Original Research Article

Facility Management for Efficient Service Delivery in Federal Polytechnic Offa, Kwara State: A Technological Approach

Abstract

Facilities management (FM) is a function that adapts because of changing external environment. Priority Service Provider (PSP) is one method used by FM to deliver this change in strategy. There is an estimated 323 million PSP usage in over 70 countries out of over 550 billion industries worldwide. This research explored FM and the invention of Priority Service Provider PSP technology to facilitate customer problems in public and tertiary institutions. The study aimed to eradicate long queues and personal influence in delivering products and services in a remote environment. To achieve this, low-cost, portable microcontroller-based electronic queue control (EQC) systems have been developed to control queues with the parameter of Federal Polytechnic Offa campuses to identify dense population areas in tertiary institutions' service units. Two different queue control systems have been implemented with slightly different features. In system-1, a general display has been used for displaying token numbers and service counter numbers, whereas, in system-2, each token number is displayed individually in each service counter with separate displays. In both systems, each visitor has to collect a token and then will be served whenever the token number is displayed. Integrated Arduino UNO carried out the experimental study to create an artefact. The control programs have been developed using the Arduino C programming language. Finally, the systems have been tested under different conditions to evaluate their performance.

Keywords: Facilities management, modelling, Arduino UNO, Processing Unit

1.0 Introduction

Facility management is one of the professional approaches to achieving organizational goals and better service delivery, and it requires deploying technological devices to solve problems in a particularly human endeavour. If technology is deployed to create a first come, first serve using a priority checker in the remote environment, it will increase confidentiality and efficiency in servicing environment [1].

Many technologies were on the ground for monitoring events like CCTV, Metal detectors and temperature sensor devices. Still, there has not been used to solve the problem of long queues and priority services in Nigeria's organizations and other sectors of labour service. However, Nigerian populations suffered from equity and VIP services in difficult circumstances [2]. Developed countries like the USA, Canada, Australia, the UK, China and many more have successfully deployed technology subject to its better management for effective services. Investigations have shown that facilities available to aid services are not adequately provided and managed to give the expected satisfaction in most public service delivery units in Nigeria. For instance, students and applicants go through rigours and protocols in terms of payment of school fees, accessing hostel accommodation and hostel facilities, submission of kits, departmental regulated instructional manual and textbooks fees, withdrawal and deposit of funds in banks etc. [3].

This failure has formed long queues, especially at the entrances of some tertiary institutions and formidable banks/offices, to access service despite the internet made easy slogan. These problem-solving (FM and PSP) are the thrust of this research concerning public and tertiary establishment's service delivery [4].

As Facility Management is one of the professional approaches to achieving organizational goals and better service delivery, it also requires deploying technological devices to solve problems in all human endeavours. Facilities available to aid services are not adequately provided and managed to give the expected satisfaction in most public service delivery units.

For instance, students and applicants go through rigours and protocols in which others are favoured unnecessarily, in terms of payment of school fees, accessing hostel accommodation and hostel facilities, withdrawal and deposit of funds in banks etc. This failure has formed long queues, especially at the entrances of some formidable banks and offices despite the banking and internet made easy slogan [5]. Similarly, the increasing rural-urban problems and the population's growing demand share a common interest virtually. All the daily business activities have made it difficult to access public goods and services despite the ever-increasing technological and innovative public and private infrastructures.

Therefore, there is the need to eradicate the increasing human and road traffic experience by customers/clients accessing public goods and services by deploying a customer/client management tracking system in public buildings to improve overall service delivery. The facility management system, i.e. Priority Service Provider (PSP), would be adapted for frequently used to complement building security and access control systems [6]. It would be familiar with fluctuations in specific zones, evaluate and compare flow tendencies by path, and better analyze service performance to customers or visitors, as shown in figure 1. As electronic facility management systems are becoming more common and more powerful, these systems are taking over many of the functions of building security and access control [7].

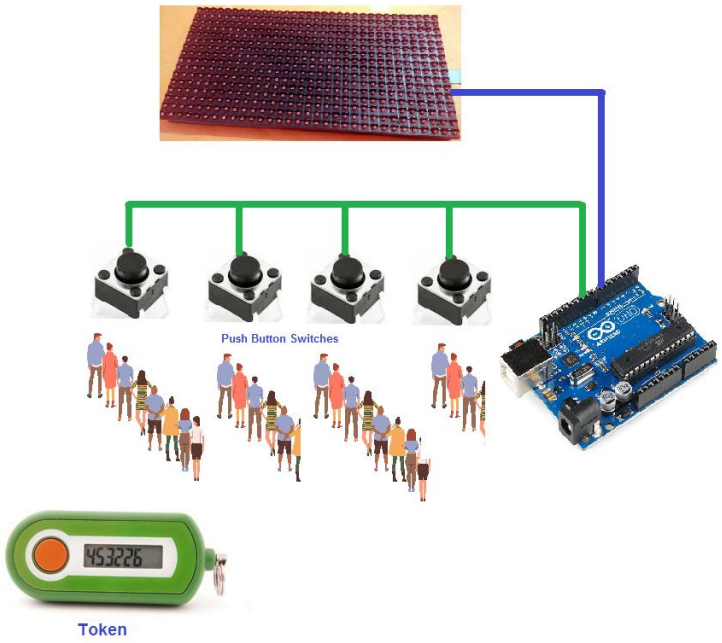


Fig 1, general conceptual view of queue management system

The study observed today's standard environment and realized the prevailing problem of everyday ethics in service delivery because ordinary Nigerians suffer to get what they want under common rights. Financial and tertiary institutions are environments where access to effective service delivery is challenging to address in terms of population on a common interest or services. It's inhumane for someone who came late first to gain access to facilities that always occur in natural environments like financial and tertiary institutions [8].

As a result, ordinary citizens' rights are deprived of the act of inconsistent service delivery. Meanwhile, effective service delivery is an integral part of the mission statement of virtually all public and private organizations. Thus, in a quest to provide adequate service delivery in

most public and tertiary organizations. Especially where the population demands services for payment and other transactions in schools, government establishments, private offices, agencies, corporate outfits etc. [9].

There are yet challenges like favouritism and long queues. This implies that Nigerian public and tertiary organizations are plagued with the habit known as 'service favouritism', which debar the masses from accessing the required services at the right time. Usually, services are expected to be delivered on a first-come, first-serve criterion (FCFSC). This favouritism is causing traffic and other problems [10].

There has been a quest to provide effective service delivery in most tertiary institutions in Nigeria, especially where the growing population demands services. These services are threatened with challenges of favouritism and long queues. This implies that Nigerian tertiary institutions are still plagued with the habit known as 'service favouritism', which debar the masses from accessing the required services at the right time [11]. This favouritism is causing traffic and other problems, such as dissatisfaction, unnecessary delay, armed robberies and thefts, disharmony, the threat of security, deaths and injuries, and waste of energy and time daily warrant the need to be solved.

In public areas, most especially tertiary institution sectors, customers, visitors/clients used to queue unnecessarily to gain access to facilities or services and queuing is frustrating. Unproductive use of the time of the person in the queue can be economically inefficient even for the enterprise concerned [12].

However, Objectively, eradicating problem queues in the public area is by incorporating a facility management system that will enable us to identify, track, manage and record the orderliness of students, visitors or customers in any establishment for an efficient response to service delivery in the sectors [13]. The system will efficiently manage large populations by segmenting them based on individual service requests. We shall invent vital tools (PSPs) for accurate and real-time traffic measurements at any public institution.

The design can be commercialized because it will offer automated means to manage human and material resources using a facility management system. We want our device to count and analyze customers' traffic in chain stores, tertiary institutions, shopping malls and other public environments [14]. The study is to develop a queuing algorithm for a wirelessly connected queue management system and design a microcontroller-based electronic system connecting the central controller and removing the call button for the queue management system.

2.0 Literature Review

Due to business transformation, global market expansion has enclosed the technology trend of queue management systems. The BLUE Active Queue Management Algorithms by Wu-chang Feng [14] establish that enterprise demands and supply for this technology from 2004 to 2010, unfolding in the Middle East, Asia and Africa, also spill over into the Europe market. With America's involvement, too, the world market is occupied because many companies producing and marketing queue management system has grown on a large scale reaching 3.5 million and now surging to 5 million customers in high demand worldwide [15].

In line with our technical contact with QTECH in the USA, Eyespy Security in Nigeria and other significant suppliers of queue Management systems in China and Canada have enabled our research team to make a feasibility study on Nigerian tertiary institutions' facilities for possible implementation [16].

To address the environmental impact of facility management, we have estimated the global usage of Electronic Facility Management for standards monitoring measures which are gaining wide acceptance as an essential part of physical security infrastructure. The scenario is applied to a mountainous United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site in northwest Yunnan Province. There is increasing concern about the potential impacts of unregulated tourist usage, access to private and public facilities in China, and many more [17]. Visitor Management is being adopted across the board in many industries, which include: Pharmaceutical and Healthcare facilities, Government agencies, Defense contractors, Food supply chain, Technology R&D centres and Manufacturing sites, Media and Communication companies, Chemical production sites, Utilities, Finance and Insurance corporate offices and many more. All have a common need to gain better visibility of their visitor traffic and queue algorithm through consistent registration and visitor policy enforcement procedures.

In Nigeria, Some private sector, i.e. First Bank Plc, MTN and a few others, has embarked on the queues management system to improve their service. Still, this technology has not been sustained due to maintenance and adaptability to Nigeria's environment. Many academic types of research or works are being published in different parts of the world and in Nigeria to compensate for service delivery in public sectors [18]. Still. They are interested in real-time implementation of this technology even if it warrants importing required components/ modules overseas and building/customizing new designs in Nigeria [19].

Global Situation;

Table 1: The World's leading Nations for Innovation and Technology on electronics facility management

Countries	Global Research &Development Investment	Scientific And Engineering Researchers Per Capita	Global research	Global Innovation
Israel	1st	N/A	5th	4th
Sweden	2nd	2nd	6th	5th
Finland	3rd	1st	4th	1st
Japan	4th	3rd	2nd	2nd
Switzerland	5th	10th	3rd	6th
U.S	6th	7th	1st	3rd
South Korea	7th	N/A	N/A	N/A
Germany	8th	N/A	7th	9th
Denmark	9th	5th	9th	7th
France	10th	N/A	N/A	N/A
Canada	13th	9th	8th	N/A
Russia	22nd	12th	34th	N/A
China	26th	39th	N/A	N/A
Brazil	31st	43rd	41st	N/A
India	38th	36th	26th	N/A
Singapore	N/A	4th	N/A	10th
Norway	N/A	6th	N/A	N/A
Australia	N/A	8th	N/A	N/A

Hong Kong	N/A	N/A	10th	N/A
Korea	N/A	N/A	N/A	8th

Source: CITYLAB (2011)

As established by CITYLAB [20] on the Leading World's Nations for Innovations and Technology, Israel was ranked 1st in global R & D investment, 5th in worldwide research and 4th in global innovation. Table 1 shows the ranking of investment, research, and technological innovation in electronics facility management in 20 countries. This indicates that Nigeria has not competed favourably with the global trend in technology invention and investment in this ongoing project. With the present administration's interest and intense efforts in technological transformation, Nigeria can also improve its technological advancement.

3.0 Methodology

Facilities Management infrastructures are conducted using a pilot survey and design science research. The result of information obtained through the survey is used to establish the population level and sample different access control on their facilities platform, including challenges of service delivery in the administrative unit campus of Federal Polytechnic Offa, Kwara State. The Federal Polytechnic Offa FEDPOFFA administrative unit of both mini and main campuses was selected as the primary target for deploying artefacts used for real-time data collection. The experience was repeated in the research domain using the PSP approach to determine if PSP in used satisfied the requirement to control the most highly populated campus areas.

The implementation is divided into two ways, hardware system and software. The system consists of modularised parts used to execute different functions that lead to the realisation of the PSP approach for the study.

3.1 FEDPOFFA Facilities Management System Architecture

Figure 2 illustrates the architecture of a Facilities management system that enables smooth administration within two campuses. It includes a few essential uses in the implementation: A microcontroller MCU for the central processing controller, a LED array module for display output in the form of a numeric figure, a toggling push button as an input signal and a token module to print the paper for the users.

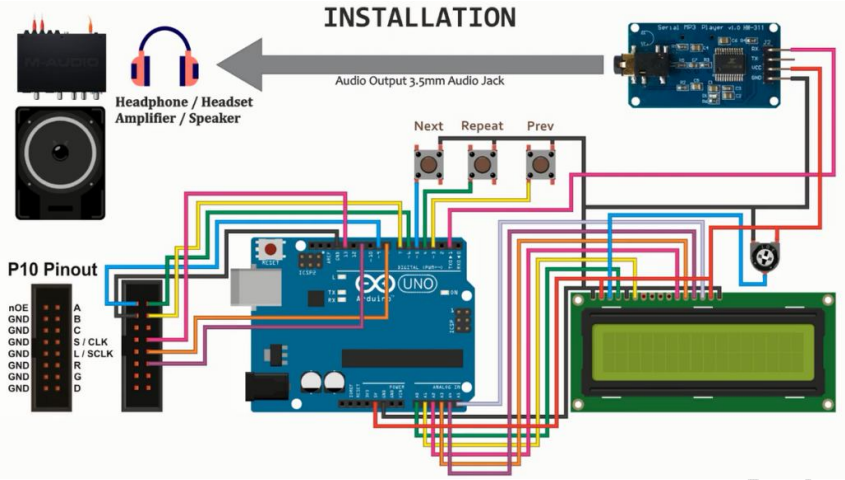


Fig 2: Architecture of Facilities management system

In this architectural design, the output display calls out the queue number to be served by displaying the called number on a P10 display panel. The counter desk that will serve the current student in the queue displays the queue number and calls the person next to serve. For the same FM system, the input was integrated with push buttons. The administrator setting on the desk office is positioned at the counter to respond to queue sequence. The student arriving at the administrative unit can request a queue number with a press button. The student receives the queue number from the phone number input in the GUI provided at the centre or sends a short code to the service number from any location to receive the queue number. The administration uses the FM system calling queue sequentially by pressing the push button from the stand.

The input and the output were communicating with each connected to the microcontroller. The programmed microcontroller can process data received from the input push button and the output signals from the output port of the microcontroller. At the same time, the LED array panel used in the implementation to the current number and the number they obtained. The connection between the input microcontroller P10 panel enables process data from the Arduino board to display and made visible to all views within the premises of the administrative unit. The counter function to send data calling for numbers is defined within the program and are shown in figure 2 below.

4.0 Research Method

This section describes the architecture of the proposed PSP artefact and its operational flow. However, each stage of the development of the PSP artefact is explained.

4.1 Proposed PSP system architecture

According to figure 1, shown below, the architecture of the proposed Facility management system is presented, and this contains modules and components which form the complete system. The composite PSP feature hardware and software application. The GUI-based of application deal with computer laptop or desktop. The GUI is configured serially with Arduino main board and communicates bi-directional with the Arduino UNO board, which serves as a central processing unit and typically referees to the system's main board.

The central processing unit interfaces with SIM900A GSM/GPRS module for data transmission and receiving SMS from the visitor. In the study, the push connects to the main board Arduino to perform the counter function to call the next person in the queue.

Figure 3 shows the operation flow of the FM when a new person arrives at the desk office for service. The new person enters the mobile phone from the GUI interface provided. The Arduino receives detailed information once the mobile number is submitted on the GUI page with a click button. Part information includes the FM number, current FMS number at the desk Office and the leftover person on the FM; alternatively, required a print-out ticket used in the conventional approach. Hence, SMS is generated and sent via SMS API and messaging system route over messaging service for a person with an android phone.

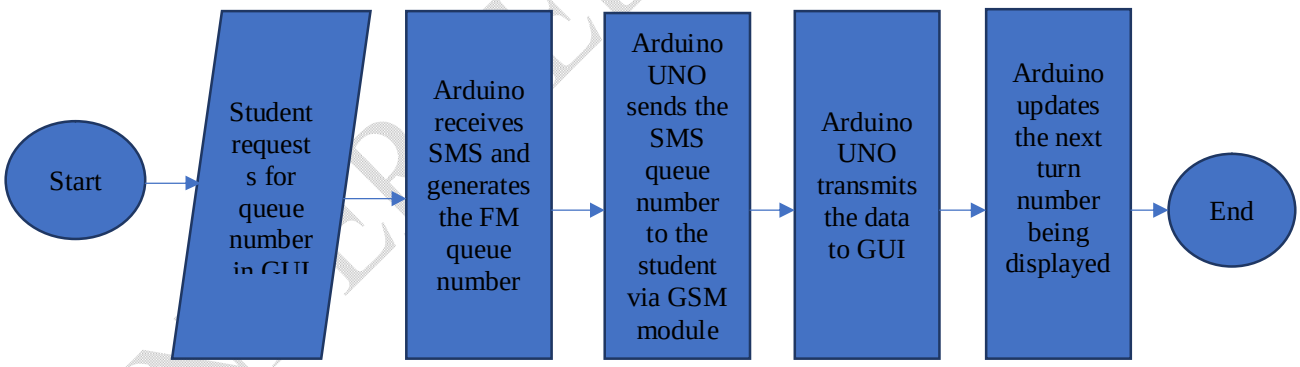


Fig 3: The FM Operational Flow Chart for Requesting SMS queue Remotely Via GSM Module

This process is shown in Figure 3. This feature is eligible for all students without pre-registration of their mobile phone numbers in the FM queue system.

Table 2 below contains a specific command to ay mp3 files with target files and folders, and each command is a selection when a push button is pressed.

[Play with folder and file name]	7E FF C6 0F 00 01 01 EF	Play the song with the directory
	7E FF 06 0F 00 01 02 EF	Play the song with the directory 01/002xxx.mp3

Table 2 : a specific command to ay mp3 files with target files and folders

Figure 4a briefly describes the playback code of the mp3 file with specific files and folders in the directory.

However, this project uses two folders inside the Micro SD Card as an illustration in fig 4a, and folder 01 contains two mp3 files (see fig 4b) named in serial order. To play mp3 files in the "01 Bell sound," the code is illustrated in the command method CMD sendCommand(CMD_PLAY_FOLDEER_FILE, 1,1); ……CMD 1

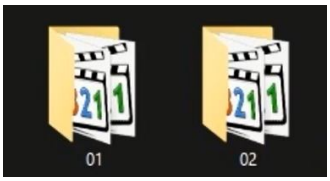


Fig 4a playback code of mp3 file with specific files and folders

Fig 4b : In the folder, two mp3 files named in serial order

Processing Unit

The FM of the system is presented by the complete setup of the Arduino board. The central processing unit controls most of its operations and functions. This function includes queue number processing requests from user GUI, creating an alert message and routing SMS

transmission. These functions were created from the coding stage in the Arduino compiler interface using C programming. The Arduino compiler contains setup () functions and loop(), which are the essential part of the programming sequence that follows;

1. readSerial() function, create a function that receives information sent by the user interface.
2. serial.println() function is a function used to send information to the user interface.
3. send_first_sms() function is used to create SMS and then transmit the SMS queue management to a designated person in need of service.
4. send_reminder_sms() function is the one that generates and then sends the SMS reminder to the selected quest.
5. send_queue_sms() function will receive and processes the SMS for the allotted queue number for remote request cases.
6. send_queue_alert() function will create an alert or notification to the person nearby the allotted queue number

5. Test, Results and Discussions

Functionality testing has been carried out from the campus unit to verify that the system functions correctly according to the design specification. Several test cases have been created to affirm the effectiveness of the queue system within the school facility. However, the test results are observed and analyzed within the parameter.

5.1 Tests

Figure 5a shows the hardware setup to perform tests. The P10 Module is serially connected to the Arduino UNO board, where the LCD x 16 character module is connected to the Arduino UNO to receive data and display it on the screen. The GSM Module is serially connected to the Arduino UNO board. At the same time, the Audio module is interfaced with the Arduino board to produce an audio signal in contact with the female plug audio jack. The Arduino UNO board is connected to the user interface on the PC via a USB port. Hence, a push button is connected as the input for the Arduino UNO via PIN 8. All connection is checked to avoid possible signal failure before performing the tests, and several test cases were created during the demonstration; thus, all possible scenarios will be covered and verified. The following steps need to be confirmed:

a. Launching the Graphic User Interface application
b. SMS Ticket transmission to new customers
c. SMS Reminder transmission to upcoming customers to be served at the counter
d. Processing remote requests for SMS Ticket

5.2. Results

Figure 5b,c shows the system's GUI after being launched on the computer. In the GUI, customers should see a textbox for entering the mobile phone number and the queue information, such as the queue number currently being served at the counter and the next queue number to be issued. New customers need to enter their mobile phone numbers in this GUI and press Enter. The Reset button at the bottom left of the GUI is used to clear the textbox.

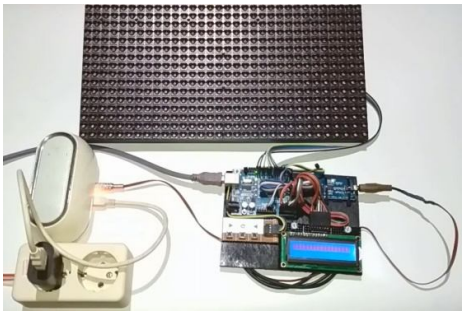
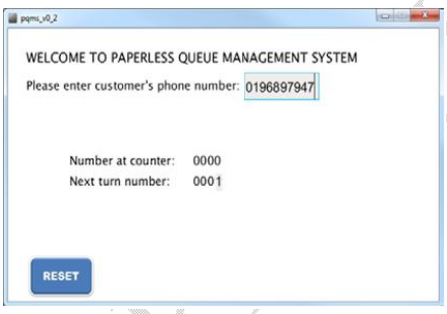


Fig 5a : Set-up of FMS



5b : Set-up of FM test on new student arrival

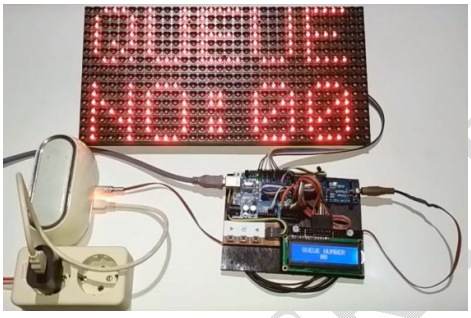


Fig 5c: Reset state of FM

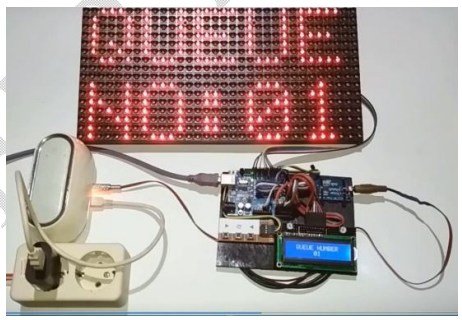


Fig 5d: FM Counting State

The experimental test is limited to queue numbers to range from o0 to 60 (see fig 5c-d) and scales up to take numbers from100, 200, 300 and so on. Figure 6a reviews when the button is short-pressed to display the next queue number. Long press to display e next queue number on FM; the queue number will continue forward until the button is released. In fig 6b, short press to repeat calling the queue number and long press to return the queue number to 0. Fig 6c describes a short press to display the last queue number, while a Long press to display the last number queue to 0, the queue number will continue backwards until the button is released.

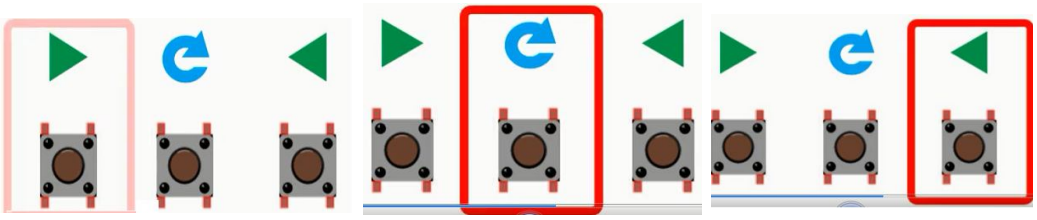


Figure 6a Figure 6b Fig 6c

Figures 6(a-c) : different working capability of button for Long press and short-press

The composition of Materials used for this study includes Arduino UNO, Serial MP3 player module, P10 Panel, LCD 16x2, Headphone/Headset/Amplifier/Speaker and Button /Push Button. P10 is one type of Dot Matrix Display used in the Arduino / microcontroller experimental study. Some studies related to running text, scoreboards, billboards and so on. This study's central idea is to make a display counter that operates using wireless RF remote control.

6. Recommendations

In the study, there are rooms for improvement which can be done on the proposed FM. For instance, to improve its efficiency, it should be deployed in the database server to support many users in need of service. Storage types like databases should be used to store data to allow more space to run in the long run. This study will be a significant advantage in the case of a power outage in the working environment and, thus, will prevent loss of data in the case when the system reboot.

7. Conclusion

This study has described the implementation of facility management in the citadel of learning (Federal Polytechnic Offa) precisely on an Arduino UNO board. The proposed FM system used the PSP approach, which replaced the conventional paper method used on campus. In addition, it creates awareness within the service provider's premises. Furthermore, it also provides additional features such as SMS Reminder generation, notification on arrival of the enrolled guest close by and the ability to process remote FM number requests via SMS, which gives efficient carrying capacity for more FM. The test results demonstrated significant performance in all functionalities in the system, where all the possible cases use are tested and verified correctly. However, this study of FM with the use of the PSP approach demand further improvement to make the FM more useful and increases its reliability effectively. The phase of the study is identified to solve the immediate problem in the

administrative unit of Federal Polytechnic Offa, which may contribute to making green technology and maximizing the administrative' satisfaction of students on campus.

This study is a small step toward easing working administration premises on the FEDPOFFA campus. The study could easily overcome the headache of waiting for one's turn to come in a long queue and eradicate procedural methods in the form of favouritism in the system. The priority check is identity to provide administrative service based on a first-come, first-serve approach. Mobile phones gave a new dimension to the remote access mode of the communication system, coupled with an alert system to help track participants' arrival.

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