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Gesture Based Retrieval for Mental Illness Recognition

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Abstract*:* In this work, we try to explore and explain content based image retrieval technique for mental illness early detection based on gesture expression. Gesture expression based to recognize mental illness due to gesture has multidimensional and may features for calculation. A technique used to detect and recognize facial expression called Content Based Image Retrieval or CBIR, in this technique needed gesture image training and referencing. This research also proposed to construct an accurate method or algorithm to detect and recognize whether one's suffers mental illness or not. In this research was carried out using gesture image database and gesture without obstacles (hat, moustache, glasses, etc). Research uses more than 5,000 gesture images with gesture which collected from Lampung mental illness hospital and from the internet. Research produce an image gesture retrieval result quite good in term of precession and recall parameters.

Keywords: Image retrieval, gesture detection, mental illness, gesture recognition

1. INTRODUCTION

Since hand gesture on the head can represents one's emotional expression and our behavior, so gesture and head considered as unique human characteristics. Human's expertise to recognize face and hand gestures can be easily done even though face expression influenced by age, obstacles (glasses, hat, hijab, and hair style). However, in face and gesture detection accurately ,particularly for absolutely new faces are very complicated due to some factors such as: recognition, expression analysis, and feature based classification [1]. There are two possibilties task in recognition namely: i. Image matching MATCH of uknow person, ii. VERIFICATION as representavives of one's identification, the system include verification and image checking for small database.Hand and face recognition technique development is very complicated since face considered multidimention and changes according the environment and situation.

Therefore, an automation of face and h and position recognition is a challenge to most researchers, recently. Some changes of face condition such as face identity and face variation happened due to lightening and different angel of shooting become an obstacle to predict how to interprets face expression in mental illness recognition. This issue considered a challenge for researches to explain one's mental condition based on hand and face recognition.

Mental illness or mental disorder caused by ancestry, age, sex, physical condition, culture, habit, beliefs, trust, marriage, pregnancy, lost of love ones, agresion, feelling guilty, and animosity [7]. According to WHO, around 450 million people currently suffer from such conditions, placing mental disorders among the leading causes of ill-health and disability worldwide, recently.

A suitable method needed to detect one's mental condiotion in order mental illness early detection and unexpected tragedy can be avoided. An application or tool is urgently needed to help he/she to recognize as early as possible his/her family whether suffer mentall illness or not. Tool also can be used by a medical doctor and psychiatrist to help to detect their mental patient condition. Expression of face and hand position is an intial activity and fundamental of recording geometric space to differentciate certain expression features. According to [2] DSM-IV-TR(*Diagnostic and Statistical Manual of Mental Illness, 4th edition with text revision*) there are some mentall ilness, such as: psychotic mental ilness, neuro mentall ilness , functional mentall illness,organic mentall ilness,primer ilness, and secondary mentall illness.

In this paper, the work tried to detect all kind of kind of mentall illness mentioned previuosly. Mentioned by [7] , a mental illness is a health problem that significantly affects how a person feels, thinks, behaves, and interacts with other people. It is diagnosed according to standardized criteria. The term mental disorder is also used to refer to these health problems. A mental health problem also interferes with how a person thinks, feels, and behaves, but to a lesser extent than a mental illness. Mental health problems are more common and include the mental ill health that can be experienced temporarily as a reaction to the stresses of life. Mental health problems are less severe than mental illnesses, but may develop into a mental illness if they are not effectively dealt with. Mental illnesses cause a great deal of suffering to those experiencing them, as well as their families and friends. Furthermore, these problems appear to be increasing. According to the World Health

Organization, depression will be one of the biggest health problems worldwide by the year 2020.

The research proposed to find method as well as automatic tools or application to predict one's mental condition such as happy, sad ,and under pressure based on hand and face position. Recently, many negative actions happened such as suicide, and criminal begins from mentall illness. Mental health and mental illnesses are determined by multiple and interacting social, psychological, and biological factors, just as health and illness in general. The clearest evidence for this relates to the risk of mental illnesses, which in the developed and developing world is associated with indicators of poverty, including low levels of education, and in some studies with poor housing and low income. The greater vulnerability of disadvantaged people in each community to mental illnesses may be explained by such factors as the experience of insecurity and hopelessness, rapid social change, and the risks of violence and physical ill-health.

As mentioned before Mental health is more than the mere lack of mental disorders. The positive dimension of mental health is stressed in WHO's definition of health as contained in its constitution: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. "Concepts of mental health include subjective well-being, perceived self-efficacy, autonomy, competence, intergenerational dependence and recognition of the ability to realize one's intellectual and emotional potential. It has also been defined as a state of well-being whereby individuals recognize their abilities, are able to cope with the normal stresses of life, work productively and fruitfully, and make a contribution to their communities. Mental health is about enhancing competencies of individuals and communities and enabling them to achieve their self-determined goals. Mental health should be a concern for all of us, rather than only for those who suffer from a mental disorder. Mental health problems affect society as a whole, and not just a small, isolated segment. They are therefore a major challenge to global development. No group is immune to mental disorders, but the risk is higher among the poor, homeless, the unemployed, persons with low education, victims of violence, migrants and refugees, indigenous populations, children and adolescents, abused women and the neglected elderly

The researh proposed to build tool or application in order to detect one's mental condition. The tool expexted has capability to recognize one's mental illness and help the community or medical doctor to recognize one's mental condition based face expression and gesture.

A semantics-sensitive method to content-based image retrieval has been proposed in [8]. A semantic categorization (e.g., graph - photograph, textured - nontextured) for appropriate feature extraction followed by a region based overall similarity measure, allows robust image matching.

A significant feature of this system is its retrieval speed. The matching measure, interm of region matching has been constructed for faster retrieval using region feature clustering and the most similar highest priority rinciple [98]. Region based image retrieval has also been extended to integrate spatial similarity using the Hausdorff distance on finite sized point sets[10]]Whilst approaches to Retrieval Once a decision on the visual feature has been made, how to navigate them towards accurate image retrieval.There has been a large number of fundamentally different frameworks proposed in the last few years [11].

A framework for region-based image retrieval using region codebooks and learned region weights has been proposed in [12]. A new representation for object retrieval in cluttered images without relying on accurate segmentation has been proposed in [13]. Additional perspective in image retrieval has been region-based querying using homogeneous color texture segments called blobs, instead of image to image matching [14].

For example, if one or more segmented blobs are identified by the user as roughly corresponding to the concept "tiger", then her search can comprise of looking for a tiger within other images, possibly with varying backgrounds. While this can lead to a semantically more precise representation of the user's query objects in general, it also requires greater involvement from and dependence on her. For finding images containing scaled or translated versions of query objects, retrieval can also be performed without the user's explicit region labeling [15].

A hybrid method had been in troduced by [16] , in this mehod they use of rectangular blocks for coarse foreground/background segmentation on the user's query region-of-interest (ROI), followed by the database search using only the foreground regions. Whilts, for segmentation is not critical.

Instead of using image segmentation, one approach to retrieval has been the use of hierarchical perceptual grouping of primitive image features and their inter-relationships to characterize structure [17]. Another proposition has been the use of vector quantization (VQ) on image blocks to generate codebooks for representation and retrieval, taking inspiration from data compression and text-based strategies [18].

Alternative wavelet-based retrieval method involving salient points has been proposed in [19]. Fractal block code based image histograms have been shown effective in retrieval on textured image databases [20]. The use of the MPEG-7 content descriptors to train self-organizing maps (SOM) for the purpose of image retrieval has been explored in [21]. Among other new approaches, anchoring-based image retrieval system has been proposed in [22]. Anchoring is based on the fairly intuitive idea of finding a set of representative "anchor" images and deciding semantic proximity between an arbitrary image pair in terms of their similarity to these anchors. Despite the reduced computational complexity,

the relative image distance function is not guaranteed to be a metric. With the similar reasons, a number of methods have relied on the assumption that the image feature space is a manifold embedded in Euclidean space [23- 25].

Clustering has been applied to image retrieval to help improve interface design, visualization, and result pre-processing [26-28]. A statistical approach involving the Wald-Wolfowitz test for comparing non-parametric multivariate distributions has been used for color image retrieval, representing images as sets of vectors in the RGB-space. A number of probabilistic frameworks for image retrieval have been proposed in the last few years [29,30]. Further more they proposed to integrate feature selection, feature representation, and similarity measure into a combined Bayesian formulation, with the objective of minimizing the probability of retrieval error. One problem with this approach is the computational complexity involved in estimating probabilistic similarity measures. Using VQ to approximately model the probability distribution of the image features, the complexity is reduced [99],so making the measures more practical for the real-world systems.

2.1 Content Based Image Retrieval and JPEG.

Content-based image retrieval (CBIR) is a low-level based features based retrieval simply based on the content or existing image [1]. Some content-based image retrieval have been done up to this time, including: Blobworld [2], the system PicToSeek [31], C-BIRD [32], and MARS system [33]. Meanwhile International standard compression has now been widely introduced and is known as JPEG and MPEG. JPEG image has been very popular as a ISO / ITU-T standard and is patented in the 1990s, some models have been defined by the JPEG [34] including the baseline model, lossless, progressive and hierarchical. Algorithm of digital image compression can be explained as follows (Wallace, 1991):

- Original pixel divided into blocks with 8 x 8 dimensions , which amounts to 64 pixels where each pixel value is shifted from unsigned integers in the range [0, 2^p-1] to a signed integer in the range [-2^p-1, 2^p- 1]
- Then every pixel within the block (Bi) are processed through the 2D Discrete Cosine Transform function and produce DCT blocks (Bi *), and every single DC coefficient (which is the average intensity of all the blocks) and AC coefficients of the number 63 on each block, can be formulated as follows:

$$F(u,v)=\frac{1}{4}\sum_{x=0}^{7}\sum_{y=0}^{7}C(u)C(v)f(k,y)\left[\cos\left(\frac{(2x+1)u\pi}{16}\right)\cos\left(\frac{(2y+1)v\pi}{16}\right)\right]$$

where: u, v vary in accordance with the direction of columns and rows, C (u), C (v) = for u, v = 0.

- After that quantizes done on a 64 coefficient is by using the following equation:

$$FQ=\text{int}\,Round\frac{F(u,v)}{Q(u,v)}$$

- Implementation of a zig-zag order and then the coefficient of each block in quantizes Application of entropy code on each coefficient either with Huffman or arithmetic.

2.2 Image Searching.

Traditional image searching and retrieval were carried out based on query-by-example (QBE) starting from the input image into the system (query image) are compared to the existing image in the database, several studies have been made by researchers, among them [8]. In face image based retrieval, they stated that standard query image can be a mental image. Furthermore they said that their research focus on face features, moreover all the algorithms developed can be applied to other domains, for example in clothing, home furnishings, and paintings, and mental face images. One example of effective mental image searching has been stated by Cox [9].

Image searching in the DC domain by using many methods have been done previously and provide satisfactory and effective results compare to image searching in the pixel domain [10]. As has been proven that with a certain level of compression, then search the face to give even better results than a search on the DC domain.

2.3 Face recognition

Although many automatic face recognition techniques are successfully applied in many areas of daily life, but the task of face recognition based only on the scale bias. Research topic in face recognition is still a challenge, especially in the uncontrolled environment (Adini, et.al., 1997). Meanwhile, to match with face image that is in the database or gallery we use the Euclidean distance calculation, if Euclidean distance equal to zero then the image will be exactly the same query image is in the database.

Face recognition can be done by using the chromatic color components, Hue and Saturation as was done by Zhao in Petrou (Petrou and Bosdogianni, 2005). Face can be considered as unique features ofuman, even twins their faces still different although they are very similar. Human epertise to recgnize a face can be done easily even if face's appearences influenced by its expression, age, and obstacles (glasess, hat, hijab).

Since face is the window or form part of the body that describes the emotions and circumstances of our lives. Face can be considered as unique features of human, even twins they are will remain distinct even though his face looks exactly the same. Human expertise to recognize faces can be done easily influenced by even the appearance of face expression, age, and obstructions such as glasses or hairstyle changes. However, to detect

faces with appropriate especially for faces in a completely new is not easy and there are many issues relating to the above, these problems include: detection of a model's face, recognition, analysis face expressions, and classification based on physical features (Samal and Iyengar, 1992).

2. METHOD

2.1. Ground Truth

In this researh more then 5,000 face and gesture, images colleted for mental hospital and internet,we use face with normal pose or forward facing 90 degree . Face and hand position recognotion in this work we used conten based image retrieval [4,5]. We used also Pricinple Component Analysis (PCA) and Bayesian Clasifier to detect face region. We extract number of face graph salient geometric in order to represent color and shape features as well as face countour and texture vector normalized by shape.

2.2 Hand and position pattern engineering

When query by example step done, then in order to find similirity we usedn eiganfaces calculation , the calculation carried out to extract vector features use to clasifify and recognize face expression. Simplicity, eigenfaces has some procedure such as : i). We assume that face image trainning (training set images) are I_1,I_2,I_3, ... I_n, where each image has I(x,y) dimension, then each image converted to vector with (mxn) matrix , and m is number image training while p is equal p x y. ii). Compute mean of face matrix;iii). Compute each mean of matrix;iv). To reduce number of matrix vector , do matrix transormation; v). compute eigenvector and eigenvalues, so each image has own matrix region;vi). Finally, re-engineer face image into vector and previous vector.

Face Recognition, after formulizing the representation of each face, the last step is to recognize the identities of these faces. In order to achieve automatic recognition, a face database is required to build. For each person, several images are taken and their features are extracted and stored in the database. Then when an input face image comes in, we perform face detection and feature extraction, and compare its feature to each face class stored in the database. There have been many researches and algorithms pro-posed to deal with this classification problem, and we'll discuss them in later sections. There are two general applications of face recognition, one is called identification and another one is called verification. Face identification means given a face image, we want the system to tell who he / she is or the most probable identification; while in face verification, given a face image and a gusture of the identification, we want the system to tell true or false about the gesture. The steps of face detection can describes as follow :

Input face edge image
Extract of mouth block set candidate
For i = 1 to N
Extract of face region candidate
Calculate face score
If i<=N then i=i+1
Else
Select mounth block with maximum face score
Eye location
Extraction of face orienation
End
Face region

2.3. Gesture recognitionn and detection

Main of gesture detection function is to determine whether human's face is exist in the image and where the face position exist. The expected output from this gesture recognition is face region and to make gesture recognition more accurate as well as easier to design gesture recognition, gesture alignment need to carried out in order to justify face region. Further more, pre-processing need to done also to do gesture detection to determine *region-of-interest* atau ROI.

After gesture detection step, human's face region extracted from the image. By using face region for gesture recognition, there some disadvantages such as: i). Each region usually has more than 1.000 pixels which mean to big to build an accurat and robust gesture recognition; ii). Face region taken from different angle with different gesture recognition . In oder to solve this problem , feture extarction needed to carried out to reduce dimension, salience extraction, and noise cleaning.

Finally, after calculating each region , the last step to be caried out is recognition and indentification this face region. Sequently, automatic recognition needs to bulid face image database. For each person, some images needed to be taken and feature extracted then save into database. When, face image input into system in this step gesture detection and feature extraction, then the features compared to face feature in the database. There two applications in gesture recognition, firstly identification and secondly verification. Gesture indentification used to recognize one's identified whilts gesture verification to determine whether one's face correctly indetified or wrongly indetified.

2.4. Maching similarity to detect mental disorder

When compute similarity between geture query and face image citra in the database carried out directly need high cost in term complex algorithm and takes time in processing. To overcome from this problem, this work was carried out in three steps to match face image and gesture. The steps are : i). Find similarity between face and hand position topology query and face image in the database which is considered as filter; ii). Information used to improve image candidate retrieved, and iii). Apply matching calculation in or order to determine image similarity between image query and face and gesture in the database. In this work used face with normal pose.

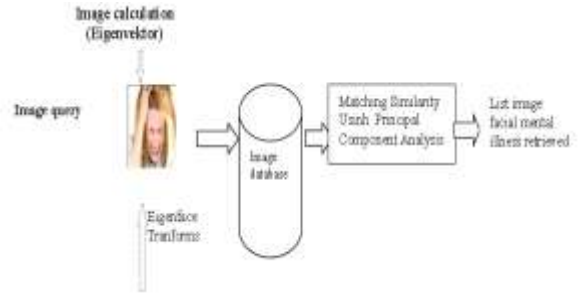

Fig 1. Matching face gesture

3. RESULT AND DISCUSSION

3.1. Retrieval effectiveness

Our work demonstrates that average precission of face retrieval more than 70 % with the highest of 1 and the lowes precision is 15 %. From this results we can say that our algorithm quite good to retrieve face with mental illness. In this work, we used 80 queries with around 5,000 face image database which consisit of 200 normal face image and 4,800 face with face image with mentall illness.

In our algorithm we used RGB image as a query which then convert to YcbCr and HVS components, more detail the algoritm can be described as followed:

1. *Face and gesture image query*
2. *Convert RGB image into YcbCr and HVS components*
3. *Statistic feature extraction by computing the Eigenfaces*
4. *Compute matrix average*
5. *Compute covanriance of matrix C by using the following formula*

$$C = \frac{1}{M}\sum_{n-1}^{M}\Phi_n\Phi_n^T$$

6. *Compute eigenvector and eigenvalue of matrix*
7. *Choose face principles component*
8. *Compute the similarity or image matching by using Euclidean Distance*

$$d(x_i, x_j) = \sqrt{\sum_{r=1}^{n}(a_r(x_i) - a_r(x_j))^2}$$

9. *Sort or rank image retrieved based on euclidean distance*

   for number of block = 1 to N
   for u=0 to 63
   for v=0 to 63
   D(Iq(u,v), Id(u,v))
   end
   end
   end

10. *Show or display the most 20 similar images*
11. *For nex query repeat step 1 to 8*

Table 1. Effectivity of image retrieval

Query	Precision	Recall
1	0,15	0,01
2	0,15	0,02
3	0,21	0,03
4	0,22	0,04
5	0,22	0,05
.....	.....	.....
.....	.....	.....
71	1	0,04
77	0,94	0,04
78	0,94	0,05
79	0,95	0,01
80	0,95	0,02
Average :	0,748272	0,030988
Highest :	1	0,09
Lowest :	0,15	0,01

In this work , we used more than 5.000 face image with gesture which suffer mental gesture suspected andaroun 1.000 normal face images. From 40 queries applied shows the effectiveness of image retrieval as 60% and 1,3 % in term of precission and recall. From the 40 queries also show the highest precission is 100% and the lowest is 10%, more detail of this results can be examined in figure 2.

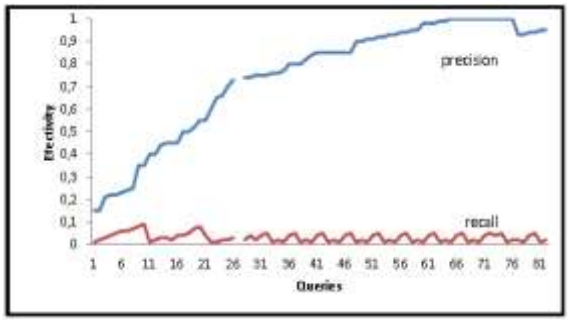

Fig. 2. The Retrieval effectivity in term of Precision and Recall

4. DISCUSSION

The result of this work shows that our algorithm demonstrate good effectiveness in term of Precission and recall. The precission of image retrieval shows aroun 60 % , it means that the face recognition algorithm used in this work quite good and simple, but demonstrate good performance. From the reslt.

5. FUTURE WORKS

Existing and future research needs to be worked to improve the effectiveness of the algorithm by using larger database both in terms of both quantity and variety. We will try to apply other methods such as segmentation, neural network, and fuzzy logic.

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