893)

0 0.003422 $Loss\ 1:8?$
Target = 1, Prediction = 0.9868998 $Loss\ 1:16?$
0 $2.12 - 16$ $Loss\ 1:32?$

Loss 1:8 = -p(1:8).log q(1:8)
= -0.log(0.003422)
= 0

Loss 1:16 = -p(1:16).log q(1:6)
= -1.log(0.9868998)
= 0,0057269

Los 1:32 = -p(1:32).log q(1:32)
= -0.log q(2.12E-16)
= 0

3.4 QoS (Quality of Service)

The data testing id 3893 will be tested using the equation in section 2.1. The parameter of testing data are as follows:

Parameter:
s = 1 (1:8)

w = 1 (1550 nm)
p = 2 (5 dB)
b = 10 Mbps
c = 1
l = 2.35801132506869 Km

Final splitter planning using 1: 8 resulted in a QoS calculation that was in excellent status where the risetime budget was 0.2530716, SNR 55.757096, and BER 0. Multiclass Classification predicted that the final splitter ratio was possible to use a larger ratio, namely 1:16 which resulted in risetime as 0.253072, SNR 48.43843, and BER 0. This showed that the feasibility of QoS can still be reduced to the minimum standard limits of SNR and BER to produce cost efficiency in network planning. This simplifies the QoS input parameters without calculating manually to produce optimal FTTH network planning (QoS and cost efficiency). The following is a comparison table of 1: 8 and 1:16:

	rt	SNR(dB)	Q	BER	QoS
1:8	0.2530716	55.757096	306.77841	0	yes
1:16	0.2530716	48.438427	132.09651	0	yes

Table 3. *Quality of Service id 3893*

The authors tried to prove that by adjusting the QoS parameter to the standard value of feasibility, it can result in cost efficiency optimization. In this experiment, we used data testing id 3893 by changing the parameter of the capacity to be 100 homepassed, SNR using a minimum standard of 21.5 and BER 1E10-9. Following are the prediction results:
1s 2ms/step - loss: 0.0014 - accuracy: 0.9998 - val_loss: 0.0480 - val_accuracy: 0.9876

[[2.0661601e-26 2.6315628e-03 9.9736845e-01]]

Referring to the clarification system result, the authors calculated manually using final splitter ration 1:32. The results are as follows:

	rt	SNR(dB)	Q	BER	QoS
1:32	0.2530716	35.7571	30.6778	5.629E-207	yes

Table 4. *Quality of Service id 3893 1:32*

4. CONCLUTION

4.1 Conclusion

From the results of the research, several conclusions can be drawn:

1. The design of passive optical network (final splitter) can be done using the Multiclass Classification method with a multilayer perceptron Neural Network.
2. The val accuracy of 98.76% can produce QoS (Quality of Service) feasibility in the design of passive optical network FTTH network.
3. The final splitter determination using Multiclass Classification can increase the cost efficiency of FTTH network development because the increased capacity of the splitter ratio can reduce the need for distribution cables.

4.2 Suggestions

Design Passive Optical Network using Multiclass Classification can utilize the ISP dataset such as ONMS (Optical Network Monitoring System) and CRM (Customer Relationship Management) to be applied in network expanding.

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International Journal of Computer Applications Technology and Research
Volume 10–Issue 06, 161-165, 2021, ISSN:-2319–8656

Traffic Sign Detection and Recognition Based on Improved YOLOv4 Algorithm

Gaoli Hu
School of Communication Engineering
Chengdu University of Information Technology
Chengdu, China

Chengyu Wen
School of Communication Engineering
Chengdu University of Information Technology
Chengdu, China

Abstract: Traffic sign detection and recognition play an important role in intelligent transportation. In this paper, a traffic sign detection framework based on YOLOv4 is proposed. The original CSPDarkNet53 backbone network model is replaced by RepVGG, and the SPP module is added in the feature pyramid part to improve the expression ability of information. The CCTSDB traffic sign data set is used to detect three categories of indication signs, prohibition signs and warning signs. In order to further improve the performance of YOLOv4 network, K-means++ algorithm was used to perform cluster analysis on the experimental data to determine the size of the priori box suitable for CCTSDB dataset. The experimental results show that the map value of the improved framework is increased by 4.1%, which indicates that the improved YOLOv4 network has a high practical value in traffic sign detection and recognition.

Keywords: Deep learning; Traffic sign detection; YOLO4; RepVGG

1. INTRODUCTION

In recent years, the intelligent transportation system has developed rapidly, and the detection and recognition of traffic signs in natural scenes are important components of it. Traffic signs provide valuable traffic information such as road names, instructions and warnings, which can help drivers to comply with traffic signs according to law, greatly prevent traffic accidents and reduce traffic congestion. Therefore, the detection and identification of traffic signs is of great significance.

Generally speaking, the traditional target detection methods usually use manual features such as color [1] and shape [2] to extract regions of interest in the image. It is difficult to achieve ideal detection results in the field of traffic sign detection and recognition. With the vigorous development of artificial intelligence and computer vision, deep learning is widely used in the image field, and significant progress has been made in target detection, and it is one of the most effective solutions for traffic sign detection. Many well-known networks based on region generation, such as the R-CNN series [3-5], have good performance in target detection. There are also single regression-based networks including SSD[6], YOLO[7-9] series, etc, which simultaneously predict the bounding box and target probability from the input image. Although many achievements have been obtained in traffic sign detection, it is still a challenge to accurately and quickly locate and classify traffic signs in the face of relatively small traffic signs, unfixed shapes, and unstable characteristics in different situations.

Based on the above related work, this paper designs an improved traffic sign detection and recognition algorithm based on the YOLOv4 model [10]. Finally, the difference between the improved algorithm and the original algorithm is compared through experiments, and the results are verified on the CCTSDB dataset. The experiment shows that the method used in this paper effectively improves the detection accuracy and obtains good detection results.

2. YOLOv4 NETWORK STRUCTURE

YOLOv4 is improved on the basis of YOLOv3, which combines the best algorithm model and training skills in the current neural network. It can better distinguish the target information and the background area through the whole image training. It belongs to a single-stage target detection algorithm with strong real-time performance. YOLOv4 is mainly composed of backbone feature extraction network (CSPDarknet53), feature pyramid structure (SPP[11], PANet[12]) and a prediction result layer (Yolo Head). The structure is shown in Figure 1.

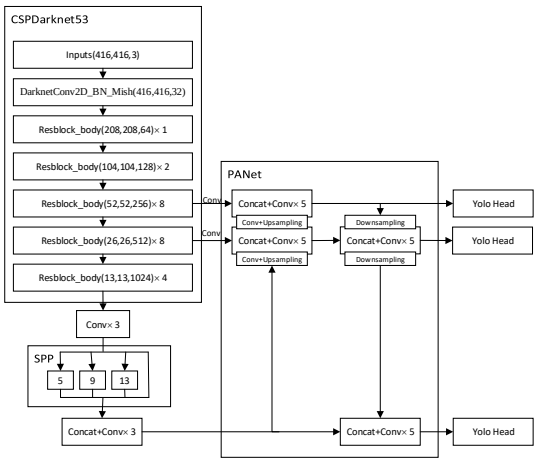

Figure 1. YOLOv4 Network Structure

CSPDarkNet53 integrates CSPNet [13] network on the basis of DarkNet53, reduces the disappearance gradient problem in deep network, and makes the structure lightweight and reduces the amount of data calculation. The feature pyramid structure adopts the path aggregation network with spatial pyramid pooling layer, which improves the problem of shallow information loss in the transmission process, increases the receptive field and improves the detection ability of the model. Yolo Head continues to use the method of YOLOv3 to extract three feature layers to complete the target detection task.

The input image is extracted from the CSPDarknet53 network, and the last three layers of semantic information are passed to the feature pyramid structure. After repeated feature extraction and feature fusion, the input image is fed to the Yolo Head network to generate the object category and the prediction boundary box to complete the target detection task.

In the task of traffic sign detection, the problem is that the image resolution is low, the background is complex, the noise is large and the information is small. Therefore, the feature information extraction in the target detection task is particularly important. This paper considers the fusion of shallow and deep semantic information to improve the effect of target detection. RepVGG [14] network model is used to replace the original CSPDarknet53 backbone network, and SPP module is added to the feature pyramid to improve the expression ability of information. The K-means++ clustering algorithm is used to process the experimental data to solve the problem that the original anchor frame scale is not suitable for the data set used in this paper and realize the demand of traffic sign detection.

3. IMPROVED YOLOV4 TARGET DETECTION ALGORITHM

3.1 RepVGG Feature Extraction Network

Since RepVGG has no complex branch structure and model design, and its performance is improved by re-parameterization, which is equivalent to the effect of multi-branch structure in accuracy and speed, we use a new network RepVGG to perform feature extraction task.

The reasoning time subject of RepVGG is affected by VGG [15], which is only composed of 3x3 convolution and ReLU activation function. The training time model is similar to ResNet using multi-branch structure. The structure reparameterization method is used to realize the conversion of training time and reasoning time model. The core structure of the model is shown in Figure 2.

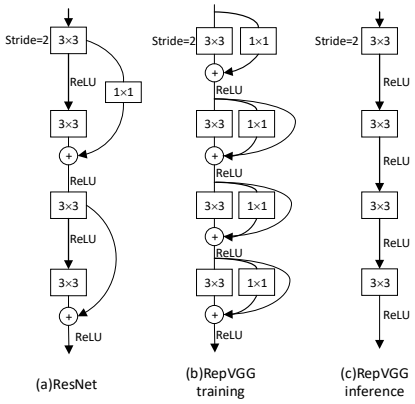

Figure 2. RepVGG Core Structure Diagram

The training time model uses identity structure and 1 × 1 branch structure block, and the information flow is y = x + g (x) + f (x). After the training is completed, it is equivalently converted to y = h (x). Finally, the training block is converted into a 3 × 3 convolution reasoning time block by using the structural reparameterization technology, as shown in Figure 3.

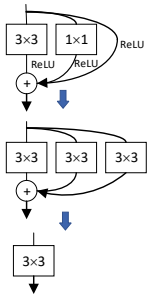

Figure 3. Reparameterization of RepVGG structure

$W^{(3)} \in R^{C_2 \times C_1 \times 3 \times 3}$ is used to represent the kernel of the 3×3 convolution layer of the C_1 input channel and the C_2 output channel, and $W^{(1)} \in R^{C_2 \times C_1}$ is used to represent the kernel of the 1 × 1 branch. $\mu^{(3)}$, $\delta^{(3)}$, $\gamma^{(3)}$, and $\beta^{(3)}$ are used to represent the mean, standard deviation, learning factor and deviation of BN layer after 3 × 3 convolution, respectively. $\mu^{(1)}$, $\delta^{(1)}$, $\gamma^{(1)}$, and $\beta^{(1)}$ are 1 × 1 convolution branches, and $\mu^{(0)}$, $\delta^{(0)}$, $\gamma^{(0)}$, and $\beta^{(0)}$ are identity branches, respectively. Let $M^{(1)} \in R^{N \times C_1 \times H_1 \times W_1}$ and $M^{(2)} \in R^{N \times C_2 \times H_2 \times W_2}$ be input and output, respectively, and * be a convolution operator. If $C_1 = C_2, H_1 = H_2, W_1 = W_2$, there is :

$$M^{(2)} = \mathrm{bn}\left(M^{(1)} * W^{(3)}, \mu^{(3)}, \delta^{(3)}, \gamma^{(3)}, \beta^{(3)}\right) + \mathrm{bn}\left(M^{(1)} * W^{(1)}, \mu^{(1)}, \delta^{(1)}, \gamma^{(1)}, \beta^{(1)}\right) + \mathrm{bn}\left(M^{(1)}, \mu^{(0)}, \delta^{(0)}, \gamma^{(0)}, \beta^{(0)}\right) \quad (1)$$

If you do not use an identity map, just use the first two of the equation. where bn is the inference time bn function :

$$W'^{i}_{i,:,:,:} = \frac{\gamma_i}{\sigma_i} W_{i,:,:,:} \quad (2)$$

$$b'_i = -\frac{\mu_i \gamma_i}{\sigma_i} + \beta_i \quad (3)$$

And each BN and its front convolution layer are converted into a convolution layer with bias vector. Let$\{W', b'\}$ be the kernel and bias transformed from $\{\mathrm{W}, \mu, \sigma, \gamma, \beta\}$:

$$\mathrm{bn}(\mathrm{M}, \mu, \sigma, \gamma, \beta)_{:,i,:,:} = \left(M_{:,i,:,:} - \mu_i\right)\frac{\gamma_i}{\sigma_i} + \beta_i \quad (4)$$

Using the above structure re-parameterization method, a 3 × 3 convolution is obtained for reasoning operation. By stacking the reasoning structure blocks, the main network of RepVGG reasoning can be constructed to complete the reasoning process.

3.2 SPP Embedded Characteristic Pyramid Structure

The semantic information contained in different feature layers is different, and the contribution to the output features after fusion is different. The feature extraction only in the output layer of the network will lead to the decline in the detection performance of small objects. Therefore, it is necessary to make full use of the semantic information at different levels to achieve the task of multi-scale detection.

YOLOv4 uses SPP and PANet structure in the feature pyramid, SPP module is shown in Figure 4.

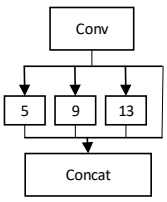

Figure 4. SPP structure

After the SPP module convolutions the output feature layer of the backbone network, four maximum pooling cores are respectively used for maximum pooling, and then the obtained different feature maps are channel spliced. The size of the output feature map, and the number of channels becomes four times that of the original. SPP structure can increase the receptive field of feature layer, capture effective context features, and improve the detection performance of the model.

The PANet structure is shown in Fig. 5. A bottom-up path aggregation network is added to the original structure of FPN, which further improves the detection effect. The three feature layers are extracted repeatedly through PANet network, and the more abstract top-level features are fully integrated with the underlying information. The feature maps of the same size generated in the forward propagation process are fused through horizontal connection, which makes full use of the feature layer information of different scales and effectively improves the target detection ability.

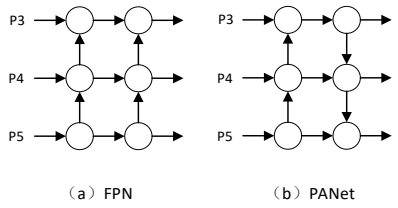

Figure 5. Characteristic pyramid structure

The YOLOv4 network sends the last layer of output to the SPP structure for up-sampling operation. In order to increase the multi-scale receptive field and improve the performance of the model, this paper adopts the SPP structure for the three-layer output on the basis of the above, and integrates it into the PANet network model to strengthen the expression ability of the output characteristic information. The structure is shown in Fig. 6.

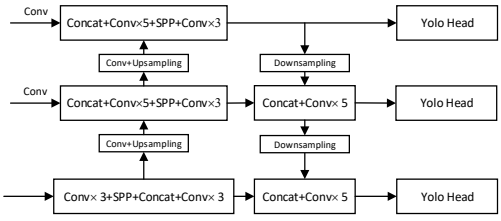

Figure 6. Improved structure diagram

3.3 Optimal anchor frame size acquisition

The Anchor box obtained by clustering can reduce the difficulty of target detection in prediction. The preset prior box of YOLOv4 network is obtained on PASCAL VOC dataset. However, for the self-set dataset, the use of the original preset Anchor box may make Yolo Head fail to select the appropriate target boundary box, which seriously affects the detection effect of the target. Therefore, this paper first clusters the real annotation boxes in the dataset.

In this paper, the K-means++ [16] clustering algorithm is used to cluster the boundary frame of the target in CCTSDB data set. Compared with the traditional K-means [17] clustering algorithm, the K-means++ clustering algorithm optimizes the selection of the initial point, and can select the optimal clustering center in the acquisition of the clustering center, effectively reducing the clustering deviation, so as to obtain a prior frame more suitable for the target data set and improve the accuracy of the target detection.

The K-means++ algorithm first randomly selects a sample point from the data set X as the initial clustering center, and then calculates the nearest distance between each sample point and the selected clustering center, and identifies it with D (x). Then the probability P (x) of each sample point selected as the next clustering center is calculated. Finally, the sample point corresponding to the maximum probability value is selected as the next clustering center.

$$\mathrm{P}(x) = \frac{D(x)^2}{\sum_{x \in X} D(x)^2} \qquad (5)$$

Repeat the above steps until K cluster centers are selected and K-Means algorithm is used to calculate the final clustering results of k cluster centers until the size of the Anchor box is no longer changed.

4. EXPERIMENT AND RESULT ANALYSIS

4.1 Experimental environment

The experimental platform is Windows10 (64bit) operating system, intel i7-8700 CPU, 16G memory, NVIDIA GeForce GTX 1060 6G memory, CUDA version 10.2, CUDNN7.5. Build a network model using the PyTorch framework.

4.2 Dataset processing

The dataset used in this paper is CCTSDB China Traffic Sign Detection Benchmark (CSUST Chinese Traffic Sign Detection Benchmark) [18]. The annotation data of CCTSDB dataset has three categories: indication mark, prohibition mark and warning mark, a total of 15723 pictures.

In the experiment, the original image in CCTSDB dataset was converted into jpg format, and the original label was converted into an xml file in VOC format suitable for YOLOv4 network, which was convenient to read the image annotation information. The proportion of training set and test set was 9 : 1.

4.3 Experimental parameters

In this experiment, YOLOv4 is used as the algorithm detection framework, and the pre-training weight is used as the basic feature extraction model by using the migration learning method. The momentum and weight attenuation are set to 0.9 and 0.0005, the batch size is set to 16, and the learning rate is 0.001. In order to train convergence, SGDM gradient optimization method is used, and the loss function is CIOU Loss.

4.4 Experimental results

Firstly, the K-means++ clustering algorithm is verified to optimize the detection accuracy of CCTSDB dataset targets. On the dataset of this paper, three classes and nine priori boxes are set up. The sizes obtained by K-means++ clustering algorithm are : (7,18), (9,24), (11,29), (13,36), (16,43), (18,27), (21,55), (30,44), (52,81). Under the same parameter settings, the average accuracy of the anchor box obtained by clustering is 1.1 % higher than that of YOLOv4 algorithm. Therefore, the target box obtained by K-means++ clustering algorithm is easier to fit the real target and obtain better detection results. As shown in table 1:

Table 1. Comparison of optimization results

Model	Map(%)	FPS
Improved ago	94.5	19.5
The improved	95.6	20

YOLOv4-R using RepVGG as the backbone network and the YOLOv4-S based on the improved feature pyramid structure are trained and tested on the CCTSDB dataset, and compared with the original target detection network. The experimental results are as follows.

Table 2. Performance comparison of different improved algorithms

Model	Map(%)	FPS
YOLOv4	95.6	20
YOLOv4-R	96.7	19
YOLOv4-S	97.9	20

It can be seen from table 2 that the performance of the new target detection network is improved compared with the original network.

The YOLOv4 detection algorithm using RepVGG as the backbone network YOLOv4-R improves the detection accuracy by 1.1 % compared with the original network, indicating that RepVGG is simple in structure but powerful in performance. As a backbone network, RepVGG can effectively complete the feature extraction task, improve the accuracy of target detection, and the frame rate is not significantly reduced.

Compared with the original network, the average accuracy of the YOLOv4-S detection algorithm based on the improved feature pyramid structure is increased by 2.3 %. It shows that adding SPP network in the feature pyramid structure can increase the receptive field of the feature layer, capture effective context features, and enrich feature information through feature fusion at different scales to improve the detection performance of the model.

In order to further verify the effectiveness of the improved algorithm, the network model integrating all the above improved methods is trained and verified on the CCTSDB dataset. The test results are shown in Table 3.

Table 3. Improved model detection comparison

Model	Map(%)	FPS
Improved ago	94.5	19.5
The improved	98.6	20

Compared with the experimental results of table 3, this paper proposes an improved YOLOv4 target detection algorithm, and its average accuracy is increased by 4.1 %, which verifies the effectiveness of the improved algorithm and shows the feasibility of the improved algorithm, which can meet the performance requirements of current traffic sign detection.

The accuracy and recall rate of the improved network model are improved compared with the original network. The P-R curve comparison diagram is shown in Figure 7:

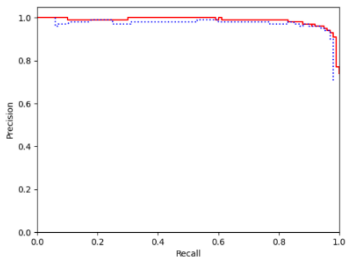

Figure 7. P-R curve comparison diagram

Test results are shown in Figure 8：

Figure 8. Detection effect diagram

The improved traffic sign recognition effect is more accurate than the original network positioning, the probability of missed detection and false detection is lower, and the recognition accuracy is higher, which effectively meets the detection requirements of traffic scenes and verifies the effectiveness of the improved algorithm.

5. CONCLUSIONS

This paper proposes an improved target detection algorithm based on YOLOv4, and verifies the effectiveness of the improved algorithm in CCTSDB dataset. The YOLOv4 detection algorithm using RepVGG as the backbone network has a reasonable trade-off between depth, accuracy and speed. Based on the improved feature pyramid structure, the expression ability of information is effectively improved. Finally, the boundary frame of CCTSDB dataset obtained by K-means++ clustering algorithm is more likely to fit the real target and obtain better detection results. The results show that the proposed network model effectively improves the detection performance and meets the detection requirements of traffic scenes.

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International Journal of Computer Applications Technology and Research
Volume 10–Issue 06, 166-177, 2021, ISSN:-2319–8656

Predicting a User's Numeric Identity from the Search of Attribute Data

Jacob MBAYDAY
Department of Mathematics and computer science
University of Ngaoundéré
Ngaoundéré, Cameroon

Paul DAYANG
Department of Mathematics and computer science
University of Ngaoundéré
Ngaoundéré, Cameroon

Abstract: In common Internet environments, most of the websites or services constrain the user account creation. Since the Internet is accessible by all and offers more and more services, a user has several accounts on the web. The difficulty in controlling their accounts does not leave indifferent to the users of the web. Hence the use of easy or insecure passwords. This is why we are victims of attacks and forgetting our passwords. Large companies such as Facebook, Google, etc., offer authorization and authentication mechanisms using the Oauth and OpenID protocol, which requires the opening of an account. To be independent of a social network or a site, it would be important to develop a model to make a statistical analysis between the attributes of the profiles of the same user and to create an account. Using the same password for all its different accounts could be an approach but avoiding the proliferation of data by proposing a model of identity analysis would be even more interesting. That is why this article proposes a centralized account management model by making a comparative and statistical study of the identity attributes and proposing a single account to the user to manage all its different accounts. So, we have a horizontal analysis between the attributes of the identity categories and a vertical analysis between these categories. This study allowed us to find a threshold to conclude that an account belongs to a user.

Keywords: Identity; Numerical Identity; Attribute; OpenID; Oauth.

1. INTRODUCTION

With the emergence of the web in the early 1990s, websites grow exponentially. It thus appears that the existence of several sites with user accounts, in order to uniquely identify a user, implies the multiplicity of user accounts. There are thus some problems such as the management of the passwords; the lack of flexibility associated with the use of different combinations of username and password. We must find a solution to minimize the creation of accounts on the web by ensuring the portability of the identity of a user from one service to another in a structure to avoid the proliferation of certain attribute data.

In a structure, each service has its database and access to a service requires the existence of an account. This article, entitled "Contribution to the Prediction of a User's numeric Identity from the Searching of Attribute Data", thus demonstrates that it is possible to have a single account on the web, Access to any other service on the web. In most cases, the private structures have several services requiring the user to have an account for each of them. This results in duplication of user information and loss of time. In view of all this, it is essential to allow a structure to propose the connection to any service from a single account. To succeed in this challenge, it is a question for us to solve the problem of portability of information. That is to say how to allow a user to carry his data from one service to another.

The main objective of this article is to propose, from the search of attribute data, a model for predicting the numerical identity of a user in order to simplify the management of user accounts.

To achieve this, we need to deepen our knowledge of the concept of numerical identity and, on the other hand, to gather the needs for which we propose a solution that will be modeled according to the choices made.

2. DATA MINING AND NUMERICAL IDENTITY

2.1 Numerical Identity

The term "numerical identity" was chosen to make the link between real entity and virtual entity.

Real identity

To define the numerical identity, it is first necessary to distinguish the real world from the abstract people of the information systems [1]. For Roger Clarke [2]: "An identity exists in the real world and not on hard drives. It is a presentation or role of an underlying entity ". For him, an entity may represent a natural person, a legal person or an object. An entity may have multiple identities, depending on the role it plays. For example, a person may possess an identity associated with his or her professional role as an employee and a more personal identity as a relative in the household [1].

Online identity

In an information system, and particularly on social networks, an individual is often represented by so-called avatars. These avatars allow, for example, to contribute to an online journal or to bid on the Internet. The identity of these avatars, that is, their presentation or role, is often called a numerical identity. In view of the definition set forth above, this so-called numerical identity actually represents the identity of the avatar entity. The Anglo-Saxon definition speaks in this case of an online identity or identity on the Internet and its stakes are above all sociological. In [3], the authors propose a classification of this

identity on-line by following the factors of the usual authentication technologies [7]. Figure 1 shows the two types of identities.

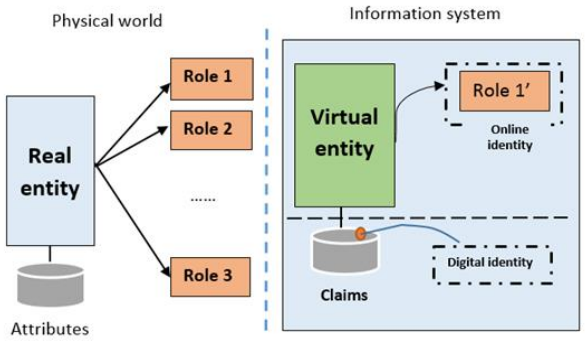


Figure 1: Representation of identity types (source: translated from [1]).

Numerical Identity

Like the identities of the real world, the identities of avatars possess a certain number of attributes which are represented in the information systems by recordings. As in the real world, some of these records allow an observer to distinguish between two identities. In the literature, numerical identity is considered as a set of records. In his laws of identity [8], Kim Cameron extends the notion of attributes for an identity by introducing the notion of "claims" within which the attributes are included. In particular, these claims are used to express the derivation of attributes such as age from the date of birth attribute. Cameron gives the following definition to numerical identity: a set of claims made by a numerical subject about himself or another numerical subject.

We define the numerical identity of a user as a global set of attributes that make up an on-line representation of who and what is the entity. It may include access credentials, personal attributes, and personal references. On the Internet, a user has many access qualifications that are published in different sites and different or multiple attributes and personal references on each site.

In each site, a user can be represented by subsets of these attributes. Depending on the situation and context, different subsets of attributes are used to represent the same user on the Internet. For example, in a bid site, a subset of a user's attributes such as user name, password and purchase history represent the identity of the user in this site, while a subset of the user's attributes such as the student ID number, the class record, can represent the identity of the user in a university site [4].

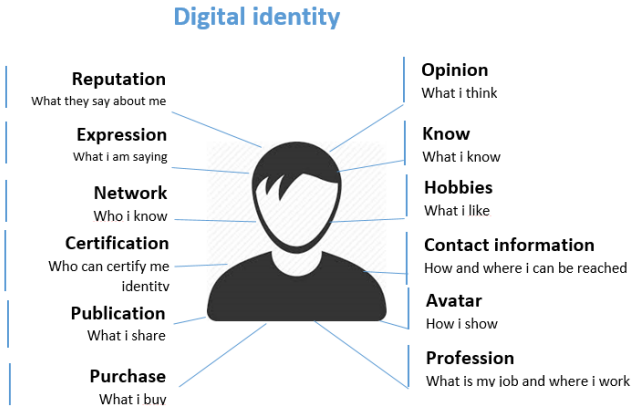
Numerical identity must be understood as self-image, self-expression, which now incorporates all the behaviors, all the uses of numerical that are recorded. Numerical identity (IDN) can be defined as a technological link between a real entity (person, organization or company) and virtual entities (its numerical representations) [5].

Linguists would like to define the numerical identity as the form of the subject of online enunciation, that is, its pseudo, its avatar, its signature. The numerical identity is the set of personal data that we deposit or leave without our knowledge on the web, that is to say what we do, say, share, love, hate, seek, etc. This is the set of our numerical footprints, brands of our online presence. A like, a site registration, a book order or a ticket reservation, a payment by card, publication of photos are all elements of our online presence.

2.1.1 Components and models

2.1.1.1 Components of the digital identity

The digital identity of an individual is composed of formal data and informal. All these pieces of information make up a more global digital identity that characterizes an individual, his personality, his surroundings and his habits. These small pieces of identity function like genes: they compose the digital DNA of an individual [6].



2.1.1.2 Identity system: form and model of the digital identity

The development and evolution of the means of communication, through the multiplication of blogs and social networks, change the relationship between the individual and others. Thus, digital identity allows the identification of the individual online and the linking of the latter with this set of virtual communities that is the Internet. Hence, digital identity can be divided into three categories:

The declarative identity

The declarative identity refers to the data entered by the user as his name, date of birth, or other personal information directly informed by the individual. The information that makes up the declarative identity describes the person and makes it possible to distinguish it within the community [9].

The acting identity

Traces of user activity complete the identity structure. That is, the acting identity is the identity indirectly informed by the activities of the user on the web. They are derived from its deliberate interaction with the application: these are the friends, the objects gleaned during the practice of the software [9]

The calculated identity

The calculated identity results from an analysis of the identity acting by the system, such as the number of virtual communities in which the individual evolves or the number of friends on social networks. Unlike the declarative identity, the calculated identity is not filled by the user; unlike active identity, it is not the immediate product of its activity.

The discrepancy or at least the discrepancies that may exist between the declarative identity and the acting identity raise a major question. Who is really the individual we are dealing with on the web? [9].

By quantifying the presence, the visibility, the notoriety of the user, the calculated identity makes comparisons more or less explicit; It develops a disproportionate importance of the figure in the identity system and reflects the actions of the user in the local cultural mirror, implicitly implying a form of social play. [10].

2.1.2 Managing and portability of a user's identity

2.1.2.1 Digital Identity management

Digital identity management is the combination of a set of processes and a technological infrastructure for the creation, maintenance and use of these identities [11]. Digital identity management therefore consists of several tasks such as maintaining user attributes and using subsets of attributes to enable secure online interactions between users or between users and systems. Digital identity management allows the addition, use, and deletion of identity attributes.

Identity management systems are categorized into three models: isolation management, centralized, and distributed identity. In the identity management isolation model, each site has its own identity management domain and its own way of maintaining user identities including employees, customers, and associates. The centralized identity management model has a simple identity provider to which brokers trust other participating members or service providers in a circle of trust. The Distributed Identity Management model provides a frictionless identity management solution by forming a federation and making authentication a distributed task. Each member agrees on trusted user identities guaranteed by other members of the federation.

2.1.2.2 Probability of the digital identity

The importance of the portability of the user's digital identity should be addressed in central user identity management procedures. In other words, users should be able to export their digital identities and transfer them to various computers in a secure manner

Data Probability

Data portability refers to the ability to manage personal data on its own, to bring it from one system to another, to share it among several systems.

Login probability

Systems like openID can only create a login / password and use it on multiple sites

Typology		*Examples*		
Category	Shifters	*Anarchy online*	*MSN*	*Livejournal*
Declarative identity	Qualifiers	Character search, craft, function	Profile search, currency, Interests	Personal information , biography, interests
Acting identity	Action	Pick up an object, cast a spell	Discuss, modify	Publish, comment
	Community	Guild, group	Friends	Favorites
	Collection	Inventory items		
Calculated identity	Numbers	Number of teammates, hit points, experience points	Number of friends connected	Number of comments, visits, login date

Table 1: Examples (instant messaging, blog)

Probability of identity

On many websites, you can create your profile. A user who uses a large number of websites must do so each time and, in general, enter the same information (surname, first name, address, etc.). Technically, the hCard microformat allows to expose its profile data

Probability of social networks

For Internet users who are members of several social networks, maintaining links with friends within these networks is a heavy business. The elementary data here is the information that the person X is a contact of the person Y. The objective of data portability is to be able to export these links between people from one site to another or to manage them outside of any proprietary website.

Probability of interests

The user, in his interaction with an online service, often declares data that are related to his "attention", ie to his interests. In addition to these declarative data, a certain number of data are also automatically deduced from its behavior (page views, clicked keywords, purchases, etc.).

Authorization management

For some luxury cars, there are special keys that you can give to a valet and that do not allow you to drive for more than a few kilometers, or do not give access to the GPS (Global Positioning System) or to the address book of the car. Phone. The idea of OAuth is in the same spirit: to give access to a third party to a part of its data only [12].

2.2 Data mining

2.2.1 Definition and types of data

Data mining can be defined as "a process of non-trivial extraction of implicit information previously unknown and potentially useful from data from the database". It consists of searching for and retrieving large quantities of data stored in databases or data warehouses (useful and unknown) [13].

Data mining factors are:

- A large computing powers
- The basic volume of data increases enormously
- The access to the global network
- Awareness of the commercial Internet to the optimization of manufacturing processes, sales**,** management, logistics

The data types are [13].

- Discrete data: binary data (sex ...), enumerative data (color ...), and ordered enumerations (answer 1: very satisfied, 2: satisfied…).
- Continuous data: whole or real data (age, salary…).
- Dates
- Textual data
- Pages / web links, Multimedia.

2.2.2 Data mining: Motivation

In [14], data mining is motivated by the following arguments:

- The process data concern both qualitative and quantitative attributes, which justifies the of discretization steps to obtain Boolean contexts
- The data are voluminous: Items per million, attributes thousands. These characteristics pose many algorithmic problems
- The data mining pursues a goal of exhaustiveness discovered knowledge. At the difference statistical techniques, that are not only global trends of the data that are sought but also local properties that concern a small number of objects
- In the light of the exploration methods used to assist the expert in his decision-making, it is desirable that the assistance provided be clearly justified, explained and understood

The exponential increase in the number of Internet users gives rise to what is now called the explosion of data [14].

- Large mass of data (million billion bodies): it doubles every 20 months
- Data are multidimensional (thousands of attributes
- Unusable by conventional methods of analysis
- Collection of large masses of data (Gbytes / hour)
- Satellite data, genomics (microarrays, ...), scientific simulations, etc
- Need for real-time processing of this data

3. DIGITAL IDENTITY MANAGEMENT SYSTEM

3.1 Identity management models

Identity Management Systems (IMS) can be categorized into three types. Type 1 and Type 3 IMSs are intended to allow the use of a digital identity to establish a trust relationship while Type 2 IMSs are intended to monitor the use of a digital identity. Their classification refers to the work of Jøsang [15].

3.1.1 Isolated management: Single database for each service

3.1.1.1 Definition and advantage

This is the historical model for managing identities on a system. Each different system will act as both a service provider and an identity provider by implementing a database of its users. The classic use case of an identity in this model is the authentication of the user requesting a service. In this model, the service provider has the list of identities and itself implements the necessary authentication functions. It is therefore in charge of both identity and service management. It is also up to him to ensure the security and protection of privacy.

3.1.2 Centralized management: common user

3.1.2.1 Definition and advantage

We sought to centralize identities in one and the same identity provider to remedy the problem of the multiplicity of identities. For this purpose, the first method is to provide a common identifier for all services. In this model, a unique identity

provided by an identity provider is used to authenticate a user to several service providers in the same security domain.

In RFC 4513 [16], it is specified that messages between the server and the client must be encrypted using the TLS protocol [17] to ensure confidentiality and integrity of the exchanges. The use of directories has greatly simplified the management of identities, especially in the corporate world. However, in an open world like the Internet, it is impossible to offer a global directory. This is why the other methods have been proposed to manage digital identities in order to allow for a scaling-up of the architecture.

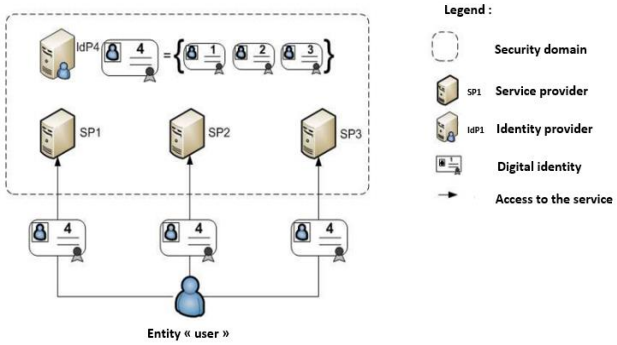
The use of IGC is now almost systematic for non-human entities (server, websites). This is the case, for example, when establishing secure connections with Transport Layer Security (TLS) [17] on websites. Today, most sites that have a private part is accessible in HTTPS and has a certificate signed by a recognized authority of the browser [1].

3.1.2.2 The limits

Whenever possible, mutual authentication using certificates is only scarcely widespread due to the difficulty of managing certificates by individuals. The use of certificates also poses a problem of privacy. Indeed, certificates are easily traceable, the link with the entity they designate is often obvious and hiding information is not possible. Certificates also do not allow expressing complex claims and are limited to expressing attributes.

3.1.2.3 Meta-identity management model

Service providers can share a number of identities needs that can be grouped under a meta-identity. In this model, shown in FIG. 7, the identities of the subject are linked to a meta-entity that will be used to access services present in a security domain. Identity is provided by a single identity provider that is responsible for authentication and therefore allows single sign-on mechanisms (SSO)



translated from [1]).

This model is present in large companies where services are controlled and where there are equivalent security policies for all service providers. This model is not applicable to an open environment where precisely the policies and security requirements differ from one supplier to another. Moreover, the use of a meta-identity is a risk to the privacy of the users since the latter contains several of the original identities

3.1.3 Federated identity management

Camenisch and Pftizmann [18] introduce the notion of federation of identity allowing the sharing of numerical identities between several security domains within a circle of confidence. A trusted circle consists of several service providers who will trust one or more identity providers to authenticate users. The goal of this federation is to allow users to access the system from another security domain without the need to change their identity.

3.1.4 User-centric management

An identity management solution must take into account how the user will use his or her identity. The models presented above are mainly used to facilitate identity management for service providers, with the exception of identity federation intended to simplify user use. However, the federation model is not realistic on a large scale because it is impossible to create a global federation. This is why the current vision of identity management is to help the user manage his identity directly while maintaining strong constraints on security.

3.1.4.1 The online model

The principle of user-centric identity management is to allow the user to more precisely control his identity and to place himself at the center of identity exchanges. The model we have described as "online" assumes that management does not require any user-side adjustments and that it will allow it to manage its identities in its identity provider (s) directly from a browser. Examples of this type of identity management can be found in the OpenID and OAuth protocols.

3.1.4.2 The smart client model

This model assumes that the user who seeks to use his identity with a service provider has a tool (the client) to enable him to manage his identity. Implementations of this model focus on the problem of privacy by offering a direct control by the user. Many of these clients are integrated directly with browsers. These customers are mostly local password managers who only address the issue of user use

3.1.4.3 The Identity management meta-system model

The model of identity management meta-system defined in [4] proposes an abstraction layer based on the seven (7) laws of identity stated in [19]

- User control and consent

- Minimum disclosure for a defined use

- Legitimate Parties: The user must be notified of the parties transmitted their personal information

- Directed Identity: An identity management system must manage both omnidirectional identifiers used by public entities and unidirectional identifiers used for private purposes

- Pluralism of Operators and Technologies

- Human Integration: A Meta identity system must put the human user as a system component

- Consistent experience between contexts: A Meta system must ensure a consistent user experience while retaining the plurality of identity management systems

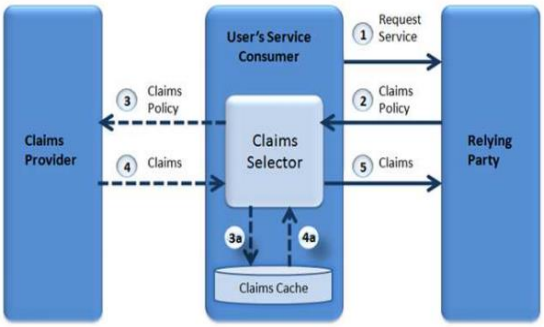


Figure 4: The identity meta-system (source: [1])

The main element of the system is the Meta identity selector that allows the user to choose the identity he wants. The identity selector works as a portfolio in which we possess several business cards that could be used to prove identity.

3.2 Protocols and languages for identity management

The models that we have described are theoretical models of identity management. To allow the implementation of complex models that are running user-centric and identity federation for example, a number of protocols and specific languages have been proposed.

3.2.1 OpenID

The open standard OpenID [20] was originally developed for the site LiveJournal. This protocol is based on HTTP protocols [21] and HTTPS [22] and the use URI or XRI [23] as identifiers. It also uses signature algorithms HMAC-SHA1 [24] and (hash-based message authentication code - Secure Hash Algorithm 256) HMAC-SHA256 [25] and performs discovery of the IdP from an XML document. It has boomed because of its simplicity and the important role given to the user. The latter has full freedom to choose his identity provider and may even become his own supplier. It also controls the data passed to service providers. Basic operation is as follows:

- The user initiates authentication with an ID (URL or XRI) in the login field of the site (Relying Party).

- The identifier is then provided "parsed" in order to know the URL to the OpenID Provider accepts messages.

- Optional step : The Relying Party and Open ID provider to agree on a shared secret. This secret will be used to check the following messages between the OpenID Provider and Relying Party.

- The user is redirected by the Relying Party to its Open Provider ID with an authentication request.

- Open ID provider verifies that the user is authorized to make this authentication.

- Open ID provider redirects the user to the Relying Party indicating whether the authentication is successful.

-Relying party verifies the information received, either by using the negotiated key 3 is directly by requesting the Open ID Provider.

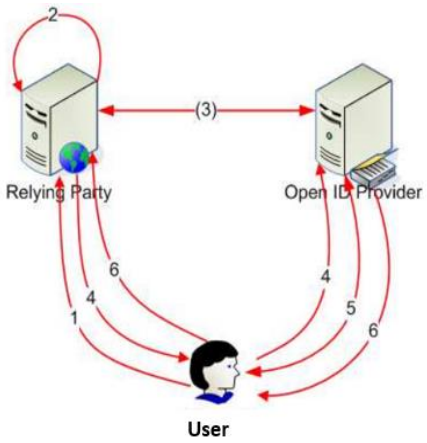


Figure 5: Schematic flow OpenID

The limits of OpenID

Several limitations are known on using OpenID: the first is that the security authentication is left to the OpenID Provider (step 5); the second is that the OpenID system is vulnerable to phishing. In fact, a fraudulent site can lure the user into believing that he is redirected to his Provider (step 4) to the login phase and can then present a fake login form to collect the username and the password of the latter.

OpenID responds initially to the question of simplicity. The solution also meets the problems of respect for private life by clearly people which data are exchanged. For cons, the identity security aspect is left to the developer for the whole party authentication and storage of identity.

3.2.2 Oauth

The OAuth protocol [25] was proposed in 2006, allows for the delegation of access to an API securely. This protocol specifically addresses access to resources authorizations. OAuth follows the model online; it is based on protocols such as HTTP [21] and HTTPS [22] and the use of signature algorithms like HMAC-SHA1 [24] and RSA-SHA1 [26]. The classic scenario of the protocol is secure use and approved by the protected resource user in a service provider from a site called consumer. The sequence of steps of the protocol is as follows:

- User visits a consumer website in which he will want to use another site resources.

- The consumer website contact the service provider to obtain a temporary debt in order to identify the delegation request.

- The valid query service provider and consumer website responds to a set of temporary loans.

- The consumer site then redirects the user to the service provider to obtain the approval of the user using temporary loans previously received.

- The service provider then authenticates the user with a method of their choice and request consent to the user to share its resources with the consumer site.

- The service provider redirects the user and informs the consumer that the user has consented to the exchange.

- The consumer site then requires a set of claims for the application of resources from the service provider. The request

is made using temporary receivables and through a secure channel with TLS.

- The service provider returns the set of claims.

- Use of these receivables, the consumer can make the request of the service provider's resources.

The limits of OAuth

The protocol ensures message integrity, but does not address the issue of confidentiality of trade. It is recommended to use it over a secure connection. Similarly, the authenticity of the service providers is not verified which therefore creates a risk of usurpation of the identity of these and also makes it sensitive protocol to phishing attacks. In this case, the user enters his login information in a fraudulent service provider. By requiring the consent of the user, OAuth addresses the issue of protection of privacy, however, the protocol does not ensure compliance with the other assumptions for the protection of the latter and the limitations in terms of confidentiality still pose here problem

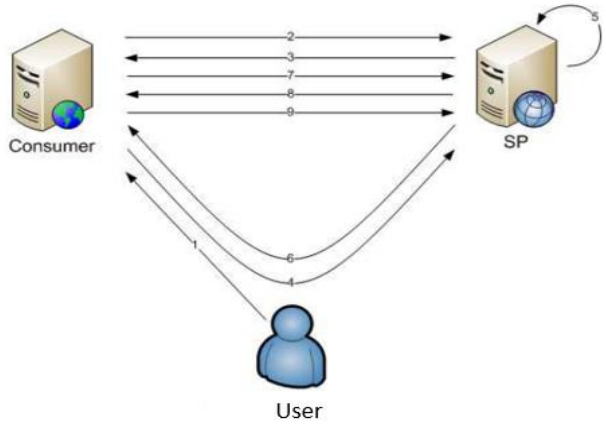


Figure 6: Schematic flow OAuth

3.2.3 SAML2

The Security Assertion Markup Language 2.0 (SAML2) is a standard proposed by OASIS (Organization for the Advancement of Structured Information Standards) dedicated to exchanging authentication and authorization data between security domains. In version 2, this standard has integrated the work of the Liberty Alliance consortium on ID-FF framework [27] to allow the federation of digital identities. SAML2 defines the syntax of identity assertions encoded with XML. [28] These can be signed using XML signature mechanisms [29] in order to certify the content. These assertions may correspond to authentication data, authorization or just the attributes of an entity. SAML2 defines a number of protocols for the treatment of requests and replies using these assertions. Similarly, assertions are usually transported to other structures such as HTTP POST requests or SOAP messages. The standard therefore defines methods to achieve this link and transport SAML2 assertions. Finally, the standard OASIS offers a number of profiles that match different use cases including SSO and identity federation. The SAML2 standard can be used in different identity management models and is not tied to a single type of model.

The limits of SAML2

SAML was never designed to enable the SSO to the new generation of native mobile apps, or to those that consolidate data and services, from different sources, through calls to APIs. WS-Trust (for SOAP services), OAuth 2.0, an open standard used for authorizations, and OpenID Connect, which is based on a specification of OAuth, were designed to address these issues and bring users more value and flexibility. Some organizations may choose to use SAML without direct LDAP connection. Although this configuration is possible, some IBM Maximo Asset Management functions require a direct connection to function properly.

3.3 Connection APIs

APIs (Application Programming Interface) interfaces are essential for inter-application exchanges, but also a philosophy of openness of its information system architecture and operational implementation. The management API that develops, also includes safety and supervision, to name a few. The APIs are a way to equip the digital transformation, to go from digital strategy to implementation.

When you connect to a site using the Google or Twitter account is a Google API or Twitter that can benefit the other site of the service ... and the way to recover your data on Google and Twitter.

When mobile of our favorite newspaper shows us the weather is certainly an API that is action. And perhaps it was marketed to this news site, weather data company that sells its data in the form of services.

The APIs are at the heart of the evolution of commodity Internet and new ecosystems. Perhaps the future business model of our company. Some "Chief Digital Officer" more advanced than others, because their industry is more exposed to the digital transformation, have already understood the stakes APIs and also structure of internal initiatives around IT architecture.

Hence the idea of trading in these new ecosystems around APIs, API during monthly gatherings Connection, and to link the actors in all industries, trades with the geeks, the ideas with tracks solutions and exchange around the initial feedback. [30].

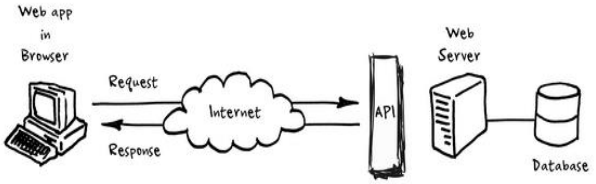


Figure 7: Connection API (source: [30])

4. PROPOSAL AND MODELING SOLUTION

In this interconnected world, the need not identify themselves only once for several sites or gadgets and specially to have fewer attributes on the Internet has become indispensable and a new term "digital identity" was born. Unfortunately, this need has not been identified during the creation of the first protocols underlying the Internet. Therefore, backup solutions were more or less successfully developed and led to an explosion of methods and tools for managing identities.

4.1 Proposed solution

Currently, identity management models are booming and the true face of the user to be determined. We therefore propose to determine this face through this study: contribution to the

prediction of the digital identity of a user from the attribute data mining. We will, from the declarative and operative identity, determined who is really the person to whom we have to do on the canvas. It is therefore necessary to collect the attributes of these identities and making a horizontal analysis between entities and vertical between identity categories. We also believe that instead of using OpenID authentication or authorization with OAuth, you must do a statistical analysis of the accounts of a user and find a unique path to its accounts.

4.2 Modeling of the solution

4.2.1 Interactions between the three categories of identity

The identity system as a whole is shown in the diagram below.

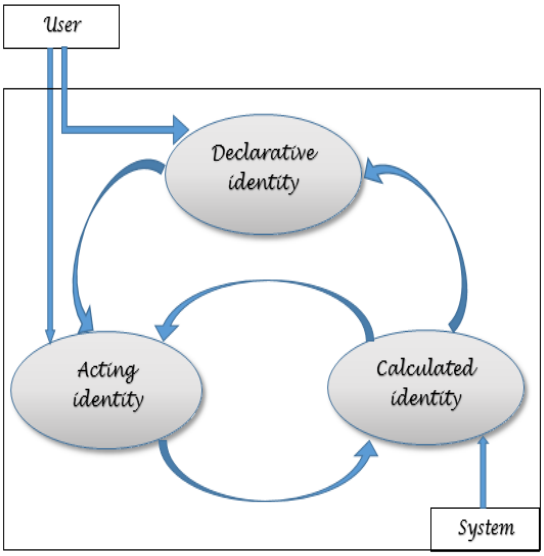


Figure 8: identity system as a whole

-User: one that is central to any identity. He leaves enormous information during the creation of account and especially when the use of his account.

- Declarative identity: User information such as name, first name, date of birth, country, profile picture, etc. provided directly by the user will give rise to the declarative identity.

-Acting identity: requesting friends, participating in an event or group, commenting or tagging or sending a gift, discussing, posting, commenting, etc. It is the product of the user and of the declarative identity without forgetting a slight participation of the identity calculated computing.

- Calculated identity: it depends on the acting identity and especially on the system. By using data of the acting identity, the system makes calculations to evaluate the activities of the user in number.

4.2.2 Identity system end data backup

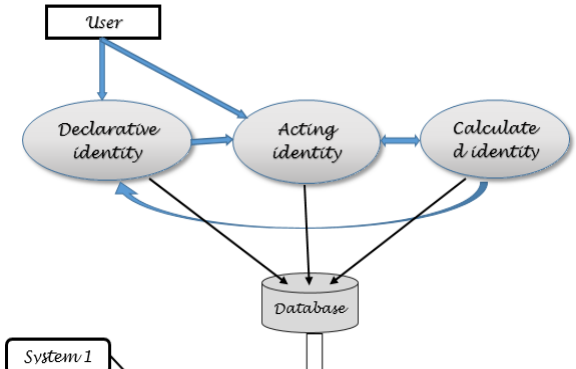


Figure 9: Identity System and data backup

All components of declarative identities, active and calculated will be saved in a database. Thereafter the data will be redirected to an OpenID or OAuth server for the unique and complete identity. This server must be accessible by any system requiring the user data.

4.2.2.1 Horizontal analysis between data

All data of each model are collected in a table and are listed in order of appearance when creating an account. The stability of a component shows more clearly that it is an important attribute in relation to that which varies regularly. The stability is determined over time. The system will therefore be based on the time that is an attribute since its appearance until analysis.

Non exhaustive list of some information collected from social networks like Facebook, twitter,

Table 2: Examples of attributes identity category.

After collecting data from each category of identity we make a horizontal study between attributes and vertical study between identity categories. For this vertical study, the result of each pair of feature is stored in tables (T1 to ID and D-ID-A, T2 for ID-A and ID-C, T3 for ID-ID and D-C). We are a horizontal analysis between these tables for a final identity. After getting a true identity of a user based social networks or websites we propose a system with all necessary attributes for enabling a user to identify himself once for all other existing systems on the canvas.

The horizontal study is to classify entities of these identities in order of relevance, importance and especially stability over time. The information characterizing the precise and safe way users are most important.

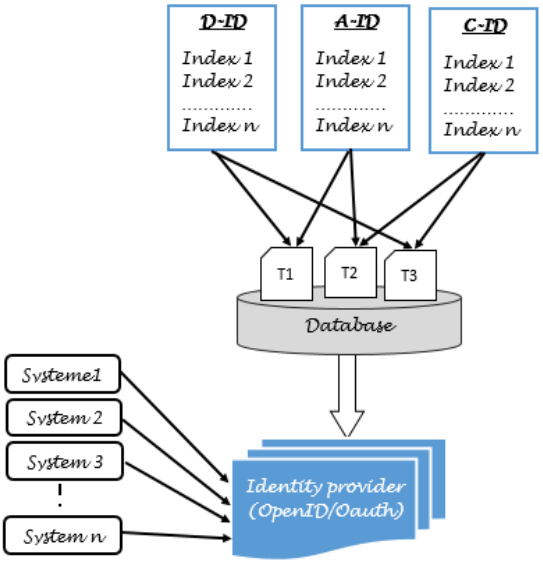
Declarative identity	Active identity	Calculated identity
- Name	- friends request	- number of friends
- Profile Sheet	- send Tweets	- number of groups
- Avatar / photography	- sent a joint post	- number of events
- Race	- has been tagged by a friend	- date of the last connection
- Function	- discuss	- number of comments
- Gender	- publish a text	- number of visits
- Birth date	- Comment	- number of positions
- country	- updated profile	- number of teammates
- The interests	- used an X application	- subscriptions Volumes
- Personal informations	- Volume of sent tweets	- attendance rate
- ...	- ...	- ...

Table 3: Study of horizontal attributes.

	Index		
Order	declarative identity	active identity	calculated identity
1	Last name and first name	Friends request	Number of friends
2	Birth date	tweets sent	Number of groups
3	Sex	Participation in events	number of events
4	Race	Create Group	attendance rate
5	Country	Update Profile	number of teammates
6	Avatar / photography	has been tagged by a friend	number of comments
7	Biography	used application	number of visits
8	Pseudonym	commented or tagged	Date of connection
9	Hobbies	sent a collective post	Number of position
10	Personal informations	Discuss	Volumes subscriptions
...	...	...	...

Figure 10: vertical and horizontal analysis of all types of identity

The index order depends on the stability over time. T1 (T2 respectively T3) contains the D-ID attributes and A-ID (respectively A-ID and C-ID, D-ID and C-ID) in order of stability and reliability.



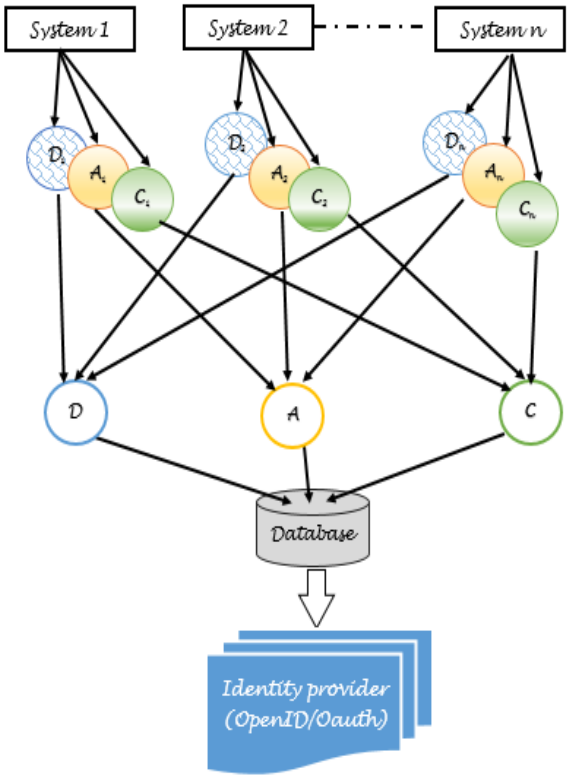


Figure 11: Multi-system

It is considered n systems each consisting of triplet (Dn, An, Cn) identity categories. We collect all the declarative identity (respectively the acting identity and calculated identity) of each system with the connection API to form the unique identity declarative D (respectively A and calculated active C). We seek a threshold to conclude whether it can merge all these systems and find one user or whether these attributes cannot allow us to conclude. Vertical and horizontal studies will be made on the final product. If we find an important threshold, the data will be saved in a database and redirected to a service provider.

The systems do not have the same objectives it is not possible to have the same components in each category above the calculated identity and identity as the active identity. To make a comparison between the attributes of identities can be based on profiles, names, surnames, date of birth, country, gender etc. for declarative identities we rely on facial recognition and comparison of profiles at the names, sex, country and date of birth will be from one system to another.

5. RESULTS AND DISCUSSION

5.1 Results

5.1.1 Collected attributes Couples

Information was collected on 60 user profiles where each user has two accounts. We rely on attributes such as names, Name, Phone Number, Date of Birth, Sex, profile picture, personal information, interests center, Marital status and religious. Table 3 presents the first 3 pairs collected accounts illustration.

Heavy weight					
Dirth of date	Phone number	Profile photo	Name	First name	**Total**
15.05%	10.53%	10.53 %	10.12 %	8.9%	48.98 %

Low weight					
Religious	Sex	Relationship status	Center of interest	Personal information	**Total**
12.16 %	11.74 %	11.74%	8.5%	6.88%	51.02 %

5.1.2 Analysis attributes collected

After having collected the data we have red incompatible attributes couples and those black compatible. By focusing us on couples of compatible attributes we get the diagram expressing percent data reliability.

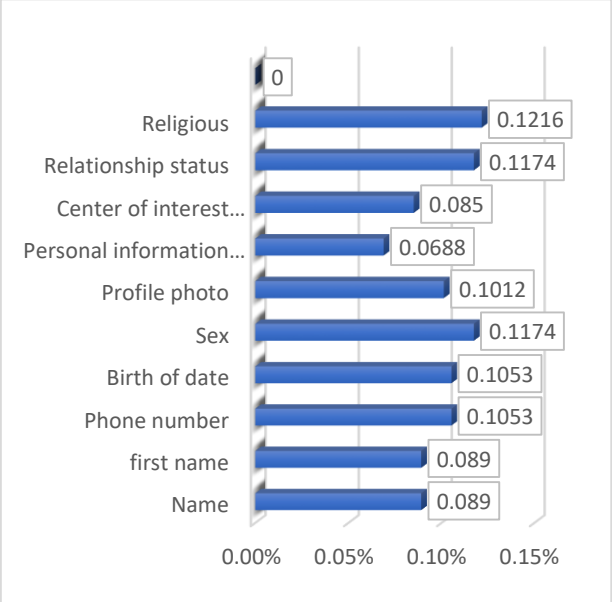


Diagram 1: data collected

5.1.3 Classification of attributes

We classify our data into two categories: Fort weight and low weight. The choice of these categories is based on stability data for the most stable data are the most characteristic, if not the most telling. When creating an account entity such as Name, Date of birth and phone number are not easily changeable and the user think almost to the modification of such information. Profile photo on it is an element that is updated almost all the time and remains a very important tool to identify a user.

Table 5: Categorization: Heavy weight

As for the category of low weight, the choice is based on the instability and diversity of information such personal information and center of interest. It is also based on attributes in easy choice as sex, religion and relationship status.

Table 6: Categorization: low weight

5.1.4 The threshold

The threshold will be defined according to two categories of attributes we have defined it above. The attributes of the most significant are the most important and therefore should be the threshold to consider. After a thorough study of our sample we find that the user who provided the information less compatible 62% compatible attributes between the two accounts. And to be more sure we are increasing our 70% threshold and we attribute this to the high weight percentage. The validation of the attributes of the most significant confirms the identity of a user. Having found p_i and the threshold we apply the following formula to find the new percentage noted p'_i:

$$p'i = \frac{70pi}{48.98}$$

	Heavy weight					
i	Dirth of date	Phone number	Profile photo	Name	First name	**Total**
p_i	10.53%	10.53%	10.12%	8.9%	8.9%	48.98 %
P'_i	15.05%	15.05%	14.46%	12.72 %	12.72 %	70

Table 7: Percentage of high order.

Low weight attributes occupy the remaining 30%. To find the new percentage we apply the formula.

$$p'i = \frac{30pi}{51.02}$$

Table 8: Percentage of low weight.

	Low weight					
i	Religious	Sex	Relationship status	Center of interest	Personal information	**Total**
p_i	12.16 %	11.74 %	11.74 %	8.5%	6.88%	51.02 %
P'_i	7.15 %	6.90%	6.90%	5.00%	4.05%	30%

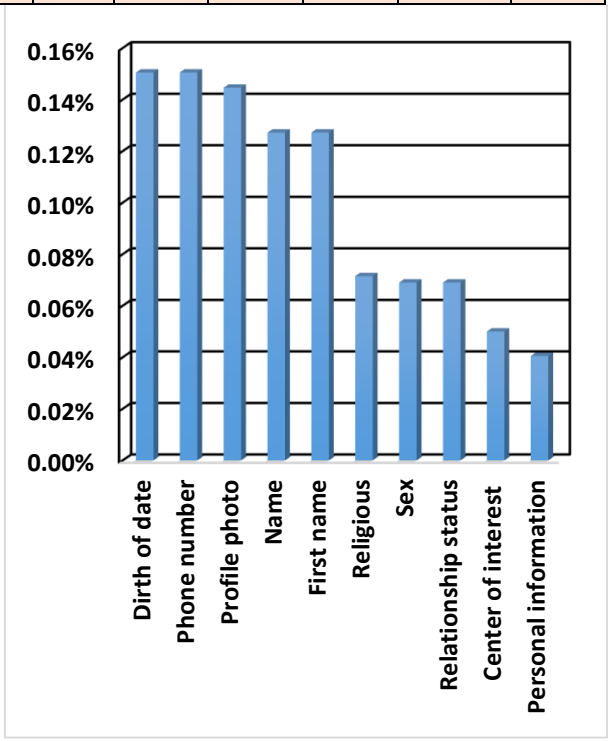


Diagram 2: Overview.

5.2 Discussion

Walking through the contours of digital identity, we find some digital identity management systems like OpenID that allows a user to authenticate to multiple sites without having to remember an identifier for each of them but each time using a unique identifier OpenID. We also have the OAuth protocol to make the delegation access to an API securely. This protocol specifically addresses access to resources authorizations. SAML2 meanwhile is a standard proposed by OASIS dedicated to exchanging authentication and authorization data between security domains.

We offer an identity management system model to analyze the attributes of different accounts of a user and enable it to create another account for all of its various accounts by considering all existing data on the canvas. All these protocols and model management system of digital identity that we offer have something in common: unique identification.

6. CONCLUSION AND PERSPECTIVES

This article is the proposal instead of a model predicting the identity of a user on the Internet. That is to say that a user must, from its attribute data, create a unique account for all accounts on the Internet. We first define the digital identity and we found three main categories of the same: declarative identity, acting identity and calculated identity. Before proposing a solution

model and then present the results and discussion we reviewed the different digital identity management systems.

The area of most scalable science today remains computing because it has always tried to solve the problem that his next leave in its wake. Since declarative identities allow well conclude membership from one account to a user, we asked whether the same formula will be applied to the calculated identities. Most users are between 62% and 70% of couples of compatible attributes and was taken as the maximum decision threshold. In our sample there is a user who has two accounts but is 22.58% because the most important attributes are different. Should bring back the threshold to 22.58%? Track a user on the web from its attribute data obtained from any site remains an as yet to be illuminated.

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International Journal of Computer Applications Technology and Research
Volume 10–Issue 06, 178-182, 2021, ISSN:-2319–8656

Smart Intruder Detection System with OpenCV and Python

P. Bhanu Teja
Sreenidhi Inst. Of Science and Technology
Hyderabad, Telangana

P. Sandeep Kumar
Sreenidhi Inst. Of Science and Technology
Hyderabad, Telangana

N. Dileep Reddy
Sreenidhi Inst. Of Science and Technology
Hyderabad, Telangana

Abstract: Thefts have been on the rise in recent years. This produces a dangerous climate in which people live in terror. In today's environment, the problem of home security is a source of anxiety. The standard intruder detection systems that we currently use are extremely expensive, and there is a risk of false alerts. This issue is solved by combining OpenCV and a mobile phone to create a framework that can accurately recognize a interloper while filtrating the movements caused by objects which are moving. If an interloper is identified, the system sends a message to the user via an API called Twilio, and the footage is saved to the local storage.

Keywords: OpenCV, Twilio API, Python, IP camera, Background Subtraction.

1. INTRODUCTION

The presence of a human safety officer is not totally effective process of security and not totally reliable. In such scenarios, our framework provides proper interloper detection and protects the owner's property. By using this system, we can reduce robberies. So, we can react rapidly with the end goal that no damages happen in our houses. Having the interloper's face detailing, we can find him by raising a complaint against him in a police station. In the planned framework, the camera is placed in a room that can continuously capture the video. We planned our framework to undergo a client-side process whenever a gatecrasher enters the room and an alert message will be sent via Twilio API to the user or owner. Our framework is totally based on motion detection and sending an alert message using OpenCV and python.

2. EXISTING MODEL

In today's world, there are many existing systems for surveillance and security systems. They either need a human safety officer or need work for installing and finally which may produce false alarms. In some surveillance systems, an interloper will be detected by using video recording cameras and stores the recorded video in an external storage disk and need a huge investment for controlling it, storing, and monitoring the activities. But the footage should be examined manually by an owner to detect the gatecrasher which may lead to wastage of time as he needs to watch the entire recording to find the interloper and may miss small details while analyzing. And the second system is a radar-based system that detects an interloper by using a radar system by transmitting microwaves or radio frequency waves which will bounce off any object in its path. The other one is the intruder alarming system which includes electric alarms delegated for alerting the owner when the interloper enters. And many other systems are passive infrared motion detection systems, ultrasonic motion detection systems, vibrate sensor systems, etc.

3. PROPOSED SYSTEM

The proposed system uses an IP webcam application that should be installed on a mobile phone and python code for detecting the intruder and sending an alert SMS. Both will work as client-server respectively. On the client-side, the video is captured continuously and filtered. The filtered information is sent to the server-side. And it displays the status of the interloper with a time and date stamp. If the framework detects the interloper, then it starts recording the current frame and has some patience level. After the patience level drops to 0 recording process will end and the framework alerts the user or owner by sending an alert message by using a Twilio API and saves the recorded footage into the local storage.

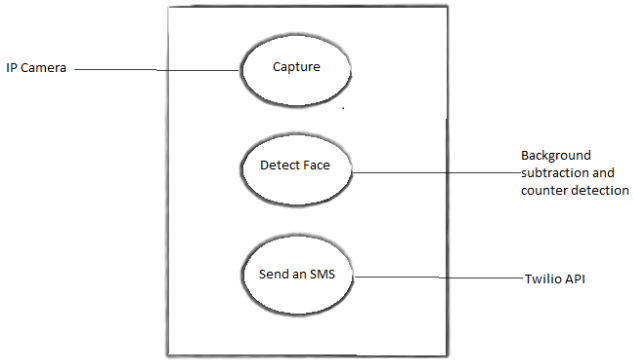

Figure. 1 System Functioning

3.1 Proposed System Work Flow

The system flow begins with an IP webcam capturing a live stream, and background subtraction is applied to the live streaming in order to detect the person. If the person is detected, the room occupied status will change to true; otherwise, it will be false. If the room occupied status is true, the framework begins capturing the current frame and after detecting the person, if he is not detected for certain frames, the framework waits 7 seconds before deciding whether to save the video to local storage and sends an alert message to the user, otherwise the streaming was aligned for background subtraction again.

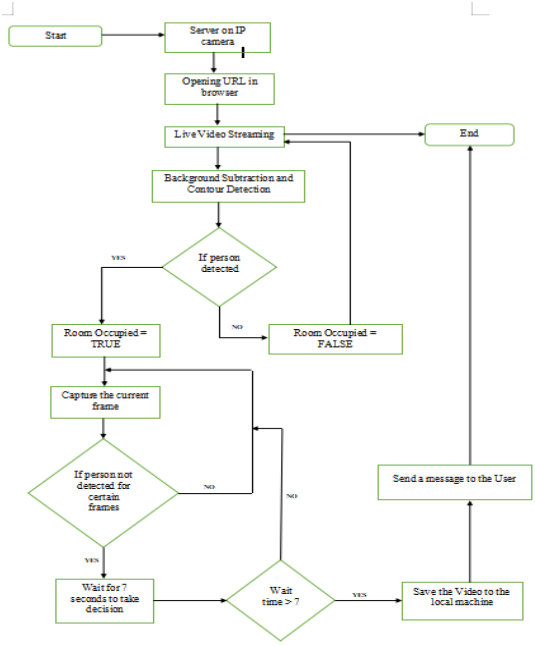

Figure.2 Flow Chart

4. ANALYSIS

4.1 Software Requirements

- ✓ Operating System: Windows 10, Mac OS 11.2.2
- ✓ TOOL: Jupyter Notebook
- ✓ Coding Language: Python
- ✓ Library: OpenCV, NumPy, Time, datetime, collections, Twilio

4.1.1 OpenCV

Computer vision is a space of computer programming which bases on making PC's fit for interpreting pictures. It got out during the 70's when Martin Minsky asked is student to interface a computer to a camera and getting the PC to evaluate what it saw [4]. During this time the state of art of computer vision transformed into reality. Today CV is consistently used with AI which setup to recognize certain features or things like remembering the portion of people [6].

4.1.2 Python

Python is a globally reputed language which is proposed to be significantly coherent. It is an interpreted language which resembles PERL and PHP. It is very interactive in nature and has user friendly interface. It is set to be object oriented which maintains procedure of programming that optimizes code inside objects.

4.1.3 Twilio API

Twilio's APIs (Application Programming Interfaces) power its foundation for correspondences. Behind these APIs is a product layer associating and upgrading interchanges networks all throughout the planet to permit your clients to call and message anybody, universally. Twilio, for instance, gives many separate REST APIs to sending instant messages, settling on telephone decisions, looking into telephone numbers, dealing with your records, and significantly more. In Twilio's environment, every item is its own API, however you will work with every one of them in generally a similar manner, regardless of whether over HTTP or utilizing Twilio's partner libraries for a few diverse programming dialects.

4.2 Hardware Requirements

- ✓ System: Intel 1.90 GHz
- ✓ Hard Disk: 1TB
- ✓ RAM: 8 GB
- ✓ A Mobile Phone: RAM: 2GB
- ✓ WIFI support
- ✓ 5 MP Camera
- ✓ Storage Space: 4GB

4.3 Application Requirements

- ✓ IP Camera
- ✓ Twilio

5. ALGORITHMS USED

5.1 Background Subtraction

The most popular Background subtraction algorithms are:

1. BackgroundSubtractorMOG() algorithm: It is one of the background subtraction algorithm which uses the concept of gaussian mixture.

2. BackgroundSubtractorMOG2() algorithm: It is same concept as BackgroundSubtractorMOG() but major difference it can provide stability even in high light intensity conditions and also stability while identifying the shadows in the each frames.

3. Geometric multigrid: It makes uses of statistical method and per pixel Bayesian segmentation algorithm .

The process becomes more complicated when there is a shadow without the actual image or appearance of the object. Simple background subtraction algorithms will consider the moving or still shadows as foreground which reduces the accuracy of the system. The solution for above complications will be solved openCV.js which can simple and easy to use. The below constructor is the solution.

The cv2.createBackgroundSubtractorMOG2() takes in 3 contentions:

1. detectsSadows: Now this calculation can likewise recognize shadows, on the off chance that we pass in detectShadows=True argument in the constructor. The capacity to identify and dispose of shadows will give us smooth and powerful outcomes. Empowering shadow discovery somewhat diminishes speed.

2. history: This is the quantity of edges that is utilized to make the foundation model, increment this number if your objective item frequently stops or stops briefly.

3. varThreshold: This edge will help you sift through commotion present in the casing, increment this number if there are heaps of white spots in the edge. In spite of the fact that we will likewise utilize

morphological activities like disintegration to dispose of the commotion

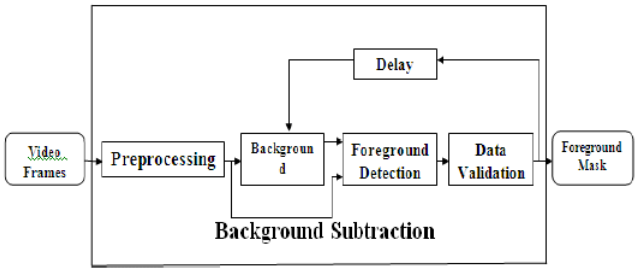

Figure. 3 Background Subtraction Flow Chart

6. IMPLEMENTATION

We will be splitting the project into four parts which have their own functionality.

1. Accessing the Live stream from your telephone to OpenCV.
2. How to utilize the Twilio API to send an Alert SMS.
3. Building a Motion Detector with Background Subtraction and Contour recognition.
4. Making the Final Application.

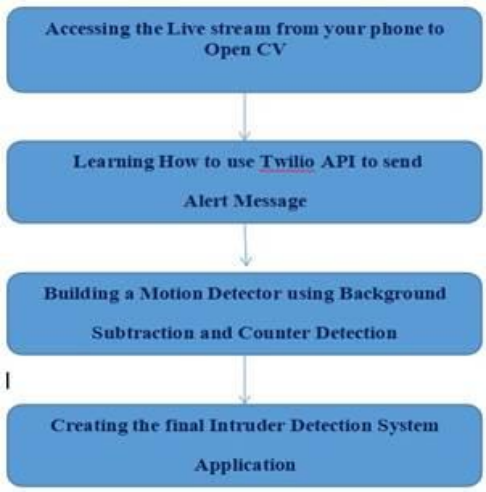

Figure. 4 Background Subtraction Flow Chart

In this framework, we developed an intruder detection system in which users can use an Ip camera application to detect an intruder. Here, live streaming is captured through the cv2.VideoCapture() method by copying the IP address of an IP camera. A person can be detected by applying a background subtraction algorithm to the video being captured. And Twilio library is installed to write a code for sending alert message whenever a person is detected by the framework. Lastly, a final application is created by blending all steps involved in the framework.

7. RESULT

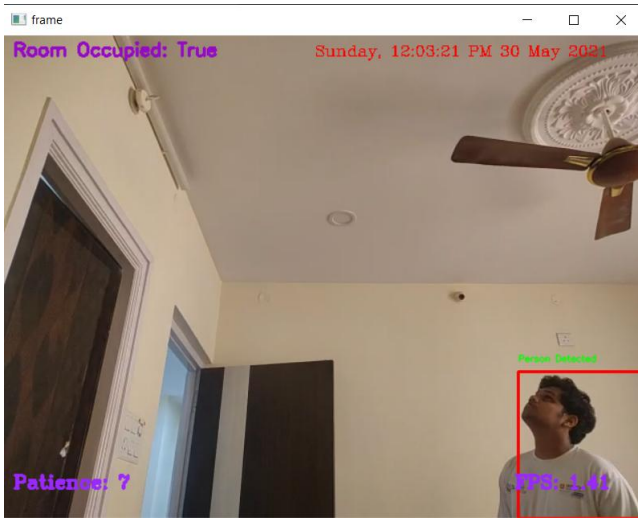

Figure. 5 Room occupied is true

Here we can see that the Room Status is TRUE as the person is detected in the frame. The time in the specified format is given on the top right-hand side of the frame is taken down. The contours drawn are of red colour of the accurate visibility to the user. The FPS meter and the Patience level are being displayed on the bottom side right and left side to the frame respectively.

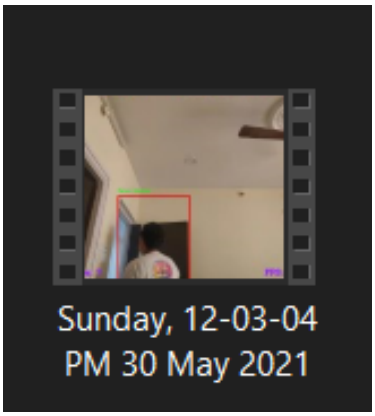

Figure. 6 Saved video of intruder with time stamp

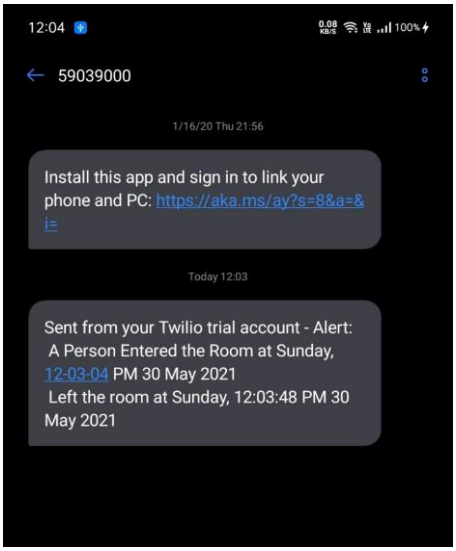

Figure. 7 Alert Message send by Twilio API

8. CONCLUSION

The application presented in this project is a proof of concept on how to create an application that can detect human motion in a room, which also saves video clips to the local machine. The created application is adapted to a smart phone with a 5 mega pixel camera to yield optimal functionality. The application also needs an internet connection and an IP camera application from the Google Play Store. The created application yields a good detection result with greater accuracy on labeling the acquired video clips with a proper file name (Date and Time Stamp) i.e., labeling the image if it contains people or not. The gathering of SMS security cautions which has sent from security gadget through SMS sending API when a interloper has been recognized. The application is suitable in an environment which is static and the movement that occurs is caused by human movement, for example a conference room. The application's motion detection has its limits, for example the application cannot tell the difference between moving objects and human movement.

The system is made up of both hardware and software components that work together to provide an effective motion detecting method. The background deduction strategy was applied in OpenCV execution and outcome got from the directed the analyses recommended the better-precision of an interloper-based movement identification system, taking out bogus alarms. The suggested system is partially self-contained and wireless, resulting in a security system that is dependable, resilient, simple to use, and inexpensive. WIFI has been used to connect to the internet for communication. Various procedures have been successfully tried, and the findings have been reported, I conclude.

9. FUTURE ENHANCEMENT

This system has a wide range of applications in a variety of sectors, including banking, forensics, and so on. The reason this system is so beneficial is that it is extremely small and enables facial detection as well as immediate email notification. In addition, face recognition may be used in the future. Any security system's most important component is recognition. Typically, for the greatest recognition system, we need a well-trained database that can serve as the foundation for our recognition. To get the database, first gather the subject's photographs. Person for the acknowledgment We will be able to give facial recognition once we have acquired and trained our system.

For face identification, we can employ the local binary pattern histogram (LBPH). This strategy aids in the creation of a recognition model. The picture is then transformed to grayscale. The picture pixels are then compared in a clock-wise or anti-clock-wise way to their neighbor's. For each image, a histogram is created, normalization is performed, and a feature vector is constructed. These feature vectors may now be used to categorize photos and identify the texture using specific techniques. After the face has been recognized, it is reviewed to determine whether it is a recognizable face. As a result, we combine face detection and recognition to create a smart monitoring system for domestic use in our daily lives.

It could be a good idea to make the binary/movement thresholds dynamic and dependent on the average distance in the room in order to make the programmed operate better in rooms of varying sizes. Because if a person goes far away from the camera, the visual difference will be smaller than if the person moved closer to the camera.

10. ACKNOWLEDGMENTS

We express our heartiest thanks to Management of Sreenidhi Institute of Science and Technology, for providing the necessary facilities to undergo this project. We would like to extend our heartiest thanks to the Mrs. Shailaja Mantha, Associate Professor, Department of Electronics & Computer Engineering whose valuable supervision and guidance in making out of this project successfully. We would like to thank our project coordinator Mrs. K. Naga Sailaja, Assistant Professor, Department of Electronics & Computer Engineering who has been an excellent guide and also a great source of inspiration to our work. We would like to extend our heartiest thanks to the Dr. D. Mohan, Professor, HOD of ECM, whose valuable supervision in making out of this project successful.

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