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Development of Fault Monitoring and Management Application for Automatic Teller Machines

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Abstract

This study is on the development of faults monitoring and management application in automatic teller machines (ATM). It was conducted to develop a monitoring and management application that will help to detect, notify and correct faults and at the same time reduce ATM frauds in the banking industry. A branch of Skye Bank Plc, in South West region of Nigeria was used as a case study. To determine areas of ATM system weaknesses, a field survey was conducted that included oral interview and questionnaires with bank staff as the major targets. From the findings, it was observed that inability of providing journal footage backup was amongst the ATM's weaknesses obtained from the respondents. The novelty of the proposed approach is to provide a journal footage backup scheme. To solve the problems highlighted, a fault monitoring and management application was developed using the .NET Framework and C# programming language. The fault monitoring and management application when put to test on an ATM, performed a combination of database management, electronic ticketing and journal footage backup.

Keywords: ATM, cash jam, footage-backup, monitoring application, software programming.

1. Introduction

Automated Teller Machines (ATM) have become a widely accepted electronic platform in the banking sector and an alternative means of conducting financial transactions as against manual methods. It is a well-known replacement for the paper-based payment instrument. ATM is an innovative service delivery mode that offers diversified financial services like cash withdrawal, funds transfer, cash deposits, payment of utility bills, cheque book requests, and other financial enquiries (Muhammad, 2010). Specifically in Nigeria, the growth of ATM in banks has risen from 83% in 2006 to 289% in 2007 (Adeoti, 2011). The use of this technology has benefited both banks and their customers in the area of self-service delivery and reduction in the cost of labour (Jegede, 2014).

While the foregoing may imply that the ATM is a great innovation that has come to stay, its use has contributed to the increasing rate of bank frauds (Ogbuji, Onuoha & Izogo, 2012). Over the years, a number of approaches have been proposed to enhance the detection of ATM faults and risk reduction in financial transactions. In investigating on how to reduce the risk associated with ATMs in financial transactions, Okafor et al, (2014) carried out a work using Automated Biometric Fingerprint (ABF). This method used biometric fingerprint and

cryptographic schemes in which pattern matching frame for an input image set at 0.99% threshold was realized for the purpose of identification and verification. Elsewhere the negative effect of continuous downtime of ATM devices to customer loyalty and reputation of business was established (Cluckey, 2011). In that report, the need for remote management solution was highlighted. A principal component analysis (PCA) method for detection of malfunctioning ATMs was proposed in Baldi, Gai and Picco (1997). The unexpected behavior of a specific ATM was detected using PCA models of ATMs joined in a special ATM cluster. An improvement of this method could be found in Rimvydas, Lidija, (2009) and Arekete, (2013). When human administrators are used for this function, their work may involve monitoring, evaluating and analysis of the various nodes attached to the network with a view to resolving problems and ensuring optimal performance and efficiency. Akinyokun, Ekuewa and Arekete (2014), explained that the process of monitoring software tools on servers and workstations in a network is one of such tedious tasks of the network system administrator.

Monitoring and searching for resources on the network often involves physical movement of the network administrator from one computer to another. This function can be tiring, stressful and cumbersome, especially in a large network. The limitations of the manual approach necessitated the need to have intelligent software that would search, detect and monitor network resources on behalf of the network administrator. The reviewed works showed that software in use does not give instant notification of actual ATM faults, making it difficult for prompt correction. The result of this is that ATM users are not maximally satisfied and banks are at the receiving end. It was also observed that existing ATM monitoring software are unable to provide backup for both journal and footage as a result of poor storage capacity, hence adequate information is lost when issues like fraud occurs. The proposed application is aimed at solving the problem of lack of footage backup facility, thus having ATMs journal footage backup platform.

Monitoring system in ATMs is imperative to mitigate frauds and other cybercrimes. This could be achieved by having an appropriate system application for ATM monitoring and management as shown in this paper. It presents a report on the development of a fault monitoring and management application in ATMs. The software executes defined diagnostic commands and sends out SMS notification to the appropriate officer when a hardware component fails. Unlike the exiting machines in use, it also transmits large footage and journal files in a configured location to a central server (Server Upload System) other than the system hard drive. This is the major contribution of this work.

2. Methodology

2.1. Data Collection and Analysis

The study involved field survey and software development. The survey was done to have an appraisal of ATMs' performance from users in the banking industry. A population of 120 staff of some banks in Oyo, Osun, Ogun, Ilorin, Ondo and Ekiti states in Nigeria were administered with a structured questionnaire. The instrument was divided into three sections.

i. Section A captured the bank staff personal data.
ii. Section B contained items on ATM Performance Ratings.
iii. Section C captures items on Monitoring and Management Application on ATMs.

The questionnaire was structured on 5 points: Excellent, Very Good, Good, Fair and Poor. The data obtained and analyzed is as shown in Tables 1 and 2 for ATM performance and management application respectively.

Table 1: ATM Performance Assessment

Variables	Frequency	Percent
Excellent	3	3.3
Very good	10	11.1
Good	25	27.8
Fair	52	57.8
Total	90	100.0

Table 2: Monitoring and Management Application Assessment of ATM

Variable	Frequency	Percent
Excellent	2	2.2
Very good	12	13.3
Good	30	33.3
Fair	46	51.2
Total	90	100.0

In Table 1, ATM performance rating is 3.3 % and 11.1 % for excellent and very good respectively. While 27.8 % and 57.8% are for good and fair respectively. Table 2 shows Monitoring and Management application on ATM. 2.2% and 13.3% are for excellent and very good respectively. The low assessment was due to lack of existing ATM's ability to monitor faults and provide footage backups. Good and fair account for 33.3% and 51.2% of the respondents respectively. From both tables, it is seen that major users of ATMs require an improved performance or function than what is obtainable presently. This outcome justifies the need for an application that could effectively monitor faults and provide footage backup.

2.2. Software Development

The application was designed to perform numerous functions like database management, fault monitoring, journal and footage uploading. As a result, the combinations of all these functions are explicitly expressed in the structure of the software. Figure 1 shows how the different ATM agents and other relevant parts are connected to the central server in order to enable detection of faults. It is structured in a way to ensure that notification of actual fault is sent to appropriate channel via the SMS provider once a hardware error is detected.

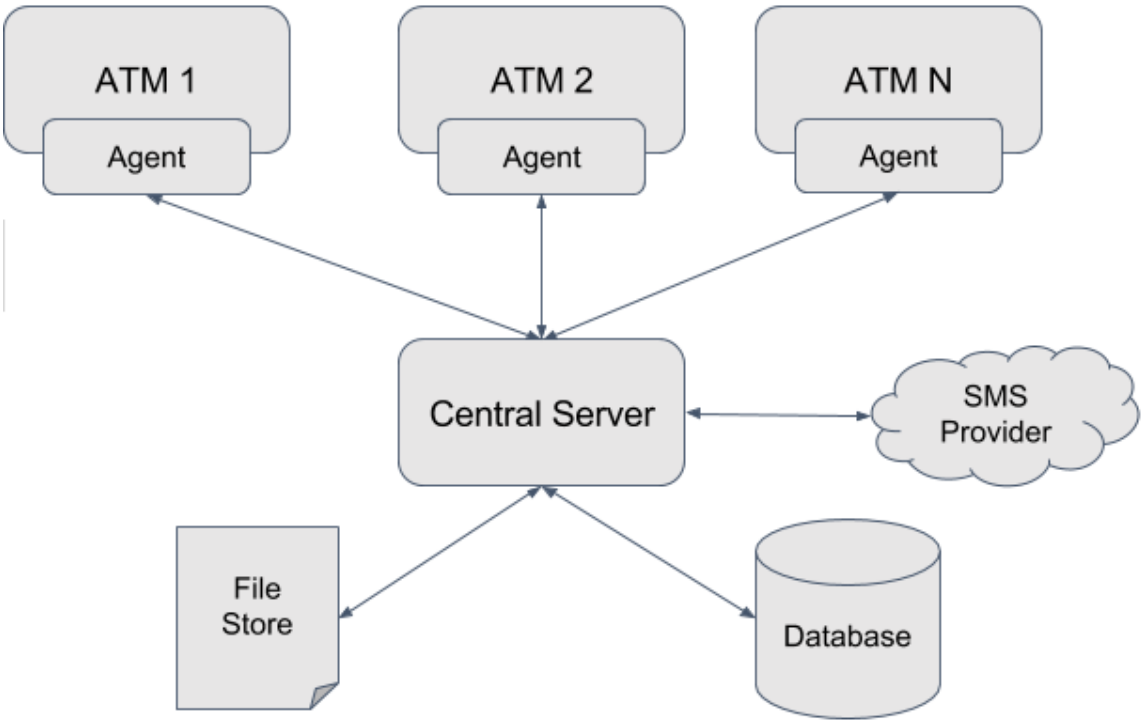

Figure 1: System Design of Faults Monitoring and Management Application

2.3. Algorithm for ATM Monitoring Application

The algorithm of the ATM monitoring application refers to the process and procedures by which the software was designed to suit the users. It shows the precise step-by-step plan for the computational procedure that begins with an input value. The application was designed using the .NET Framework and C# programming language. C# was used to program the client or administrative side of the ATM monitoring system. The algorithm of the ATM monitoring application is illustrated in Figure 2.

With the system 'ON', access is gained by inputting the Username (UN) and Password (PW). If UN and PW are correct after verification it is directed to measuring station, firmware loading, etc. The error statistics are obtained, viewed and with the availability of internet connectivity the reports are uploaded otherwise the process starts all over again. The process can be terminated from the management side or with the input of incorrect UN and PW.

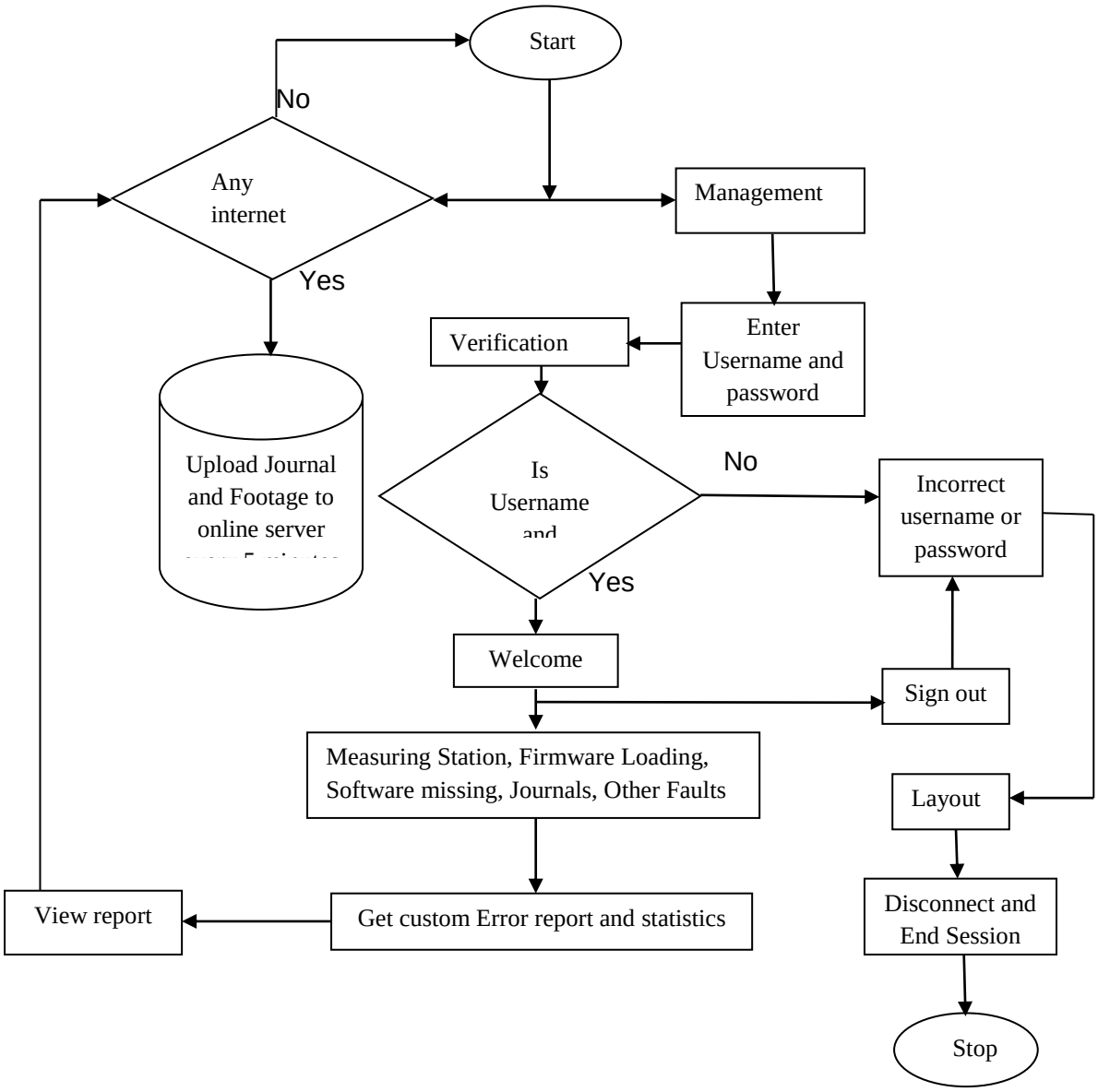

Figure 2: ATM Monitoring Flow Chart for Management

3. Result and Discussion

3.1. Validity and Reliability

The application was tested on a bank's ATM at Agodi Ibadan in Oyo State of Nigeria. The ATM used for the validity test was *Wincor Nixdorf* machine with serial Number *530012342*. This was used to confirm if the application met the desired design objectives. The faults were manually introduced after the ATM under test was loaded with the application. The result showed the following error reports:

(i) Cash Jam**:** This refers to a situation when money got stock making cash dispensation difficult. When such error occurs it is detected and shown as in Figure 3.

Figure 3: Cash Jam indication

(ii) Faulty DDU Belt**:** . It is the belt that propels the extractor gear in the DDU (double dispensing unit). Once, the DDU belt becomes slack, it results into constant cash jam. DDU belt fault will appear as shown in Figure 4.

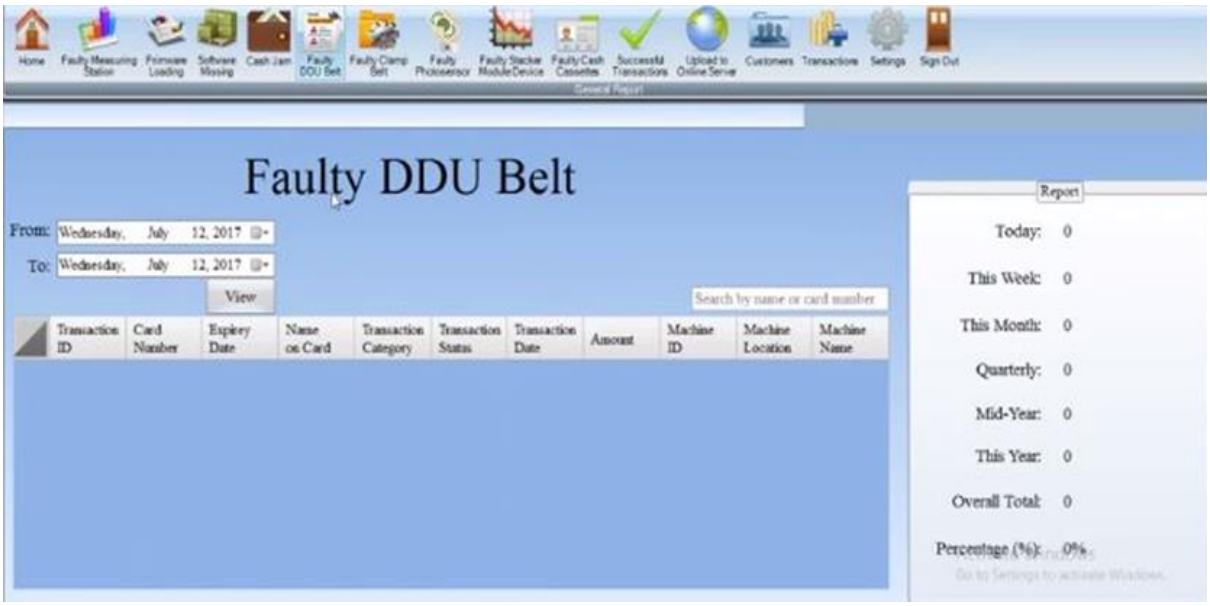

Figure 4: Faulty DDU belt

(iii) Faulty Clamp Belt: The clamp belt controls the movement of the clamp that picks cash from the cash cassettes and sends it to the shutter before presenting it to the customer. This fault was detected and is as shown in Figure 5.

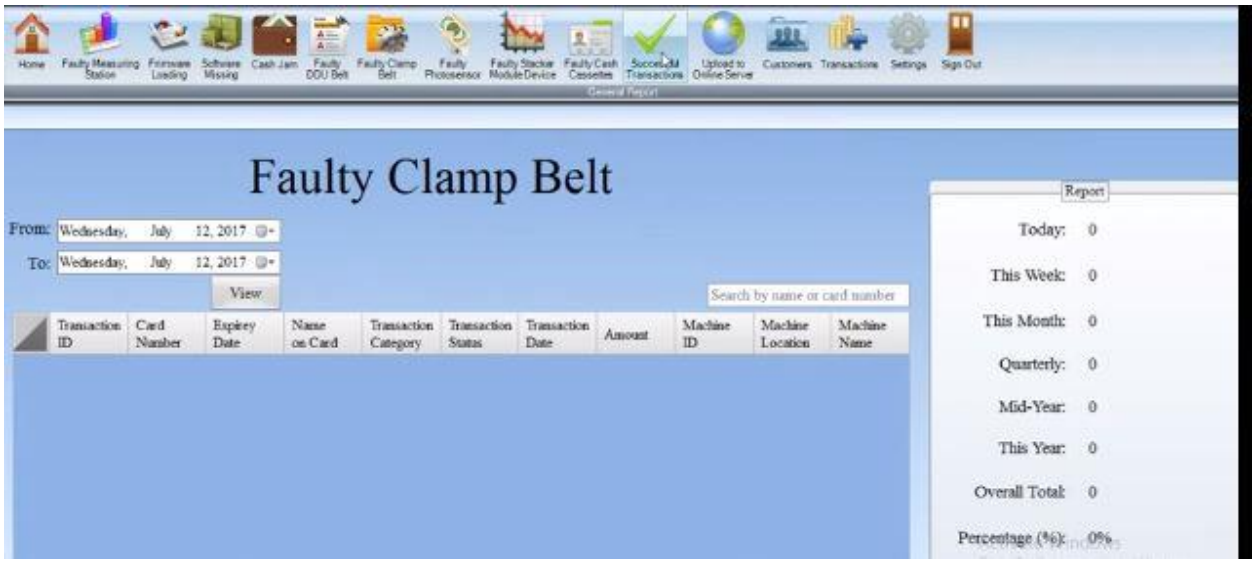

Figure 5: Faulty Clamp Belt

(iv) Faulty Measuring Station: This is the component that ensures that the correct quantity of cash is picked and dispensed to customers. The fault is illustrated as shown in Figure 6.

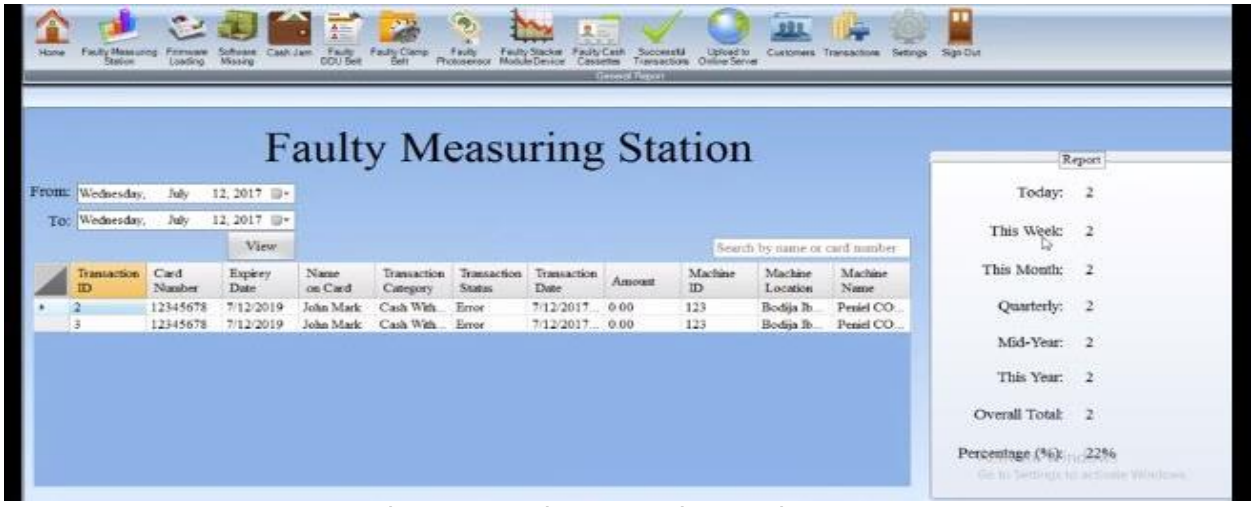

Figure 6: Faulty Measuring Station

(v) Software Missing: It happens when the ATM application does not load properly. It is as indicated in Figure 7.

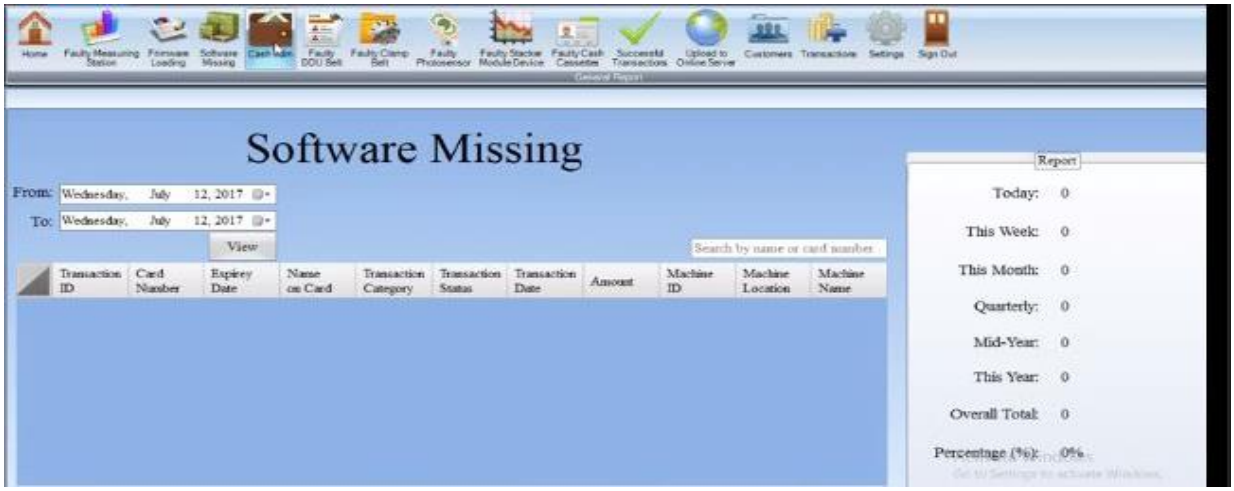

Figure 7: Software Missing

(vi) Error Reports: The error report gives the ATM custodians a tip of what is the actual issue with the ATM at every point in time. This is shown in Figure 8.

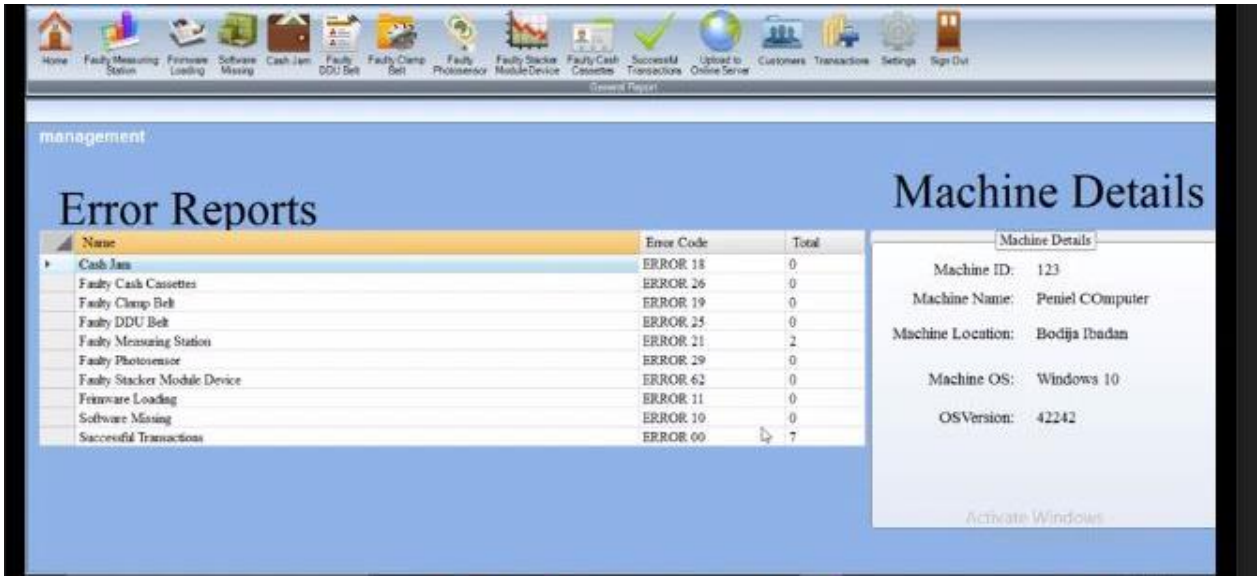

Figure 8: Error Report

(vii) ATM Server Dashboard for Journals and Footages**:** The ATM Server Dashboard for Journals and Footages is shown in Figure 9 and consist of the uploaded journal and footages. The journal contains some information like, Machine ID, Card Number, Card Name, Transaction Date/Time, Amount, Machine Location and Name. The footage contains Machine Name/ID, Transaction Date/Time.

3.2. Journal and Footage backup

A journal is simply a chronological record of changes made to a database or other system; along with a backup that allows recovery after failure or reinstatement to a previous time. It is usually an accurate historical data of transactions that are executed on the ATM, programmed to record every aspect of withdrawal transaction from the beginning to the close of the record. In certain cases, discrepancies occur between the physical cash in the machine and the journal and this is usually the case when the ATM fails to dispense cash

because of a system failure, error or a problem with the dispensing mechanism, yet the ATM electronic journal records that cash was dispensed during a withdrawal transaction. Hence, most times it is recommended that footage be used in addition to a journal to solve such problem and other related fraud cases.

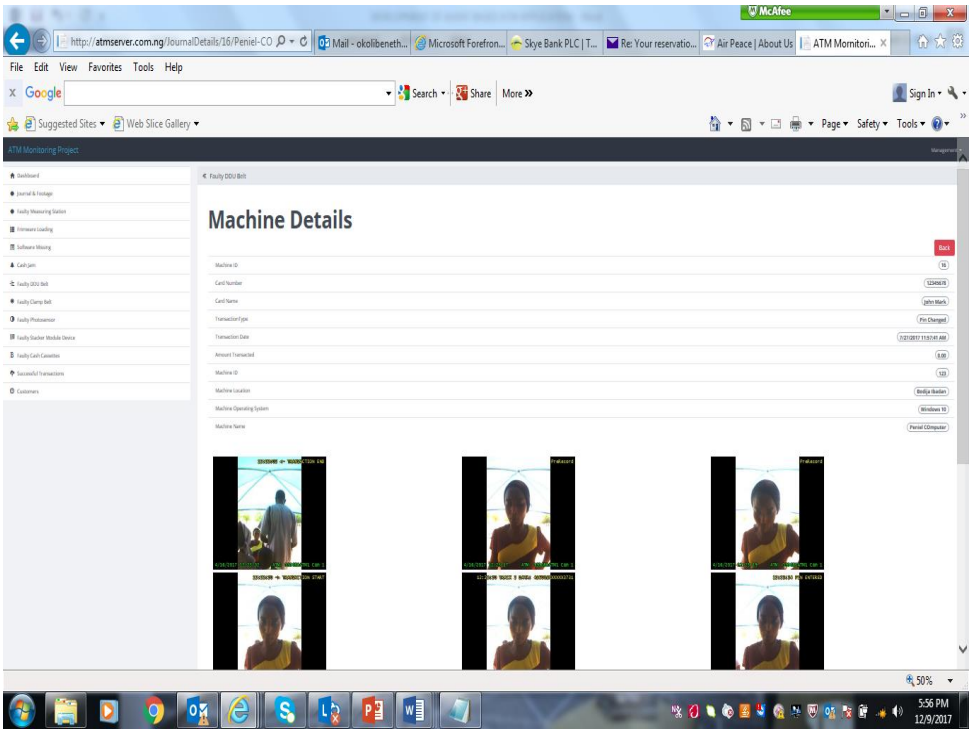

Figure 9: ATM Server Dashboard Journal and Footages.

4. Conclusion

The paper has presented a software designed to detect hardware malfunction of an ATM such as faulty measuring station, software missing, cash jam, faulty DDU belt, etc. It can perform database management and backup for journals and footages. This is necessary in order to check internal fraud by bank employees and other ATM users. The Journal contains all the transaction information done on the ATMs. It drops on the journal folder inside the hard drive in notepad format. The journal is used for reconciliation purpose once there is a retract case such as an ATM debits a customer without paying. Where available, footages which are snap shots (pictures) on customers during ATM transactions come in JPEG format and drops video archive folder on ATM hard drive. This is only a one level backup system.

The developed application is an improvement of this system by providing backups of Journals and Footages from the Hard Drive to an online server where it can be retrieved urgently if the ATM's hard drive fails. Thus, with this application which is the major contribution of this paper, a secondary backup for information retrieval in the case of system hard drive malfunction is possible. Most Banks that do not have backup system for their Journals and footages can be sanctioned by the regulating body when they are unable to produce required data needed for reconciliation purposes with an aggrieved customer after an ATM transaction. Such cost could be averted with the use of this application.

Based on the result obtained after the software was used on an ATM for test purposes, it is recommended for banks in the reconciliation of cash verification, journal records and footage uploading which are not obtainable with the present ATMs in Nigerian banks.

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