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A WEB-BASED SCHOOL IDENTIFICATION AND ATTENDANCE SYSTEM

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ABSTRACT

One of the many challenges facing schools today is accurate identification and clearance of persons who brings a pupil to school in the morning and/or takes a pupil from school after closing hours. Nowadays there are several threats to pupils in the schools such as intruders, kidnappers and a known person to a pupil, who deceived parent of the child to be out-of-town. Nevertheless, in developing countries, most schools still depend on manual security and attendance system that is not 100% secured because of inevitable human errors. In this paper, a web-based school identification and attendance system using QR code was developed. The system was designed using UML diagrams and implemented using JavaScript, Cascading Style Sheet, and HTML5 in Microsoft Visual Studio Code for the frontend, and PHP and MySQL relational database management system for the backend. The system was tested/validated severally using arbitrary information, which shows that it was user-friendly, reliable, has fast response time and secured.

Keywords: School pupil, identification, attendance, clearance, quick response code, web-based.

1.0 INTRODUCTION

Intuitively, schools need to provide a safe and secure environment for all their students and staff. Over the past few decades, schools have been implementing new technologies to both improve student achievement and streamline operations. Smart boards, laptops and real-time internet resources are just a part of a student's everyday experience [1]. However, in this 21st century, schools face a countless number of problems never encountered in previous decades due to advancement in technology e.g., security challenges. Security has become a significant concern.

It is imperative on school administrators to know who is in their schools and where the students are at all times. Accurate and auditable attendance and reporting is vital in not only securing, but also maintaining essential governmental funding [2]. Accurate identification and tracking of students is now critical in all aspects of the day-to-day management and administration of schools. Schools cannot afford to ignore the threat of crime, as assaults on pupils and teachers in schools are increasing in number, which only not the assailant on pupils of the school or a parent, but also incidents of intruders entering schools and attacking staff or children and the bad people picking up the pupils on the school premises. While such incidents are still uncommon, the consequences to those involved can be devastating. To this end, the safety of pupils in schools should be the utmost priority objective to achieve.

From the aforementioned reasons, in this paper, Quick Response Code (QR code for short) is employed to identify each pupil and the person who brought him/her to or pick him/her from school. In addition, it serves as attendance and clearance for each pupil, implicitly. This is because QR code has fast readability and greater storage capacity as compared to other bar codes [3]. A QR code consists of white background with black squares organized in a square grid on it (as shown in Figure 1), which can be read by an imaging device such as a camera, and processed using Reed-Solomon error correction, till

the image can be appropriately interpreted [1]. Using QR code for identification of pupil and their guardian, as well as taking attendance, not only help limit the incidences of missing of pupils from school, but also keep records of the total number of pupils in school per day. In addition, it will help limit the parent worries over their children arrival at school in the morning, and departure from school after closing hours, as well as identifying the person who brings the child or takes the child from school via sending an email to the parent each time the QR code is scanned, indicating time of arrival and departure of the pupil, respectively.

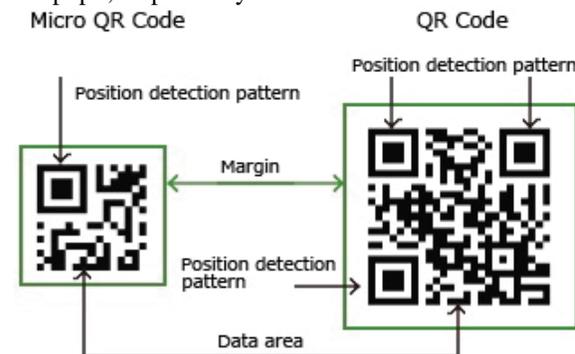


Figure 1. Micro and regular QR Codes

The contribution of this paper is twofold. First, we propose web-based school identification and attendance (SIA) system using QR code for identifying and preventing illegal guardians into the school premises for collecting pupils. Second, we implement and validate the QR code based SIA system using smart-phone and webcam.

The rest of this paper is organized as follows. In section 2, we discuss the related work. Section 3 describes the SIA system and the method used to develop it. In section 4, we demonstrate the results obtained by performing experiments in simulation. Lastly, we present concluding remarks in section 5.

2.0 RELATED WORK

Subramaniam *et al.*, [4] proposed bar Code Scanner Based Student Attendance System (SAS) to replace the manual attendance record system with the bar code scanner technology in order to record and regulate the student attendance records more efficiently and effectively. According to the authors, In the bar code scanner technology, each student will be given a student card for each of them with the bar code displayed on the card for a scanning purpose every time he/she attend a classes.

A student attendance status will be recorded into the system once a lecturer scans a student card with bar code scanner automatically. This shows that the attendance system using bar code scanner technology is much better than the traditional attendance system in school as a lecturer just requires to scan the bar code on the student cards as a prove that the student attended the class. More so, the system allows the administrator to generate warning letter if a student does not meet the attendance requirements, however, the generated warning letters will be given to each default student for onward delivery to his/her parent without giving a short message service (SMS) or email to the parent. Therefore, there is every possibility that some students may throw away the letter without handing it over to their parents. Since the letter is not a good news on their part.

Arulogun, *et al.* [5] proposed RFID – Based Student Attendance Management System. The Radio frequency identification (RFID) technology system in this application area is to observe the presence and absence of the student data to be transmitted wirelessly by mobile device, called a tag, which is read by an RFID reader and processed according to the programmed instruction on the personal computer (PC). The RFID reader will automatically observe the student attendance and record it while the RFID card get closer to the RFID reader, which means it is using the non-contact type of reader and passive types of card. However, the system cannot identify non-members of that class or course instantly.

Fadi and Nael [6] proposed student attendance system based on QR code using smart phones to fast track the process of taking attendance by University instructor. The system requires a simple login procedure by the class instructor through its Server Module to create an encoded QR code with exact information. This can be done at any time before the class. During the class, or at its beginning, the instructor displays an encoded QR code to the students.

The students can then scan the revealed QR code using the system Mobile Module, provided to them through the smart phone market by the university. Along with the student's facial image taken by the mobile application at the time of the scan, the Mobile Module will then communicate the information collected to the Server Module to confirm attendance. The proposed system allows fraud detection based on the GPS locations as well as the facial images taken for each student. However, precious time is being lost during the period, instead of the lecturer to lecture the student they tend to use the period to take their attendance.

Masalha and Hirzallah [1] proposes a system in which fingerprint verification is done by using extraction

of minutiae technique and the system that automates the whole process of taking attendance. Since biometrics are concerned with the measurements of unique human physiological or behavioral characteristics, the technology has been used to verify the identity of users. It is becoming critical to be able to monitor the presence of the authenticated user throughout a session. The authors discuss a prototype system that uses facial recognition technology to monitor authenticated user or students. A neural network-based algorithm was implemented to carry out face detection, and an Eigen face method was employed to perform facial recognition. The experimental results demonstrate the feasibility of near-real-time continuous user verification for high-level security information systems.

Liao and Lee [7] observed that user authentication is one of the fundamental procedures to ensure secure communications and share system resources over an insecure public network channel. Thus, a simple and efficient authentication mechanism is required for securing the network system in the real environment. Nevertheless, in general, the password-based authentication mechanism provides the basic capability to prevent unauthorized access. Especially, the purpose of the one-time password is to make it more difficult to gain unauthorized access to restricted resources. Instead of using the password file as conventional authentication systems, many researchers have devoted to implement various one-time password schemes using smart cards, time-synchronized token or short message service in order to reduce the risk of tampering and maintenance cost. However, these schemes are impractical because of the far from ubiquitous hardware devices or the infrastructure requirements.

To remediate these weaknesses, the attraction of the QR-code technique can be introduced into our one-time password authentication protocol. Not the same as before, the proposed scheme based on QR code not only eliminates the usage of the password verification table, but also is a cost effective solution since most internet users already have mobile phones. For this reason, instead of carrying around a separate hardware token for each security domain, the superiority of handiness benefit from the mobile phone makes our approach more practical and convenient.

3.0 SCHOOL IDENTIFICATION AND ATTENDANCE SYSTEM

The proposed SIA system using QR code is a web-based application, which is resourceful to enhance pupil's identification and attendance in an effective and reliable manner for the school. The SIA system involves two parties: Pupil and Duty Staff (or Security personnel). On one hand, every registered student must have an Identity (ID) card. On the other hand, a web camera can be attached to Desktop Computer Systems while often; it is embedded in Laptop Computers. Therefore, QR code image can be embedded in an ID card, which Duty staff can scan using the web camera to verify and identify each

student daily. The architecture of the proposed system is shown in Figure 2.

In other words, at the beginning of each academic session, the new pupils will be registered on the system and their information saved into the database. Similarly, any changes to information of returning pupils will be updated accordingly. After registration, a unique admission number will be assigned to each newly registered pupil. This admission number will be used to generate a unique QR code to be integrated on the pupil's identity (ID) card. Whenever, a pupil arrived at the school gate in the morning, the pupil's ID card is scan for identification and attendance. Similarly, when the pupil is about to leave the school premises after the school closing hours each day the ID card is again scan for clearance. Each time the process is performed an SMS and/or email is sent to the parent of the pupil indicating that the pupil got to or left the school safely and the time of arrival or departure will also be indicated on the message. The following subsections describe the steps adopted to develop SIA system.

3.1 Requirement Definition

The requirement definition for the proposed SIA system consist of two parts. These include functional and non-functional requirements.

- 1) *Functional requirements* specify SIA system behavior or its functions, which are as follows:
 - It can validate and display pupil's information when required.
 - It can scan and verify QR code embedded in the pupil's ID card.
 - It can generate a unique QR code per pupil.
 - It can send an email and/or short message service (SMS) notification to pupil's parent or guardian.
- 2) *Non-Functional requirements* specify criteria that can be used to judge the operation of an SIA system, rather than its specific behaviours, which are as follows:
 - The SIA system is user friendly.
 - The SIA system is secured.
 - The SIA system is reliable.
 - The SIA system has fast response time.

3.2 The SIA System Architecture

The SIA System was designed based on MVC (Model, View, and Controller) model as shown in Figure 2. The Model part of the MVC provides an interface for manipulating the database, in which each table is represented with a model for manipulating it. The Controller part of the MVC handles all the application logic, it communicates with both model and view parts. The view of MVC is the User interface with which the system users interact.

For this purpose, the SPIA system is divided into two phases (see Figure 3): registration and verification. In the first phase, personal details of each newly enrolled pupil and his/her parents and guardian/helper is registered. While in the second phase, Duty staff and/or security personnel verify each pupil and his/her parent/guardian/helper.

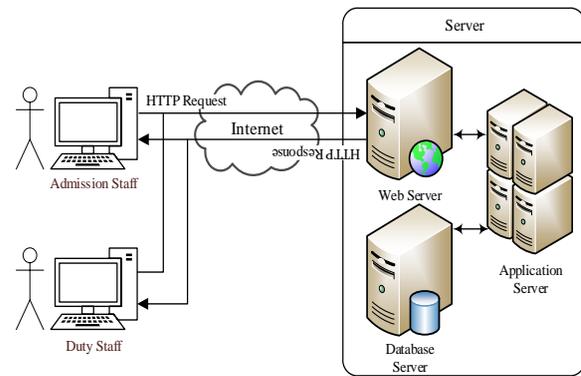


Figure 2. System architecture

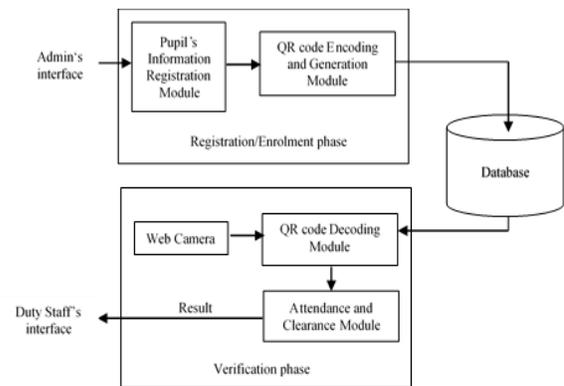


Figure 3. SIA system detail view

3.2.1 Registration phase

This phase, also known as enrolment phase, is where pupil's profile is being created and it is further divided into two modules: pupil's information Registration module and QR code encoding and generation module. Each of these modules are described as follows:

- 1) The *pupil's information registration module* is an interface where the Admission staff starts the system to login and if successful, he/she is able to register the pupils, otherwise, it goes back to the login page (see illustration of the process in Figure 4). For each newly enrolled pupil, the following information is collected and saved into database: the child's details and two persons' names, passports of the trio, addresses, e-mail addresses (if any) and phone numbers of the parent or guardian/helper; one of whom at least is the parent or guardian. For each term, until further notice in contrary these persons are those officially recognized by the school management to be responsible for bringing to and/or picking the child from the school daily. Whenever a different person brings the child to school in the morning, the child will not be accepted until the parents are contacted. Similarly, when a different person come to pick the child from the school such a person will not be allowed until the parents are contacted. Therefore, for exceptional situations, the parents must notify the school management in time with details of their representative.

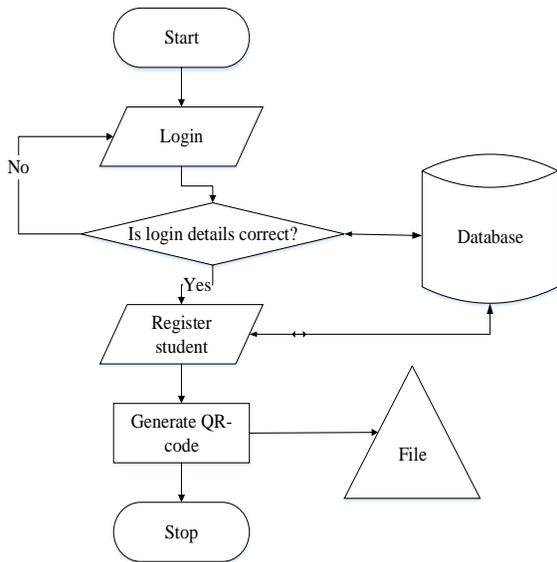


Figure 4. Registration phase flowchart

2) *QR encoding and generation module* is an interface where after registration, the admission number issued to the newly registered pupil is used to encode and generate a unique QR code (as shown in Figure 5). This is done once throughout his/her studentship in the school. This QR code saved in a file as shown in Figure 4 will be embedded on the student’s ID card. This is because the admission number for each student does not change throughout his/her studentship in the school.

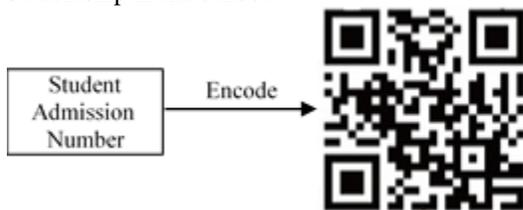


Figure 5. QR code encoding and generation

The sequence of interactions among the entities of the SPIA system during the registration/enrollment of a new pupil is illustrated in Figure 6.

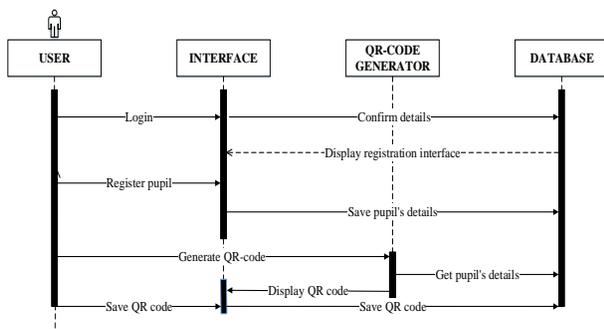


Figure 6. Sequence diagram for Registration phase

3.2.2 Verification phase

At this stage, every student’s identity is being verified with respect to the person responsible for bringing to and/or picking the child from the school daily. This is further divided into the following modules: QR

code decoding, attendance and clearance, and database update modules.

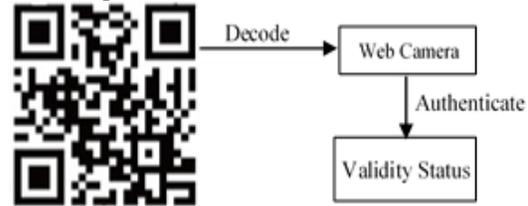


Figure 7. QR code decoding and authentication

1) *QR code decoding module* is an interface where a session of the day (i.e. morning attendance or afternoon clearance) for which a student is to be examined is selected and then identification of the parent/guardian is verified. The ID card of each student is scanned using web camera and SIA system displays the validity status (see Figure 7). The entry scanning represents morning attendance and the exit scanning after school closing hours signifies clearance.

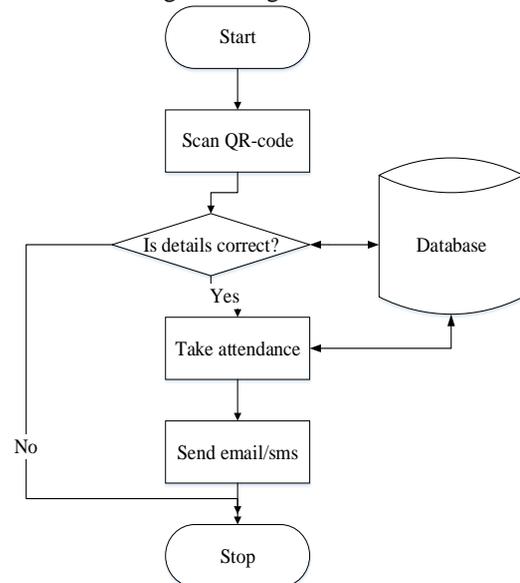


Figure 8. Attendance submodule flowchart

2) *Attendance submodule*: In this submodule, the Duty staff use the system to scan the QR code on the pupil’s ID card and check if it is the registered parent or guardian that brought the pupil to the school. If the QR code is validated correctly, then attendance is taken and an email/SMS is sent to the parent of the pupil. Otherwise, the school management is alerted and the parent of the pupil is contacted for explanations. This process is illustrated in Figure 8.

3) *Clearance submodule*: In this submodule, the Duty staff use the system to scan the QR code on the pupil’s ID card and check if it is the registered parent or guardian that came to pick the child from the school. If the QR code is validated correctly, then the pupil is cleared to leave the school for that day and an email/SMS is sent to the parent of the pupil (see Figure 9).

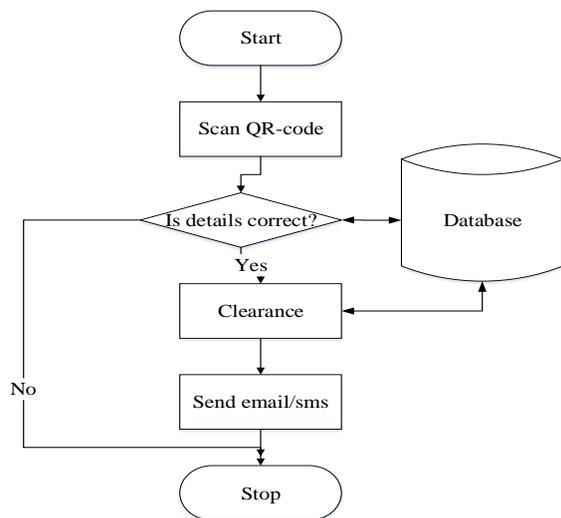


Figure 9. Clearance submodule flowchart

Otherwise, the pupil is not cleared to leave for that day, and the school management is alerted and the parent of the pupil is contacted for explanations.

- 4) *Database update module* is a storage where all the information of all the students is stored. Furthermore, a log file is being created here that keeps track of morning attendance and afternoon clearance for each pupil including details such as full name, admission number., class, time and session. This can be printed out as daily attendance list for record purpose in Headmaster’s office and to Class Teachers.

3.3 Database Structure

The structure of the database for the SIA system is shown in Table 1.

Table.1: Structure of Database

S/No.	Field_Name	Data_Type	Size
1.	admission_number	Varchar	255
2.	first_name	Varchar	255
3.	mid_name	Varchar	255
4.	Surname	Varchar	255
5.	Class	Varchar	50
6.	Gender	Varchar	100
7.	Religion	Varchar	50
8.	residential_address	Varchar	500
9.	contact_address	Varchar	500
10.	date_of_reg	Date	
11.	father_name	Varchar	255
12.	father_phone_number	Int	15
13.	father_phone_number_2	Int	15
14.	father_email	Varchar	30
15.	mother_name	Varchar	255
16.	mother_phone_number	Int	15
17.	mother_phone_number_2	Int	15
18.	mother_email	Varchar	30
19.	guardian_name	Varchar	255
20.	guardian_phone_number	Int	15
21.	guardian_phone_number_2	Int	15
22.	guardian_email	Varchar	50

4.0 SYSTEM IMPLEMENTATION

We implemented the front-end of SIA system using JavaScript, Cascading Style Sheet and HTML5 in Microsoft Visual Studio Code and the back-end was implemented using PHP and MySQL relational database management system. Chrome was used as a browser not only because is an open source program for accessing the World Wide Web and running Web-based applications but also available for Windows, Mac OS X, Linux, Android and iOS operating systems. Furthermore, it is remarkably fast and manages a level of simplicity, which other internet browsers lack. Therefore, some menu description, results and discussions are as follow.

4.1 Description of the system interfaces

- 1) *New pupil registration/enrollment page* allows the Admission staff to register newly enrolled pupil on the SPIA system. The page provides the fields for pupil’s information, and information about two persons responsible for bringing to and taking the pupil from the school daily as described earlier (see Figure 10).

Figure 10. New pupil registration/enrollment page

- 2) *Pupil’s profile page* displays information of a successfully registered student including the generated QR code image. Therefore, this

information can now be embedded onto the pupil's identity card for subsequent verification and clearance (see Figure 11).

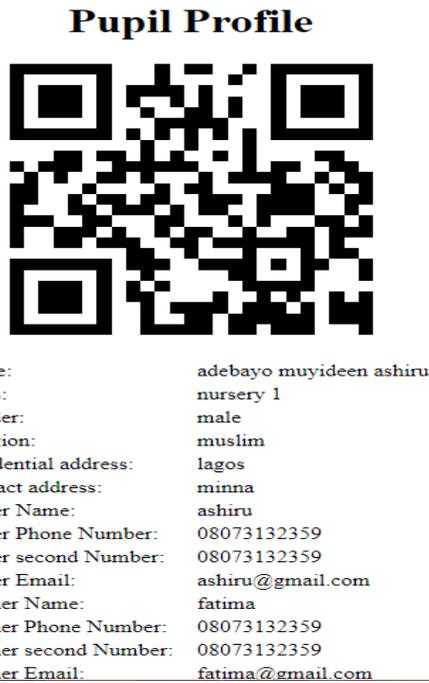


Figure 11. Pupil's profile page

- 3) *Morning attendance page* shows the QR code scanner at the center where the QR code on the ID card is captured, the images of the two persons recognized by the school management as contained in the pupil's profile, the admission number of the pupil and a send button for email/SMS notification. The Duty staff will select the person that brings the child to school before sending notification. The email/SMS notification contains the name of the person that brings the child to school and the time of arrival (see Figure 12).

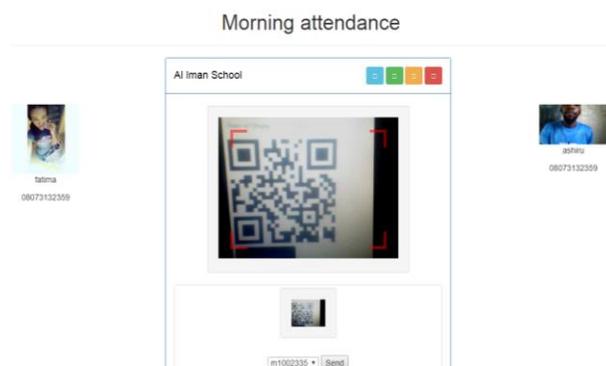


Figure 12. Morning attendance page

- 4) *Afternoon clearance page* shows the QR code scanner at the center where the QR code on the ID card is captured, the images of the two persons recognized by the school management as contained in the pupil's profile, the admission number of the pupil and a send button for email/SMS notification. The Duty staff will select the person that came to pick the child from school before sending notification. The email/SMS notification contains the name of the

person that picks the child from the school and the time of clearance (Figure 13).

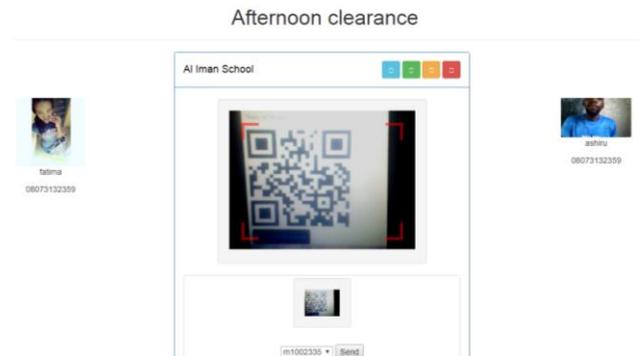


Figure 13. Afternoon clearance page

5.0 CONCLUSION

In this paper, a web-based school identification and attendance system was proposed to identify illegal parent, guardian or helper who comes to schools to pick children after closing hours. This was achieved using quick response code due to its attractive features such as large capacity, small printout size, high-speed scan and damage resistance. Therefore, if a person that is not registered as either a parent, guardian or helper to a child in a term appears at the verification center, the SIA system will identify him/her as not the right person to bring or pick that child, accordingly.

Furthermore, the SIA system create a log file that keeps track of daily attendance for each pupil. To demonstrate the implementation of SIA system smart-phone was used to scan the generated QR code image, which took 4 seconds to authenticate and verify identity of a parent. This shows that 300 students can be verified in 20 minutes. Finally, smartphone can be employed to check for identity conveniently, as pupils queue up together with their parents for entry to or exit from the school premise, thus leveraging ubiquitous devices that support mobility.

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