Enhancement of QR code Student's Attendance Management System using GPS

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Abstract: *Attendance used in universities as a category to award marks to students, so attendance has always been a topic of debate. This paper shows a methodology based on QR code technique to take attendance which automates the complete process and the attendance is marked as well as stored in the database, when required professor can check the attendance by calling the values from the database. The introduced system in this paper is being displayed for students during or at the beginning of each lecture. The students will need to scan the code in order to confirm their attendance. The paper explains the high level implementation details of the proposed system and enhancement of the accuracy using the GPS technology. It also discusses how the system verifies student identity to eliminate false registrations. The system also generates and updates daily student's attendance record, so we can extract analyzed reports for Lectures/Labs/Tutorials attendance for students which can improve the educational environment process.*

Keywords: *Educational Attendance Systems, QR code, GPS.*

I.   Introduction

Regular attendance in all classes at university is essential to improving academic achievement. Also it is necessary to determine how the learning process and attendance of university affect personal characteristics of students: their professionalism, willingness to work, depth of knowledge, and a total success in the future profession [1], [5]. Taking students' attendance by university instructors during each class is a time-consuming process especially when classes are big. Some faculty policies require this task to be performed by the instructor in each lecture. That will lead to loose not less than ten minutes per lecture [6], [16], and [17].

QR code Attendance Management System is a combination of two applications one is Mobile application and the other is Desktop application for taking and storing the attendance of the students on the daily basis in the faculty. Here the Instructor, who is handling the subjects, will be responsible to generate the QR code of the subject. Each student will get a free mobile application that is used for taking attendance by him. The main objective of the automated attendance system is to computerize the traditional way of recording attendance and provide an efficient and automated method to track attendance in institutions [2].

Using the QR code attendance system gives advanced features like: Providing better security, Maintenance of the system become easy and cost effective, Generating quick statistical results, Providing accurate and efficient data, and the system will be user friendly [19].

II.   Related Approaches/Work

There are many proposals for Automatic Attendance Systems in the literature and in the market. Most of them do focus on applications to be installed on the lecturer device, whether a smartphone or a laptop [3].

Approach 1: Software to be installed in the instructor's mobile telephone. It enables it to query students' mobile telephone via Bluetooth connection and, through transfer of students' mobile telephones' Media Access Control (MAC) addresses to the instructor's mobile telephone; presence of the student can be confirmed.

Approach 2: Using real time face detection algorithms integrated on an existing Learning Management System (LMS). It automatically detects and registers students attending on a lecture. The system represents a supplemental tool for instructors, combining algorithms used in machine learning with adaptive methods used to track facial changes during a longer period of time.

Approach 3: Using fingerprint verification technique. The 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 is 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.

In most proposals, applications being used by the instructor during class. Hence, if the attendance system requires some action from the instructor, then the class time will be disturbed each time the instructor allows some late students into the class. In classical method where attendance register is used both student's as well as professor's time is consumed in taking attendance [17], and [18].

On the other hand, our proposal does require the instructor to do nothing extra beyond presenting the slides of the course to the students. Hence, students may register their presence at any time they wish during the class, while having in mind that registration times are recorded [20].

III. QR Code

Is a machine-readable code consisting of an array of black and white squares, typically used for storing URLs or other information for reading by the camera on a smartphone. Figure 1 shows the QR code generated design [7].

Fig. 1 QR Code design

3.1 Types of QR Code
- Micro QR Code

Micro QR code is a smaller version of the QR code standard for applications where symbol size is limited and can hold 35 numeric characters. Figure 2 shows the Micro QR code generated design [8].
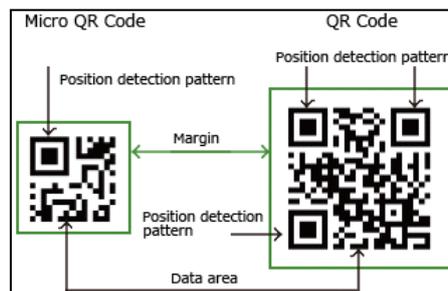
Fig. 2 Micro QR Code

- iQR Code

iQR codes can be created in alternative to square or rectangular formations. This is intended for situations where a rectangular barcode would otherwise be more appropriate, such as cylindrical objects. Figure 3 shows the iQR code generated design [9].
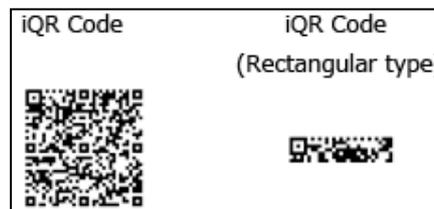
Fig. 3 iQR Code

- SQRC Code

Secure Quick Response Code (SQRC) is a type of QR code that contains a "private data". This can be used to store private information and to manage company's internal information. Figure 4 shows the SQRC Code generated design [10], and [11].
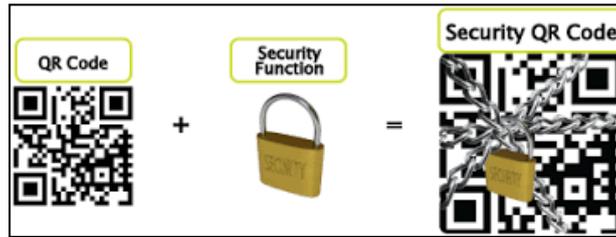
Fig. 4 SQRC Code

3.2 QR Code Applications

- Mobile operating systems

QR codes can be used on various mobile device operating systems. These devices support URL redirection ,which allows QR codes to send metadata to existing applications on the device. Many paid or free apps are available with the ability to scan the codes and hard-link to an external URL.

- URLs

URLs aided marketing conversion rates even in the pre-smartphone URLs aided marketing conversion rates even in the pre-smartphone era, but during those years faced several limitations: ad viewers usually had to type the URL and often did not have a web browser in front of them when they first viewed the ad.

- Virtual stores

The use of QR codes for "virtual store" formats started in South Korea, and Argentina, but is currently expanding globally. Walmart, Procter & Gamble and Woolworths have already adopted the Virtual Store concept.

- Payment

QR codes can be used to store bank account information or credit card information, or they can be specifically designed to work with particular payment provider applications. QR codes are commonly used in Bitcoin.

- Website login

QR codes can be used to log into websites: a QR code is shown on the login page on a computer screen, and when a registered user scans it with a verified smartphone, they will automatically be logged in.

- Video games

Popular video games, such as Fez, The Talos Principle, and Watch Dogs, have incorporated QR codes as story and/or gameplay elements.

- Business card

With these business card QR Codes, a contact card with the details you entered will be automatically stored into the contact list of the smartphone. You can enter your names, address, phone number, email and so on.

- Wireless Network

You can create QR Codes that contain wireless network credentials. After scanning, smartphones will connect automatically!

- Send an SMS

Save the content and the recipient's phone number of an SMS. After scanning, you will only have to confirm before sending it.

- Send an email

This works exactly like the SMS QR Code type. Only this time, you enter the email content, the subject and the recipients to enable sending after scanning.

- Call a phone number

Type in a phone number when you create the QR Code. When scanning, users will be proposed to call the phone number.

- Add an event to a calendar

After scanning these QR Codes, you will be asked if you want to save the event in your smartphone's calendar. By adding the event to your calendar, you will be reminded of the correct date.

- Geolocation

When creating these QR Codes, you enter the latitude and longitude coordinates of a location. By scanning them, users will be able to find the location on their favorite geolocation application.

- Plain text

This is the simplest QR Code type. A raw text is encoded and will be displayed on the screen after scanning. You can write anything you like.

- Dynamic QR Code

This new QR Code type is available with the Live plan Live. Since it sends users to a webpage it is very similar to the website type or business card, but it offers new useful features.

- Analytics tracking

Get real time analytics like the volume of scans, the smartphones used, geolocation and time of scan to see where and when your QR Codes were the most scanned.

- Editable URL

Change the website which your QR Code redirects to anytime you want. This is particularly useful if you want to start printing without having the related website or if you want a dynamic marketing campaign.

- OS-based redirection

Apply a different content to your customers depending on their smartphone model or language. This is particularly useful for developers who have an application that can be downloaded for different platforms via a single QR Code or worldwide QR Codes.

IV. GPS

Currently, Global Navigation Satellite Systems, (GNSS) receivers are becoming more and more sensitive due to ceaseless progress in chip technology and processing power. High Sensitivity GNSS receivers are able to receive satellite signals in most indoor environments and attempts to determine the 3D position indoors have been successful [30]. Besides increasing the sensitivity of the receivers, the technique of A-GPS can be used, where the almanac and other information are transferred through a mobile phone. Furthermore, as smart phones embrace always-on, ubiquitous location, location-based sensor fusion will become a standard feature [31].

V. Design diagrams

In the introduced research the QR code technology will be used in a simple way to figure out who attended the lecture\lab\Tutorial by a system without any required external devices. The Instructor just connect the QR code to the presented slides for the lecture then students just scan it to make sure that they are attended. Figure 5 shows the component diagram for the introduced system.
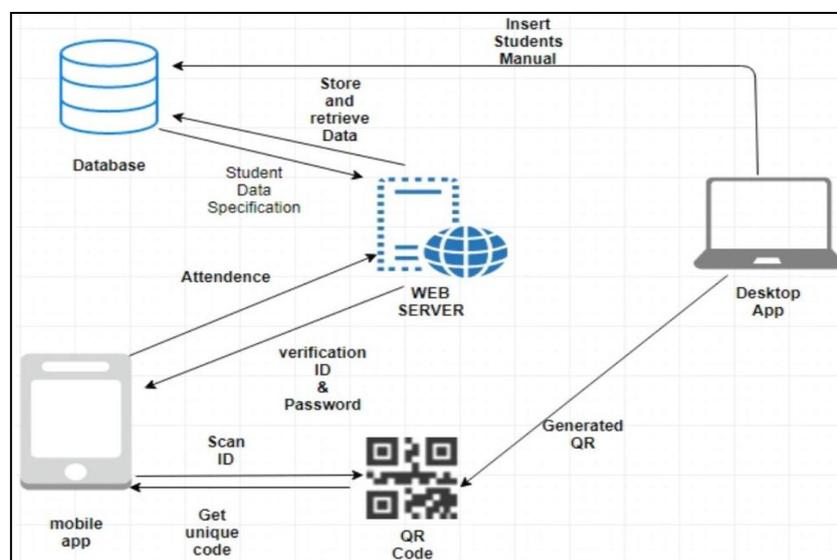
Fig. 5 Attendance system design

- **Student:** Log-in to system: Student can log-in the system by entering valid ID and Password. After log-in Student can scan the QR Code generated then the student will receive a message that the process has been done.
- **Instructor:** Log-in to system: After log-in and generating a new QR code for the lecture depending: Course Code, Academic level and the type of session, then the QR Code is Generated. The instructor will give the chance to the students after that to scan QR code by their Mobile phone application.
- **Student details:** Instructor can view all student details. And also, attendance list.
- **Update data:** Instructor has the availability for Manual attendance for the student if he\she hasn't not registered yet in the system automatically.

5.1 System Flowchart Diagram

Flowcharts are graphical representation of steps. It was originated from computer science as a tool for representing algorithms and programming logic, but had extended to use in all other kinds of processes. Nowadays, flowcharts play an extremely important role in displaying information and assisting reasoning. They help us visualize complex processes, or make explicit the structure of problems and tasks. A flowchart can also be used to define a process or project to be implemented. Figure 6 shows the Flow chart diagram for the introduced system.
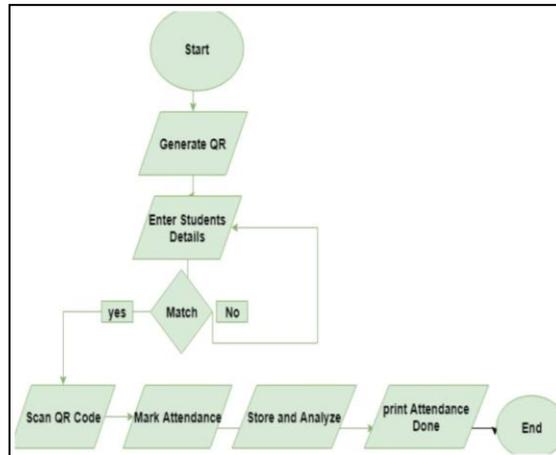
Fig. 6 Flow chart diagram for the introduced system

5.2 Use case diagram

The use case diagram consists of six graphics elements that represent whole system: Systems, User, Use cases, Association, Dependencies, and Generalization. Figure 7 describes Use case diagram for the introduced system.
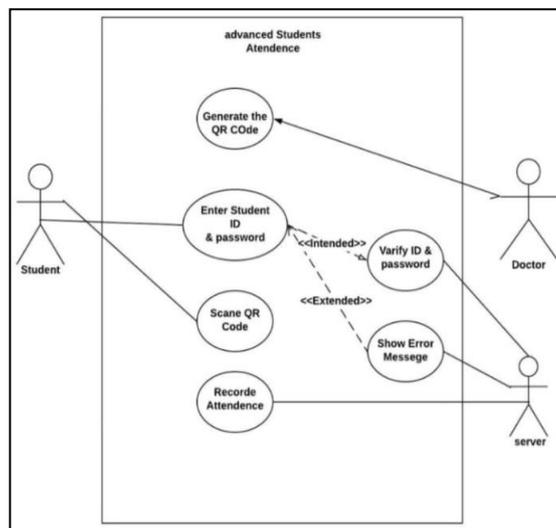
Fig. 7 Use case diagram

5.3 Data Flow diagram
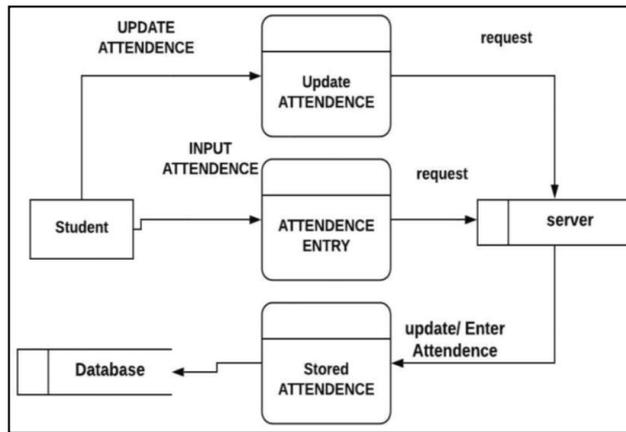
Fig. 8 Data Flow diagram

A data-flow is a path for data to move from one part of the information system to another. A data-flow may represent a single data element such the Student ID or it can represent a set of data element (or a data structure). Figure 8 describes Data Flow diagram for the introduced system.

5.4 Sequence Diagram
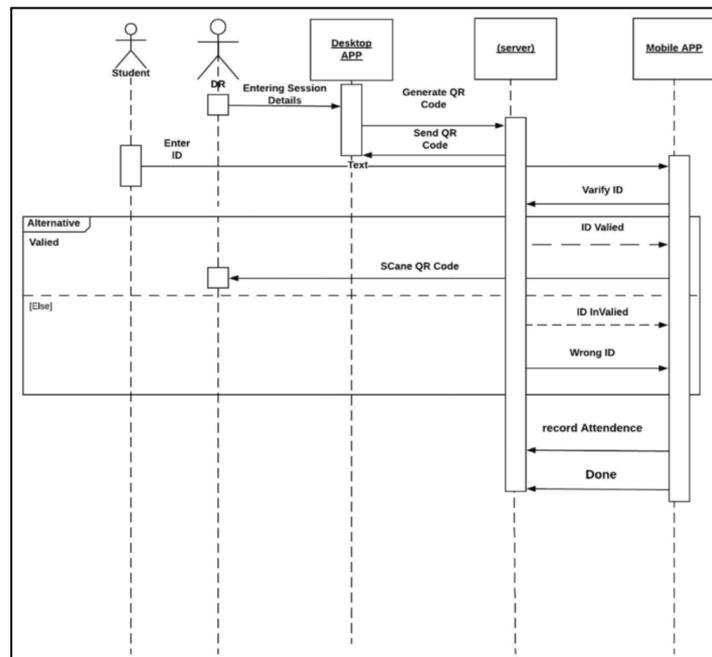
Fig. 9 Sequence Diagram

It is a model for high-level interaction between active objects in a system. Sequence diagram is a model the interaction between object instances within a collaboration that realizes a use case. Model the interaction between objects within a collaboration that realizes an operation. Either model generic interactions (showing all possible paths through the interaction) or specific instances of an interaction (showing just one path through the interaction. Figure 9 describes Sequence Diagram for the introduced system.

5.5 Entity Relationship Diagram
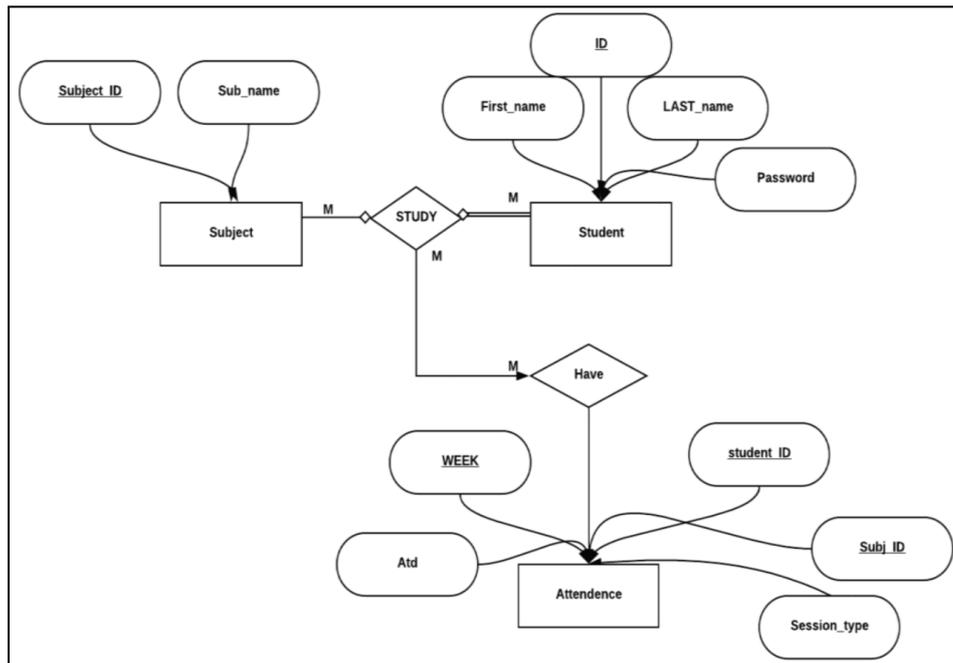
Fig. 10 Entity Relationship Diagram

Database is absolutely an integral part of software system. To fully utilize ER Diagram in database engineering guarantee you to produce high quality database design to use in database creation, management and maintenance. An ER model also provides a means for communication. Figure 10 describes Entity Relationship Diagram for the introduced system.

VI.   Implementation and Practical work

After an entire semester work our team was able to identify a solution for the attendance problem from all fields around us, companies, school or universities. Attendance plays almost the main role in any successful organization so any manipulation with this system may lead to sever injustice in grads, salary, etc.

Our team with the aid of our professors were able to find the ideal solution with using the pervious tools listed before, in this chapter we will be talking about each tool, how it was used, pervious alternative tool we've tried.

This application is verified using C# Windows form gives the instructor ability to generate a QR Code with the specifications of Session type, Subject year, Subject Name, Location Longitude & Latitude, and also give the instructor the ability to manual register the attendance of any student that doesn't have mobile or forgot it at home.

At first the application will request the Subject Name as an input of a combo box, session type and subject Year and press generate the program generates a QR code automatically. Another case if the student forgot his mobile or doesn't have one, the instructor can register the student manually into the System, and also can check on the overall attendance statistics or each student's statistics.

Also, the application identifies the location of the device and verifies it with the mobile location to make sure that this device is attending form the lecture not form another area. Figure 11 shows the C# first user interface for the introduced system.

Fig. 11 C# first user interface

Figure 12 shows the manual attendance process items for the introduced system; the instructor is asked to insert the Student ID, Year and also the course he is attending based on his year.

Fig. 12 Manual Attendance Insert

Figure 13 shows a sample of a Real QR generated by the introduced application contains the elements mentioned previously.
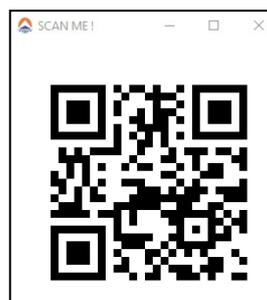
Fig. 13 Generated QR Code

Figure 14 shows how the instructor could check on a student's attendance in a specific Course.
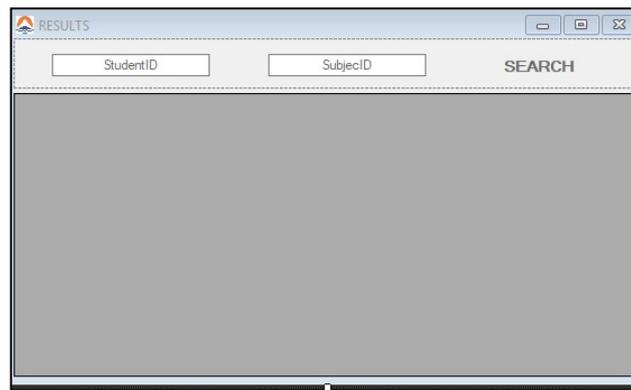
Fig. 14 Search tab

6.1 Real Time Database

The basic definition of real-time data is that it is data that is not kept or stored, but is passed along to the end user as quickly as it is gathered. It is important to note that real-time data does not mean that the data gets to the end user instantly. There may be any number of bottlenecks related to the data collection infrastructure, the bandwidth between various parties, or even just the slowness of the end user's computer. Real- time data does not promise data within a certain number of microseconds. It just means that the data is not designed to be kept back from its eventual use after it is collected.

Real-time data is enormously valuable in things like traffic GPS systems that show drivers what is going on around them. It is helpful for all sorts of analytics projects and for keeping people informed about their natural environment through the power of instant data delivery. During the early days of computing, the model was to capture any data for storage.

Now, with the proliferation of mobile devices and other advancements in technology, it is becoming more common for software to simply port collected data directly to an end user the Real time database that we used is PhpMyAdmin since it's the Database supported by our application server. Figure 15 explains in details the Database Schema for the introduced system.
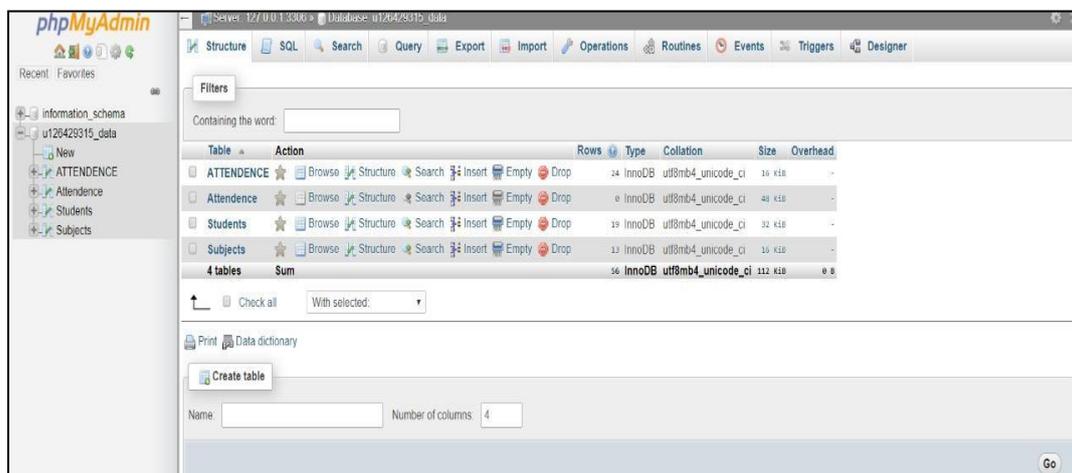
Fig. 15 Database Schema

6.2 Mobile application

Most of free mobile applications that scans QR code cannot fulfill the introduced needs to preform specific tasks after scanning. So it was mandatory to create a customized mobile application that Reads the generated QR and Registers the attendance of the Student that owns that mobile.

The application is downloaded from the Google store and the opened inside the lecture and requests the students ID and Password given to every student when he/she gets accepted is the university, then scan the Generated QR; any other QR Will cause exception and close the program, afterwards the application automatically reads the QR and analyze it to the components mentioned above then registers the attendance of the id given by the student at the beginning. Figure 16 shows the User Interface for the mobile application

related to the case of blank password. While Figure 17 shows the User Interface for the mobile application related to the invalid ID case.

Fig. 16 First GUI case blank password

Fig. 17 GUI case invalid ID

Figure 18 shows the User Interface for the mobile application related to the Scanning process. While Figure 19 shows the User Interface for the mobile application related to the valid ID confirmation request. Figure 20 shows the User Interface for the mobile application related to the valid ID confirmation message to the student after completing the attendance process.
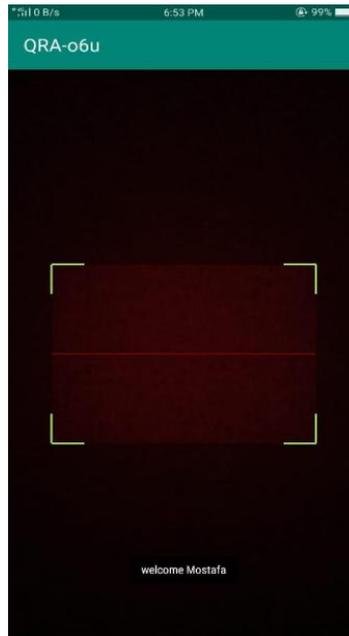
Fig. 18 GUI for QR Code Scanner
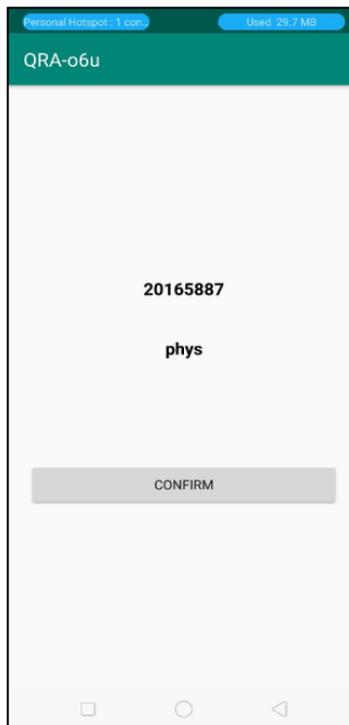
Fig. 19 GUI Confirmation Request

Fig. 20 GUI Confirmation message

VII.   Conclusion

These days it is required to keep up with the latest technologies, especially in the field of education. Educational institutions have been looking for ways to enhance the educational process using the latest technologies. The introduced system has high accuracy level as compared to other systems because sometime student tries to give fake attendance of their classmates, which is not possible with the introduced system. What makes QR Codes especially attractive for marketing is their low cost and universal applicability. Targeted to mobile users, QR Codes help to reach the audience at any time and place. Apart from a smartphone, no special equipment is required, and there are no intermediaries between you and the user. QR codes are extremely fast scanning and versatile, the can encode almost all types of data e.g. numeric, alphabets, special and binary. The proposed system allows fraud detection based on the GPS locations as well as the QR code taken for each student. The introduced system can also be used to extract important reports related to the attendance process such as total percentage and pointing out those students who are low on attendance. The system can also keep all the record very accurately as it's not possible in the case of professor making and keeping the record as human's mostly makes mistake.

Acknowledgement

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