Design and Implementation of Smart Attendance System Based On Raspberry pi

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Abstract

The attendance system proposed is used to manage attendance system in large and branched factory or university from central unit. It consists of terminal units and a central unit. Each terminal unit consists of Raspberry pi, screen GUI, RFID, transponder card with each user (like student) and GSM board. The central unit consists of Arduino, GSM board and a computer. Each unit has a special program to achieve its purpose. The terminal unit is responsible of making a connection with a transponder card to bring its ID's and make a comparison with the names listed in the database of SQL server to get the names of the absent students and send their serial numbers by using GSM message. The central unit is considered as a heart of system where it is responsible of collecting all the information from the terminal units, displaying them and making special processing to take a decision about persons whose absence exceed the threshold line.

Keywords: Attendance system, RFID, GSM, Raspberry pi, Arduino

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الخلاصة

يستخدم نظام الحضور المقترح لإدارة نظام حضور في مصنع كبير ومتفرع أو جامعة من وحدة مركزية. يتكون النظام المقترح لحل هذه المشكلة من وحدات الطرفية و وحدة المركزية. تتكون كل وحدة طرفية من راسبيري باي، شاشة تستخدم كواجهة مستخدم رسومية، لوحة التعريف بالترددات الراديوية، بطاقة مستجيب مع كل مستخدم (مثل الطالب) ولوحة النظام الموحد للاتصالات المتنقلة. تتكون الوحدة المركزية من لوحة اردوينو، لوحة النظام الموحد للاتصالات المتنقلة وحاسوب. كل وحدة لها برنامج خاص لتحقيق الغرض منها. الوحدة الطرفية هي المسؤولة عن إجراء اتصال مع بطاقة مستجيب لجلب هويتها وإجراء مقارنة مع الأسماء المدرجة في قاعدة بيانات في خادم لغة الاستعلامات البنيوية للحصول على اسماء الطلاب الغائبين وإرسال ارقامهم التسلسلية باستخدام رسالة في النظام الموحد للاتصالات المتنقلة. تعتبر الوحدة المركزية هي قلب النظام حيث تكون مسؤولة عن جمع كل المعلومات من الوحدات الفرعية وعرضها وإجراء عملية معالجة خاصة لاتخاذ قرار حول الأشخاص الذين تجاوزت غياباتهم خط العتبة.

الكلمات المفتاحية : نظام حضور، التعريف بالترددات الراديوية، النظام الموحد للاتصالات المتنقلة، راسبيري باي، اردوينو

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1. Introduction

Successful schools tend to make sure that their students come to school regularly. The consequences of low attendance of students are serious and they affect the community. The classical way of taking attendance by saying students names or by paper indicating causes time consumption, insecurity, and inefficiency. The attendance system depending on Radio Frequency Identification technology is one of the tools to solve this trouble. This system is used at universities, school, and business sites. Several studies is published in this field for improving and replacing the classical method of taking attendance by RFID technology. The principle operation of RFID depends on tagging objects to identify them. The RFID technique gives several benefits over classical method of taking attendance in class whereas the system is able to uniquely identify each person depending on their RFID tag, so that the operation of taking the attendance is easier, faster, and more secure comparing with classical method. The real time clock attendance taken will be more accurate (Karthikeyan *et.al.*, 2013).

RFID is a data collection technique which collects information by using data of radio frequency that communicates between a mobile tag and the reader to recognize, classify and track them. There are many different applications for RFID systems like tracking of product through industrialization and assembly, controlling of inventory,

parking lot access and control, searching of equipment in hospitals, searching of container, etc.

The RFID system consists of tags with antenna, Reader with antenna, Middleware, and backend or stored database. The tag includes a chip which stores a special series identifier that is utilized to identify the things individually. The tag can be indicate the object from multi meters distance and in front of the RFID reader. RFID tags have three kinds which are active, passive, and semi-passive tag. The active tag is that which does not require external source, it has battery source built in it, the passive tag is that which is initiated by the reader, it does not has battery source built in it, and the semi passive tags have the properties of both of them.

The RFID reader is a system which transmits a pulse of radio signals to the RFID tag and waits for the response of the tag. The RFID tag senses these signals and transmits a response which includes sequence number of tag and remaining data. The tag sends these data to the Middleware for additional operation. The middleware is a connection part that provides interfacing needed for controlling of the data flowing from the reader and for transmitting of the data in an efficient manner to the stored database management systems. The data came from the tag can be filtered, converted, and corrected by using software (middleware). The antenna is medium which provides communications between the reader and the tag. The database deals with the collection of data, and storage of reader data recording. Figure (1) below shows the RFID system components (Ankita *et.al.*, 2013; Arulogun *et.al.*, 2013).
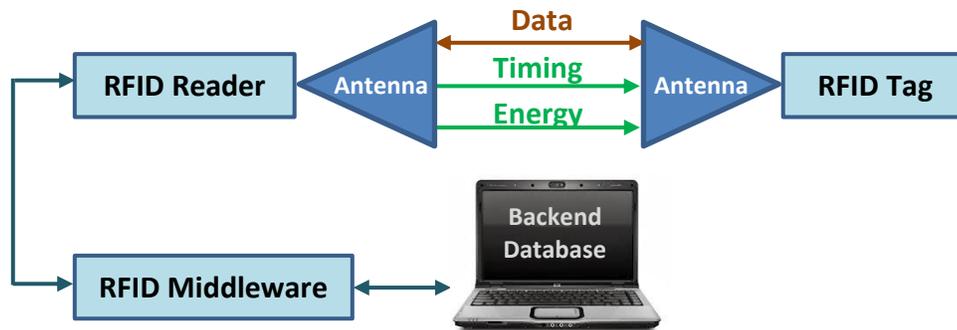

Fig 1: Components of an RFID system.

GSM is an international standard for mobile communication used for transmitting voice of mobile and services of massages. It is evolved to make use of the same subscriber parts or mobile phone units throughout the world. A modem of GSM is a specified kind of modems that has a Subscriber Identity Module card (SIM card), and works over a subscription to mobile operator, such as mobile phone. Time Division Multiple Access technology has been used to send the signals where various calls (signals) can use the same carrier (Pallavi *et.al.,* 2013; Zatin *et.al.,* 2012).

A GSM network is made up of various components and interfaces which simplify signal transmitting and receiving and messages of traffic. It is transceivers collection, registers controllers, routers, and switches. The Mobile Station (MS) consists of two components which are Mobile Equipment (ME) which is the phone hardware and the SIM card as it is shown in Figure (2) below (Pallavi *et.al.,* 2013; Zatin *et.al.,* 2012).

Fig 2 : SIM 900 GSM Shield (Zatin *et.al.,* 2012**).**

The Raspberry Pi is a general purpose computing device that transforms an engineering concept to an actual interacting electronics module. It can be utilized for applications of embedded systems and for particular applications of Internet-attached embedded. Raspberry Pi is utilized to introduce learners to programming of computer and general computing because the models of it are able to general purpose computing devices. The Raspberry Pi 3 platform board is illustrated in Figure (3) below (Derek Molloy, 2016).
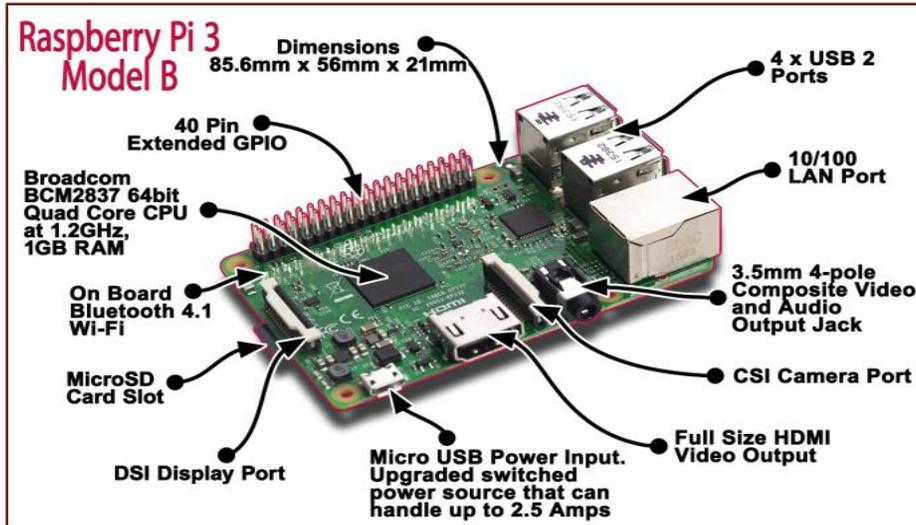

Fig 3 : Raspberry Pi 3 platform board (Derek Molloy, 2016).

The Raspberry Pi platform can run the Linux operating system. which means that many libraries and applications of opened source software can be used directly with it. The availability of drivers of opened source software makes the raspberry pi interfaced with devices such as keyboard, camera with USB, and adapter of WiFi, without having to source proprietary alternatives (Derek , 2016).

The functionality of recent Raspberry Pi models can be extended with daughter boards which is the Hardware Attached on Top (HATs), that are connected to the GPIO pins which are 40 pins (rows of dual pin connectors in the platform in Figure 3). The HATs can be designed and attached securely to the raspberry pi using this header (Derek, 2016).

On the other side , the Arduino is also an open source hardware prototyping board confirmed by environment of open source software. The Arduino was appeared in 2005 to make the software and hardware easy to be used and available to all users (Charles , 2013).

2. Proposed System Design

The system proposed in this paper is based on the use of Raspberry pi3 model (B V1.2) and Arduino UNO for hardware implementation of attendance system using RFID-RC522. The proposed attendance system is demonstrated in the block diagram in Figure (4) below . It consists of terminal units and base station unit. Each terminal unit includes RFID unit, control unit and communication unit. The RFID unit consists of tags and reader. The tags is carried by the users or students, each tag has a unique ID, the reader will send an issue to each tag present in the reading range of the reader, so it is responsible for getting information and sending it to the control unit. The control unit consists of Raspberry pi and screen GUI user interface. This unit is responsible for receiving the information (IDs) from the RFID unit and making all processing needed to the attendance system.
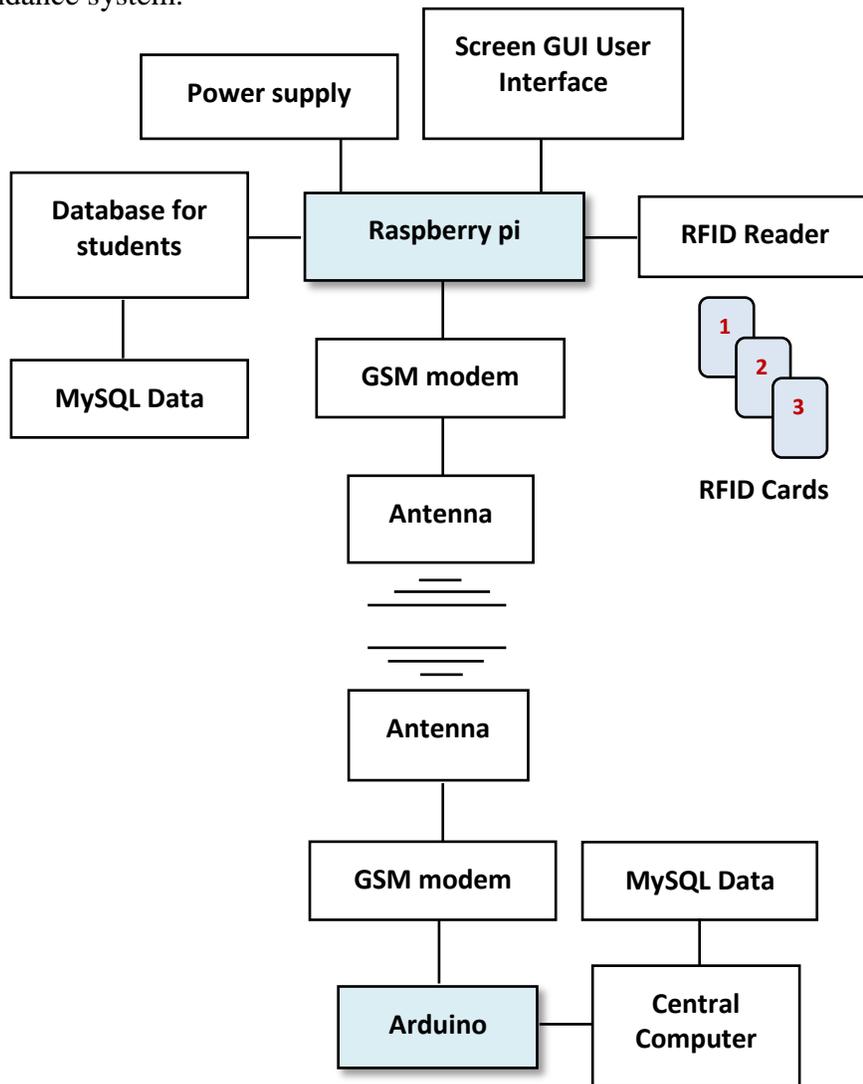
Fig 4: The proposed attendance system block diagram.

A database of all the students names and their serial numbers has been built by using SQL server in the Linux operating system. The control unit makes a comparison between the received IDs and the IDs stored in the database of SQL server. The GSM unit is used as communication unit which is responsible for sending and receiving the coded information from all rooms of classes to the base station in order to give the overall indication about the attendance in the college or university.

Figure (5) below shows the experimental system of the block diagram shown in Figure (4). RFID and Raspberry pi with GUI screen are used at each room or class to take the attendance of the students. A database of all the students ID's was built by using SQL server in Linux operation system. The system brings the IDs of the students and makes a comparison with the names listed in the database to get the absent names and send those serial numbers (IDs) via GSM message to the base station to be summarized.
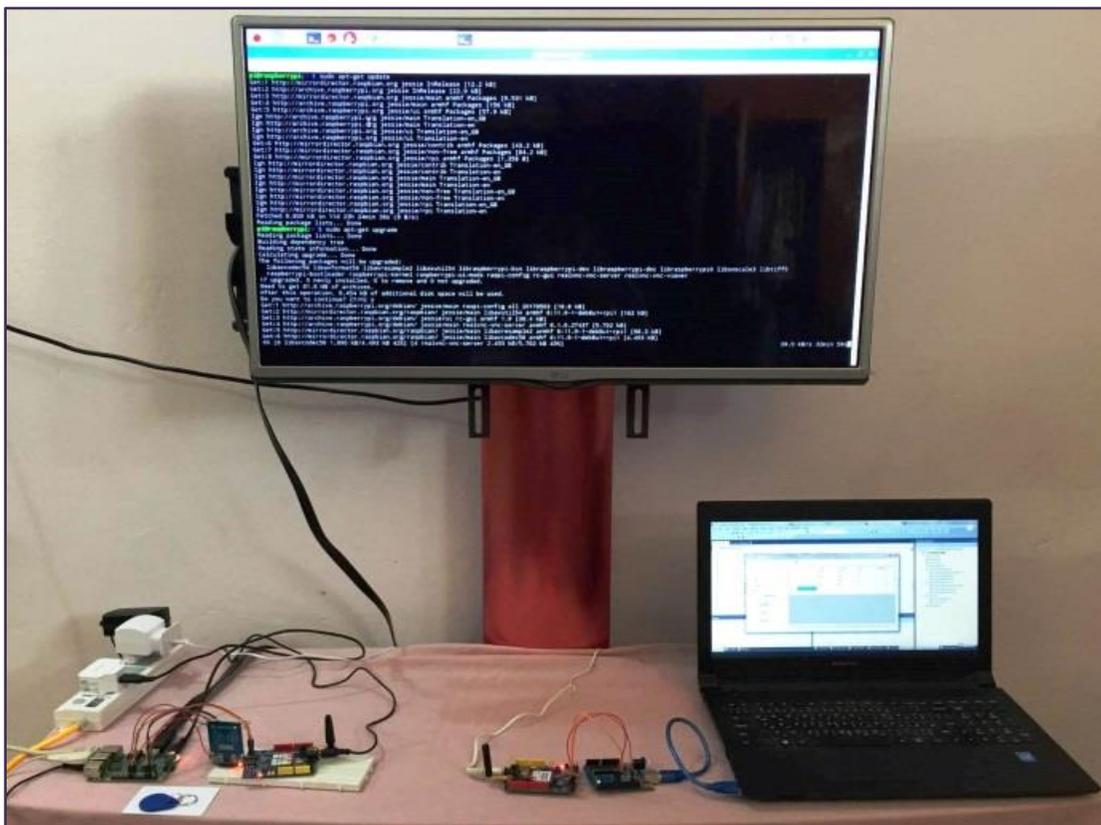
Fig 5: Experimental System

The system operation can be summarized by five steps. The first step: when the student puts its tag near the reader, the reader will send the tag an issue in order to get its ID's. The second step is that the tag receives the issue and sends its ID's to the Reader which is connected with the Raspberry pi. The third step was represented by sending all received IDs to the control unit (Raspberry pi). The Raspberry pi makes a comparison with the names listed in the SQL database to get the absent names. The fourth step represented by sending the IDs of the absent students to the central unit (Arduino and GSM shield). The final step represented by receiving the information from all the terminals units to save these information and take a decision about the states of the students.

The practical connections of raspberry pi with RFID and GSM shield are demonstrated in Figure (6) below. The Raspberry pi can be programmed by using a high level programming language which is the open source python language. The raspberry pi needs an operating system to startup, Linux operating system is more suitable for Raspberry pi . A blank SD card is needed to flash the Linux operating system onto the card. After that, the internet is connected to the Raspberry pi in order to download the required libraries. Mouse and Keyboard are also utilized with the Raspberry pi which are needed to work with the operating system and hence the raspberry pi can be programed.
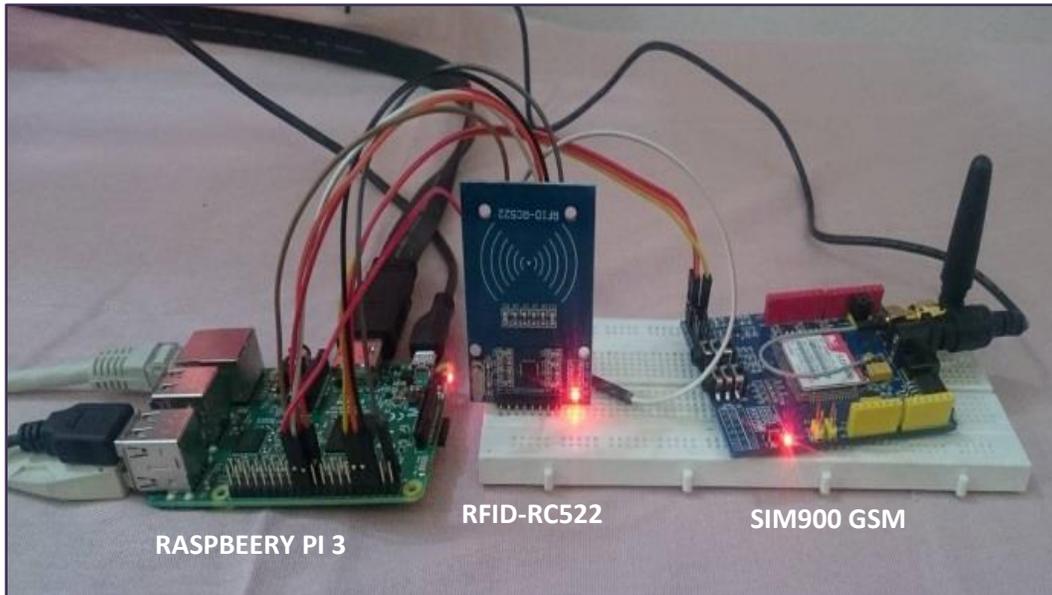
**Fig 6 : Connection of raspberry pi with RFID and GSM**

The practical connection of GSM shield with the Arduino and computer is shown in Figure (7) below. The Arduino is connected to the computer via serial port , it is used to process the data coming from the GSM shield.

Fig 7 : Connection of Arduino and GSM shield

The Arduino UNO supports a number of digital and analog pins which is used to connect the Arduino with the real world including devices and sensors. The processor of

the Arduino UNO is the Atmel MCU (ATmega328). The Arduino UNO contains the ATmega328 MCU and this platform is the open source platform which is easy to be used in terms of software and hardware as it is shown in Figure (8).
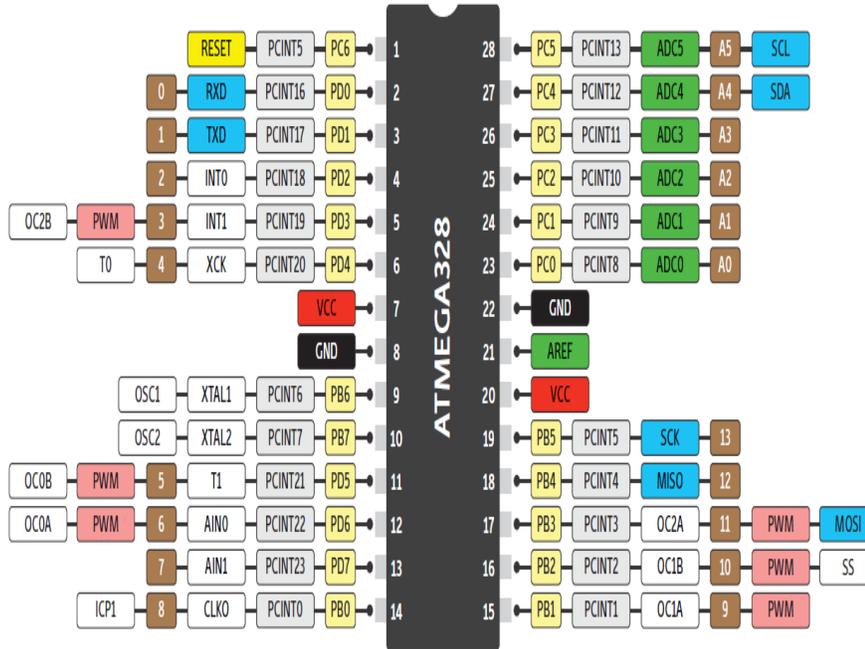
Fig 8 : Atmel MCU (ATmega328) and the Arduino pin out

The most important specifications of the MCU are :

Digital I/O	14 Pin
Analog Input	6 Pin (10-bits ADC)
DC Current per I/O	40 mA
Flash Memory	32 KB (ATmega328)
Clock Speed	16 MHz

MCU is programmed through the IDE which is a language driven from C++. The RFID is interfaced with the raspberry pi so that the RFID can bring the IDs of the users, then the Raspberry pi manipulate them to get the IDs of the absent students. The python code used for this process is shown in Figure (9) below


```
raspberry pi and RFID - Notepad
File  Edit  Format  View  Help
sudo apt-get update
sudo apt-get upgrade
sudo apt-get install python-dev
git clone https://github.com/thiery/SPI-Py.git
ls
cd SPI-Py/
ls
sudo nano spi.c
ls
sudo python setup.py install
gitclone https://github.com/mxgxw/MFRC522-python.git
cd..
ls
cd MFRC522-python/
ls
sudo python Read.py
```

Fig 9 : Python Code for Interfacing Raspberry Pi With RFID

3. System Operation And Results

The system is designed and implemented with a high-precision security. It is flexible and friendly GUI for the users because it has simple graphic windows. Figure (10) below shows the login window which contains the communication port with Arduino and the user password that gives the security for the system.
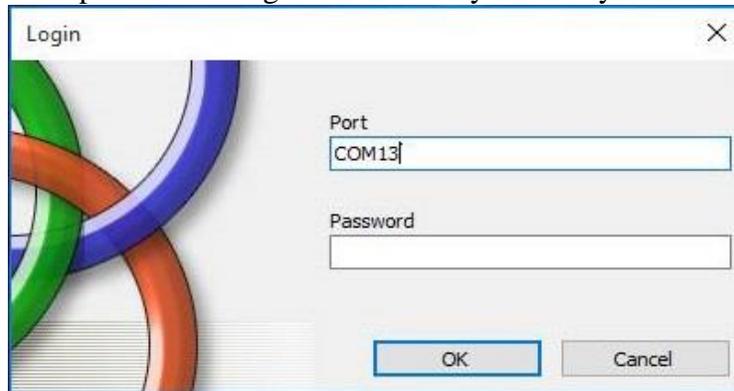

Fig 10: Login window

Figure (11) shows a window that displays the states of the students . It contains the department, stage and the subject. The Arduino receives the IDs of the absent students from Raspberry pi via GSM, and adds a specific number of hours that the students were absent for each lecture then displays them in that window
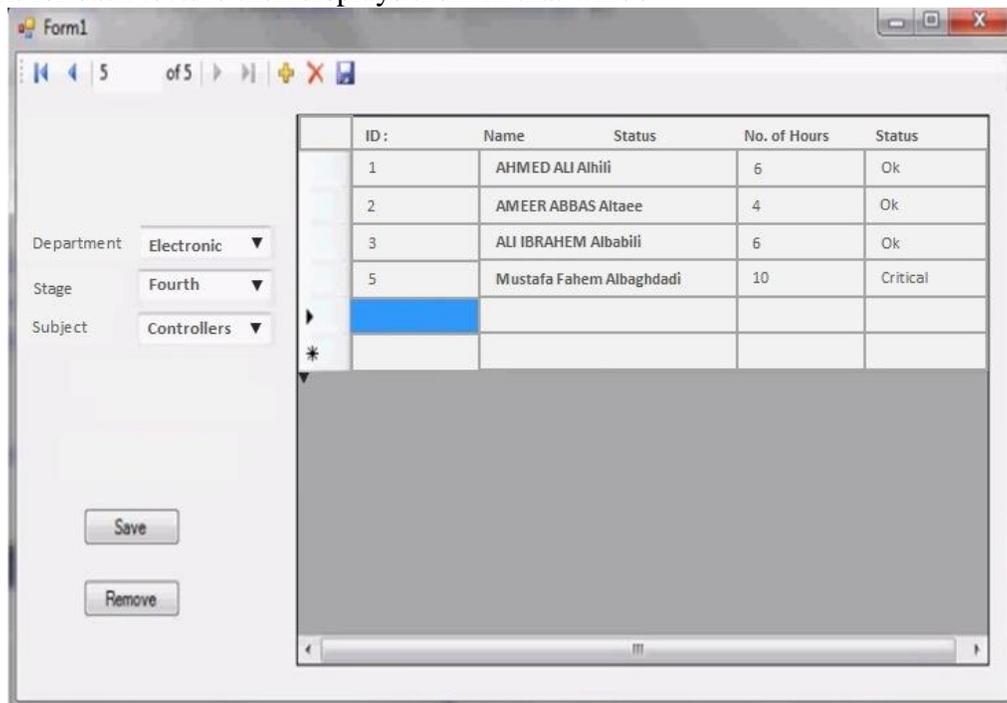
Fig 11 : Form 1 of Student States Windows.

The system includes search window as it is shown in Figure (12) below. The window provides search by name, stage, and subject.

Fig 12 : Form 2 of search windows.

4. Conclusion

The proposed attendance system provides flexibility in taking attendance of students or users whereas the system is efficient, easy and friendly GUI for the users with high-precision security. Raspberry pi and Arduino have been used effectively for designing and implementing the attendance system proposed based on radio frequency identification and GSM technologies.

5. References

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