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M Payment Prototype for Mobile Bill Payment System

Jimoh, R. G.
Dept. of Computer Science
University of Ilorin, Nigeria

COCO, K. B
Dept. of Computer Science
University of Ilorin, Nigeria

OLUOBO, Abdel, M. F. O.
Department of Computer Science
University of Ilorin

Abdulsalam, S. O
Dept. of Computer, Library & Info. Science
Kwara State University, Malete, Nigeria

Isiaka, R. M.
Dept. of Computer, Library & Info. Science
Kwara State University, Malete, Nigeria

Abstract: Mobile devices and wireless technologies have come to make a great impact on our lives. Mobile devices have been widely used in the last few years which have led to the e-revolution. This suggests the electronic mode of payment in sustaining the new innovations. The manual payment system has been revealed to be associated with a numbers of problems such as fatigue of standing in long queue, human error, forgery and lots more. This made a number of authors to have suggested electronic payment system with proven advantage in terms of accuracy, speed, cost and security. The Electricity Holding Company of Benin Republic (EHCB) is currently facing a lot of challenges using manual payment system which has made the stakeholders in company to suggest mobile payment system as an alternative. This informs the aim of the researcher to develop an m-payment prototype for EHCB and confirm its usability. The prototype was developed based on prototyping model using WINDEV while the usability was tested using an adapted survey questionnaire with ten metrics. It was discovered that the developed m-payment prototype for Electricity Holding Company of Benin Republic is usable.

Key words*: WINDEV, M-payment, E-revolution, Prototype and EHCB.*

1. INTRODUCTION

A mobile payment or m-payment may be defined as any payment where a mobile device is used to initiate, authorize and confirm an exchange of financial value in return for goods and services [1]. Mobile devices may include mobile phones, PDAs, wireless tablets and any other device that connect to mobile telecommunication network and make it possible for payments to be made [3].

In recent years, mobile and wireless technologies have been a hot topic [9]. Many mobile and wireless applications developments are still going on [8]. Instead of paying with cash, cheque or credit cards, a consumer can use a mobile phone to pay for a wide range of services. Consumers and mobile industry representatives are looking forward to the third generation (3G) of mobile phones, one that promises higher quality services to consumers. There are already more than 6 billion mobile subscribers worldwide [2]. This rapid growth has made a mobile phone to provide extra functions and services like bill payment. Consumers are using their mobile phones not only as voice communication tools but also as multi-function tools that can send SMS, play games, and perform other functions.
Mobile payment represents another opportunity for the mobile industry and financial service companies [6]. Perhaps, in the near future, it will be a service that is demanded by consumers [6]. Imagine it is the last date of bill payment and you are stuck in an unavoidable meeting; imagine standing in long queues when you could be having fun with friends and family**.** By sending an SMS your bills are paid and payment is really just a click away.

This research work is particularly to achieve electricity bill payment system via mobile phone. The responsibility of EHCB is to supply electricity to their numerous customers. It is desirable in this work to examine the potential technologies for mobile payments systems and to also identify the opportunities and issues for mobile payments with respect to EHCB.

2. PROBLEM STATEMENT

There are a number of challenges facing the manual payment system. This approach is not effective in solving the perennial problem like bill distribution, billing and cash collection [4]. According to the source, the following could be identified as major shortcomings of a manual payment system:

1. Time consuming
2. Lack of real time information storage
3. Lack of prompt updating
4. Possibility of human error
5. Lack of accurate and prompt reports
6. Possibility of data duplication

The aforementioned shortcomings among others serve as the justification for migrating from manual bill payment system to the proposed mobile bill payment system in

Electricity Holding Company of Benin Republic (EHCB). It is equally revealed that, it is not all about developing mobile payment system but also ensuring the usability of such a system [3]. The need for m-payment system at EHCB was equally revealed by the stakeholders of the company [7].

3. RESEARCH QUESTIONS AND OBJECTIVES

In addressing the research problem, the following research questions are required to be answered:

1. How can mobile bill payment prototype for EHCB be developed?
2. What is the usability of the developed mobile bill payment prototype for EHCB?

The main objective of this study is to develop mobile billing application that will allow registered customers of Electricity Holding Company of Benin Republic (EHCB) to pay their bill. In achieving this main objective; the following specific objectives are thereby formulated:

1. To develop a mobile bill payment prototype for EHCB
2. To evaluate the usability of the prototype developed.

A mobile phone user communicates with a merchant and makes an economic transaction. The merchant obtains the phone number of the customer and initiates the m-payment transaction request stating the amount for which payment is required. The customer confirms the request and authorizes payment. The Mobile Application Service Provider (MASP) receives the authorization and verifies the authenticity of the customer. The MASP then debits the customer account and credits the merchant account by interacting with the bank. Once the electronic funds transfer is successful a confirmation message is sent to the customer and the merchant advising them of the debit and credit respectively. The Certifying Authority shown in Figure 1 supplies digital certificates for the users in the system to provide security. This model can be extended to handle the interaction between the MASP and the financial system taking into account inter-bank payments and settlement. This study is guided by the generic Model for M-Payments Application Service Provider as described in Figure 1.

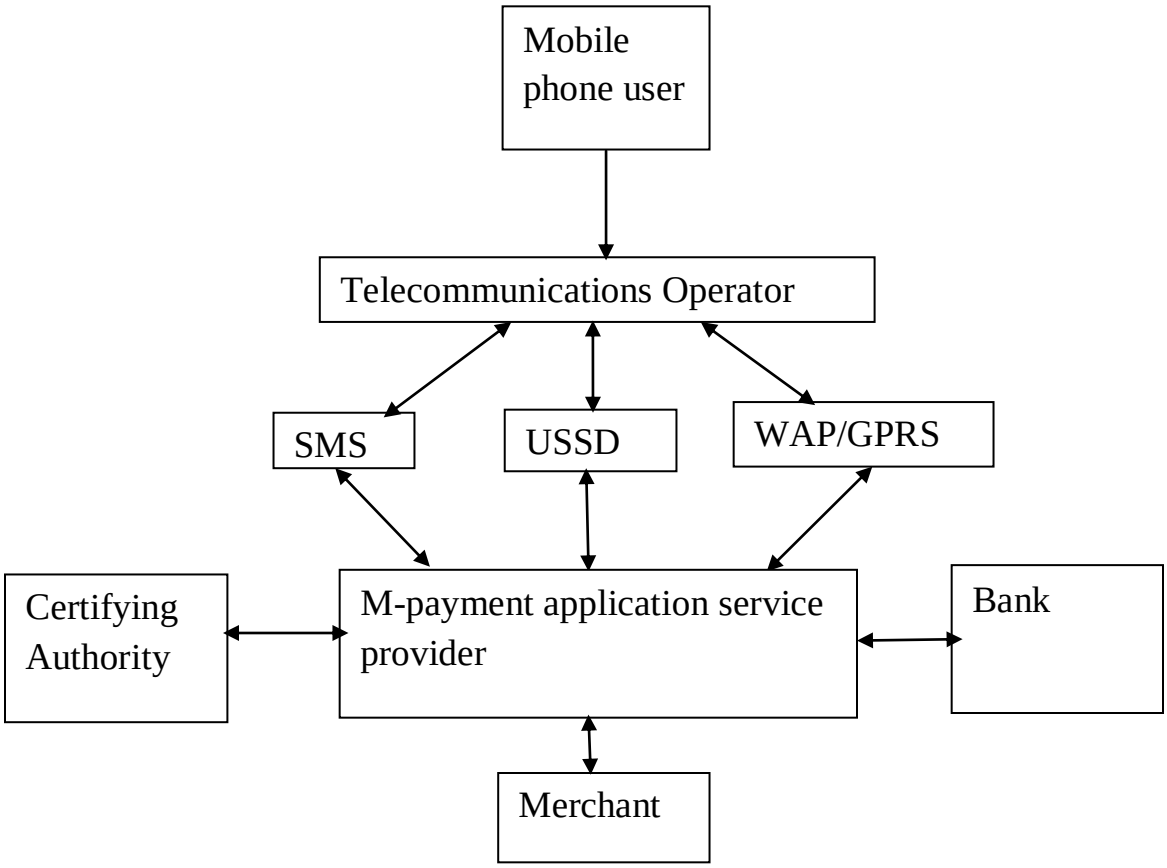

Figure 1: A Generic Model for M-Payments Application Service Provider

Prototyping approach is employed in this study due to its many advantages as follows:

1. **Reduced time and costs**: Prototyping can improve the quality of requirements and specifications provided to developers. Because changes cost exponentially more to implement as they are detected later in development, the early determination of what the user really wants can result in faster and less expensive software.

2. **Improved and increased user involvement**: Prototyping requires user involvement and allows them to see and interact with a prototype allowing them to provide better and more complete feedback and specifications. The presence of the prototype being examined by the user prevents many misunderstandings and miscommunications that occur when each side believe the other understands what they said. Since users know the problem domain better than anyone on the development team does, increased interaction can result in final product that has greater tangible and intangible quality. The final product is more likely to satisfy the users desire for look, feel and performance.

4. UML DIAGRAMS OF THE PROPOSED SYSTEM

The Class Diagram shows the class definition and relations, also depicts interfaces within the design of your system as described in Figure 2. Customer can possess one or more meters, nevertheless more than one customer cannot be linked with the same meter. In the same vein, the account of a meter can be detailed in more than one bill; however, one bill cannot detail the account of two meters. Figure 3 describes the Use Cases Diagram of the system. An Activity Diagram depicts the detailed behavior inside a single functional requirement; it shows an elaboration of the behavior of the system as shown in Figure 4. A Sequence Diagram depicts the detailed behavior over time within one path or scenario of a single functional requirement. It is useful for understanding the flow of messages between elements of the system; it shows object interactions over time as shown with Figure 5.

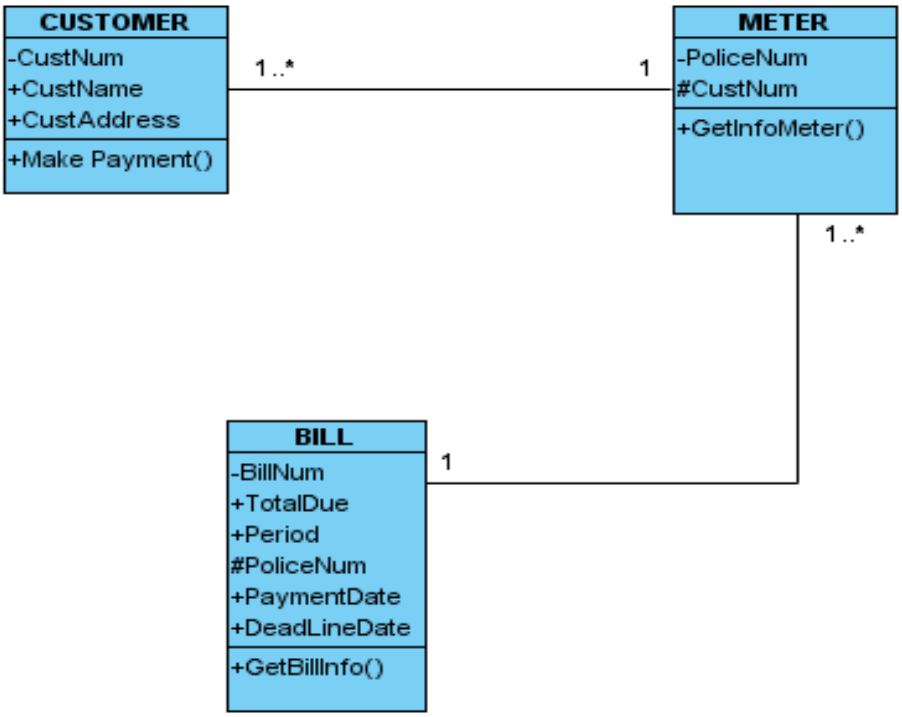

Figure 2: Class Diagram of the Proposed System

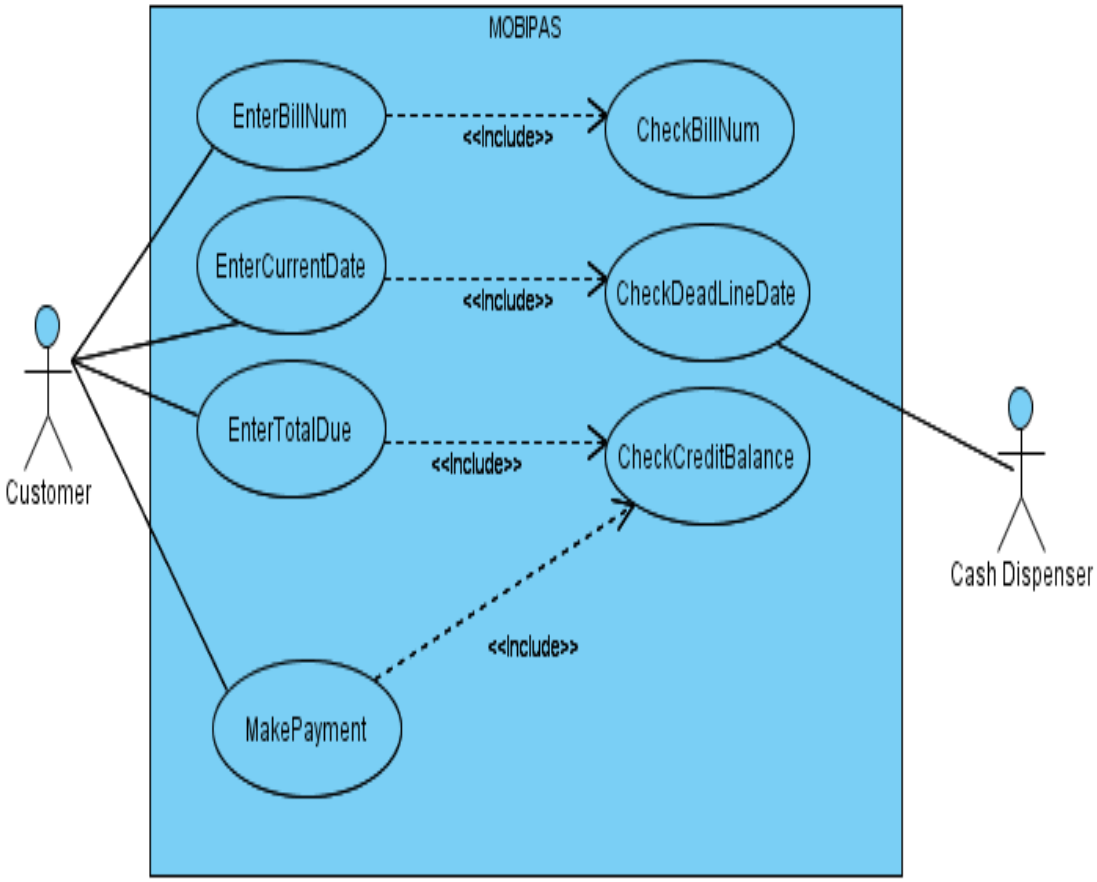

Figure 3: Use Case Diagram of the Proposed System

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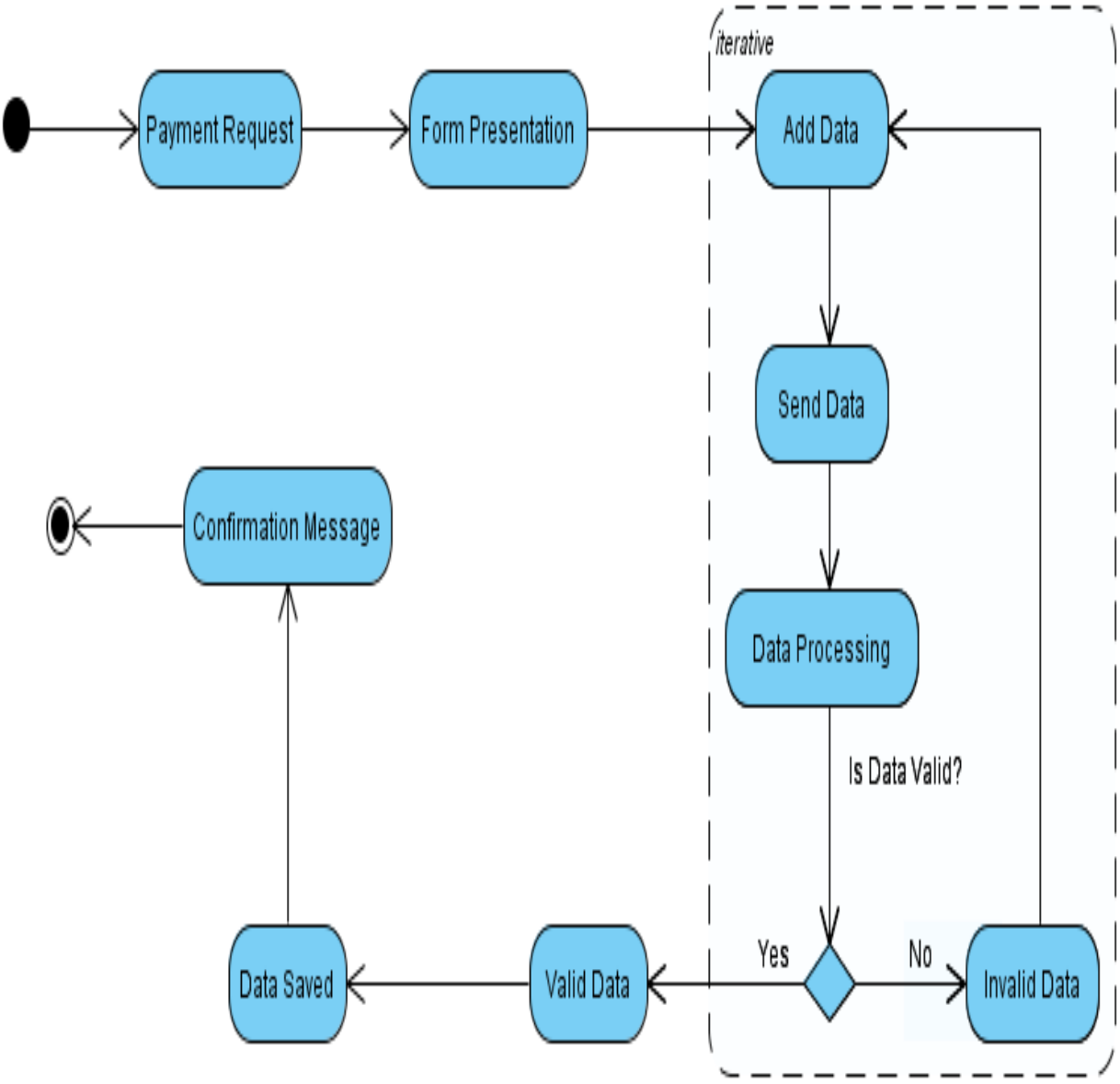

Figure 4: Activity Diagram of the Proposed System

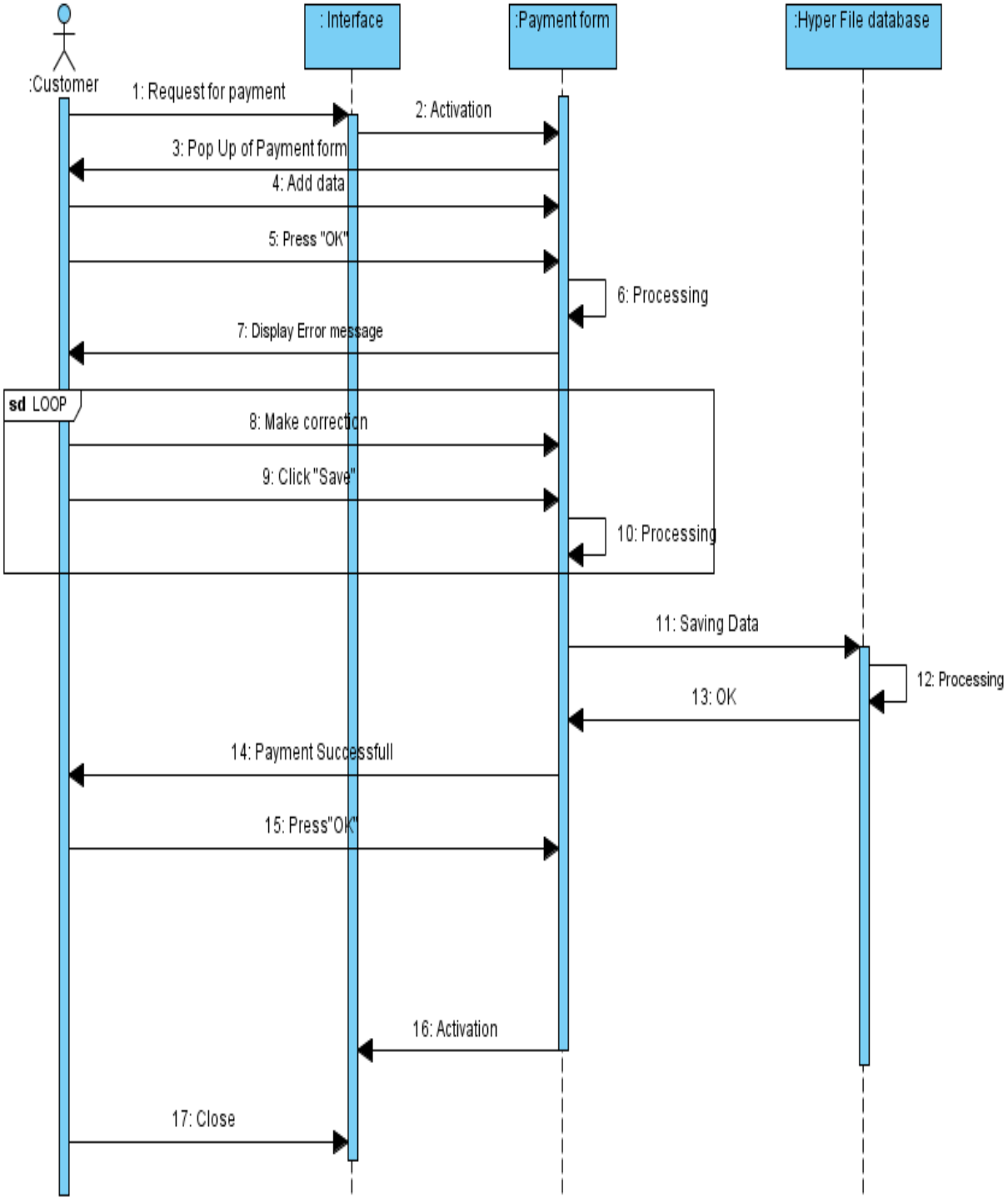

Figure 5: Sequence Diagram of the Proposed System

5. USABILITY TESTING

The usability of the developed prototype is evaluated using the items from the usability evaluation questionnaire developed by [5] which was adopted in this study. The questionnaire consists of 10 questions which covers software system metrics like simplicity of dialogue, clarity of language, memory load, consistency, feedback mechanism, clear point of exit, shortcut facilities, clear error messages, minimal error, adequate help and documentation. The items contained in the questionnaire are described in Tables 1 to 10 as follows:

6. USABILITY RESULT

Table 1: MPUQ1 (Simplicity of Dialogue)

		Undecided		Agree		Strongly Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	1	100,0%	5	62,5%	4	36,4%
	2	0	,0%	3	37,5%	7	63,6%
	Combined	1	100,0%	8	100,0%	11	100,0%

The result of usability testing shows that the language used is clear and unambiguous as shown in Table 2 with more 80% of respondents agreeing to the fact that the dialogue of the prototype is simple.

Table 2: MPUQ2 (Clarity of Language)

		Undecided		Agree		Strongly Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	1	100,0%	7	58,3%	2	28,6%
	2	0	,0%	5	41,7%	5	71,4%
	Combined	1	100,0%	12	100,0%	7	100,0%

The usability testing reveals that the prototype is of acceptable memory load as can be seen from Table 3.

Based on the metrics used to measure system reliability which include simplicity of dialogue, clarity of language, memory load, consistency, feedback mechanism, clear point of exit, shortcut facilities, clear error messages, minimal error, adequate help and documentation, analysis of data collected from users of the prototype gives the following results. The results as shown from Tables 1 to 10 show that positive indication of all observed metrics as majority of the respondents fall between Agree and Strongly Agree. The result of the usability testing shows that the prototype is perceived simple to use with more than 90% of sample respondent on the agreement side as shown in Table 1.

Table 3: MPUQ3 (Memory Load)

		Undecided		Agree		Strongly Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	3	100,0%	5	38,5%	2	50,0%
	2	0	,0%	8	61,5%	2	50,0%
	Combined	3	100,0%	13	100,0%	4	100,0%

The developed prototype is perceived to be consistent with over 70% of respondents on the agreement side as shown in Table 4.

Table 4: MPUQ4 (Consistency)

		Strongly Disagree		Undecided		Agree		Strongly Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	2	100,0%	3	100,0%	3	23,1%	2	100,0%
	2	0	,0%	0	,0%	10	76,9%	0	,0%
	Combined	2	100,0%	3	100,0%	13	100,0%	2	100,0%

The result of the usability testing shows that the feedback mechanism in the prototype is acceptable with 50% of the sample respondent on the agreement side of the Table 5.

Table 5: MPUQ5 (Feedback Mechanism)

		Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	3	100,0%	3	100,0%	3	75,0%	1	11,1%	0	,0%
	2	0	,0%	0	,0%	1	25,0%	8	88,9%	1	100,0%
	Combined	3	100,0%	3	100,0%	4	100,0%	9	100,0%	1	100,0%

The developed prototype is perceived to have a clear point of exit with more than 75% of the sample respondents on the agreement side as shown in Table 6.

Table 6: MPUQ6 (Clear point of exit)

		Disagree		Undecided		Agree		Strongly Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	0	,0%	1	25,0%	5	100,0%	4	40,0%
	2	1	100,0%	3	75,0%	0	,0%	6	60,0%
	Combined	1	100,0%	4	100,0%	5	100,0%	10	100,0%

The result of the usability testing shows that the sample respondents perceive the shortcut facilities with more than 50% of the respondents on the agreement side as shown in Table 7.

Table 7: MPUQ7 (Shortcut Facilities)

		Strongly Disagree		Disagree		Undicided		Agree		Strongly Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	1	100,0%	5	71,4%	0	,0%	2	100,0%	2	100,0%
	2	0	,0%	2	28,6%	8	100,0%	0	,0%	0	,0%
	Combined	1	100,0%	2	100,0%	3	100,0%	8	100,0%	6	100,0%

The developed prototype is perceived to have a good error trap system with more than 80% of the respondents on the agreement side as shown in Table 8.

Table 8: MPUQ8 (Clear error message)

		Disagree		Undecided		Agree		Strongly Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	1	100,0%	2	100,0%	1	12,5%	6	66,7%
	2	0	,0%	0	,0%	7	87,5%	3	33,3%
	Combined	1	100,0%	2	100,0%	8	100,0%	9	100,0%

The developed prototype is perceived to have minimal error with the 50% of the sample respondents on the agreement side depicted in Table 9.

Table 9: MPUQ9 (Minimal error)

		Disagree		Undecided		Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	3	100,0%	1	14,3%	6	60,0%
	2	0	,0%	6	85,7%	4	40,0%
	Combined	3	100,0%	7	100,0%	10	100,0%

The developed prototype is perceived to have an average help and documentation facility with 60% of the sample respondents on the agreement side as can be seen on Table 10

Table 10: MPUQ10 (Help and documentation)

		Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Cluster	1	2	33,3%	4	66,7%	0	,0%	1	100,0%	3	100,0%
	2	4	66,7%	2	33,3%	4	100,0%	0	,0%	0	,0%
	Combined	6	100,0%	6	100,0%	4	100,0%	1	100,0%	3	100,0%

7. DISCUSSION

There is no doubt that the beauty of Information Technology has brought about electronic revolution in virtually all aspects of human endeavor. Electronic payment system is not left out in this regard. This study

aimed at suggesting a usable m-payment prototype for Electricity Holding Company of Benin Republic having identified the need for such innovation both locally and globally. In achieving the goal of the study, extensive literature review was carried out to justify the required research effort. Various software development methodologies were also reviewed. It was discovered that, prototyping model is more suitable for this work. The system requirement was specified using use case diagram and class diagram. The usability of the prototype was tested using the survey questionnaire of [5] with ten software usability metrics which includes simplicity of dialogue, clarity of language, memory load, consistency, feedback mechanism, clear point of exit, shortcut facilities, clear error messages, minimal error, adequate help and documentation. The results show that the developed prototype is perceived to be usable based on these metrics.

8. CONCLUSION

The introduction of Information Technology (IT) has introduced ubiquitous way of transacting businesses. This cannot be achieved without making the payment system also ubiquitous. Since mobile payments services provide an attractive, simple and rapid payment channel for users, it is therefore concluded that such payment medium poses a promising future for the emerging ICT-driven transactions. but still lack the proper regulations and standardization with associated are numerous challenges to be overcome. Network operator, businesses, and consumers have to come forward and make value-producing investments for a successful implementation of mobile payments to be widely accepted as a mode of payment. If all these are properly provided, it can be concluded that m-payment system will deliver in Electricity Holding Company of Benin Republic. It is advised to test this application in other different domains.

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