

# SMART CLASSROOM ENERGY MANAGEMENT SYSTEM AND AUTOMATIC ATTENDANCE SYSTEM USING RFID TECHNOLOGY

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*Abstract—The increase of energy costs urged the need in minimizing the energy consumption. As significant amount of energy is used for lighting and air ventilation (air conditioning and fan) in educational buildings such as classrooms, improvements is needed to avoid energy waste for unoccupied classroom. The electrical energy will be controlled based on demand in order to save the energy costs. In addition, current practice for monitoring students' attendance by calling names or signing on paper have a few weaknesses such as time wasting and insecure. Hence this conventional method lead to inefficient record. RFID based attendance system is one of the solutions to solve the problem. This paper is about a concept of smart classroom energy efficient and automatic attendance system based on Radio Frequency Identification (RFID) configuration.*

**Keywords:** energy saving; energy efficient; energy management; automatic attendance; Radio Frequency Identification (RFID)

## I. INTRODUCTION

Smart classroom energy efficient and automatic attendance system is example of the problem solving due to electrical waste energy and inefficient conventional attendance monitoring. Nowadays, there has been a great rise in demand for electrical energy in daily lives. Most of daily activities would involve the use of electrical devices which require use of electrical energy depend on types of devices and the operation frequency. For example fans, air conditioning and light require high electricity energy. Although consumers do not immediately recognize the connection between individual behaviorism and global environmental problems but it is clearly identifiable for an area where domestic energy consumption links together [1]. They highlighted that awareness related to consumer behavior and how it was connected to problem such as global warming. The majority of energy consumption takes place within the educational

institution buildings [2]. Thus, a smart classroom energy management system was designed to reduce the usage of electricity in Uitm. Overall, this system is based on technology that automatically and systematically function. With this system, user can reduce the cost for electricity usage without involving man power which may lead to more inefficient output at the end.

Besides that, student's attendance monitoring method also is a critical issue. Student's attendance is one of important matter to keep track because it will reflect their result at the end of semester. There are strong correlation between attendance and result by analyzed their data. It is important to identify the correct tools to use in attendance record [3]. One of technology that can be apply is Radio Frequency Identification (RFID) system as a tools to improve attendance record system [4]. Hence, RFID based student attendance system for systematic attendance management record was designed. This RFID student attendance system provides systematic and automatic attendance management in university. Combination of RFID hardware and software will enhance the whole system process of students' attendance data recording. RFID system can be applied for real-time attendance data of the students. Besides, RFID based attendance system automatically record all basic informations such as name, time in and out of the class, and student's ID number. Thus, it has an ability to monitor each student based on their RFID tag. This approach makes the process of recording the attendance easier, faster, and systematic as compared to conventional method. There are some problem related to conventional method of taking attendance such as pass attendance sheet around the class may lead to fake students' signature by their friends while they are absent. Hence the lecturer may

receive false attendance data. Besides, another issue faced was lecturer may lose the attendance sheet [5]. Hence, with this RFID based attendance system, student attendance record management will become easier, more efficient and more systematic compared to conventional and manual method attendance system.

## II. METHODOLOGY

### A. Total System

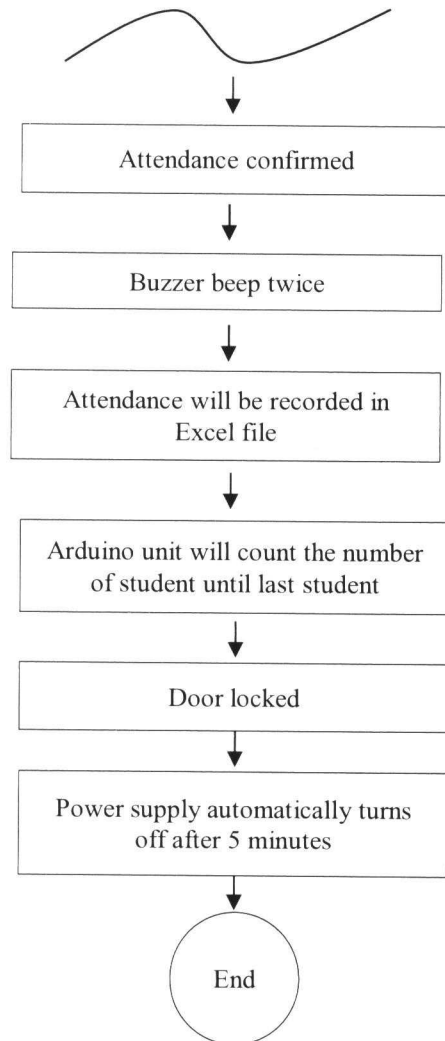
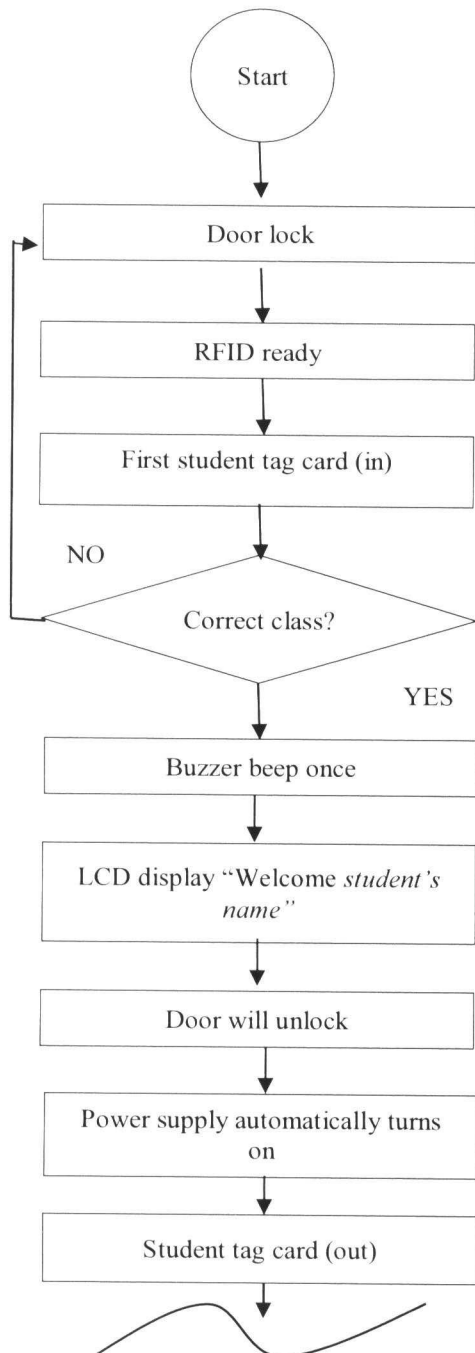


Figure 1: Flowchart of Total System Functionality

This is about energy management system which is include all the electrical appliances will be turn ON and turn OFF automatically when it detect student id card. RFID will be used as the main part and it will be interfaced by using Arduino board. The system functions when student card is tag to the reader at the outside of class to unlock the door. If the correct student card at the particular class then buzzer will beep once and LCD will display "Welcome student's name". After that the door will be unlock and power supply will be automatically turned on. After class dismiss, each student needs to tag their card for second time for the purpose of attendance record then all students' data will be recorded in an excel file. Buzzer will beep twice indicates that attendance is recorded. Arduino will count until the last students tag their card before it send signal in order to lock the classroom door and the deactivate power supply in the classroom.

## B. RFID Components and Principle of Operation

RFID technology is an automatic identification and data collection that offers more accurate, systematic and real time data entry. The RFID technology enables precise and accurate data that will improve in efficiency [6]. RFID is a device that can be interface with computer [7]. Besides, it is used to transfer data automatically by radio wave from RFID tag attached to an object through a reader in order to track, identify and categorize [8]. RFID uses the electromagnetic or electrostatic coupling that operates the radio frequency in the electromagnetic spectrum [9]. When the reader device queried a coded identification number, radio transmitter in RFID chips will emit those code to the reader device [8].

An RFID system consists of four components which are:

- RFID Reader
- RFID Antenna
- RFID Transponder (tag) electronically programmed with unique data
- Host Computer with appropriate application software

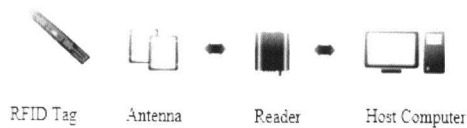


Figure 2: Connection of RFID Components

Figure 2 shows a connection of RFID components in a system. An RFID tag carries information in a chip that contains an antenna that stores data. Radio waves transfer data between a reader and a moveable item. Then an antenna captures the item's ID number. The reader that contains radio frequency module will convert the radio waves into digital information. Finally, a host computer provides control over and access to logistical data.

## C. System Controller (software architecture)

The software architecture is designed based on modules namely; communication module and database module. The function of each module is summarized as follows:

### 1. Communication module

Communication module used in this project is Arduino module that will communicate between input and output. Arduino module are able to read inputs from the sensor (RFID data) and turn the input data onto an output to activate power supply in the classroom and records attendances' data.

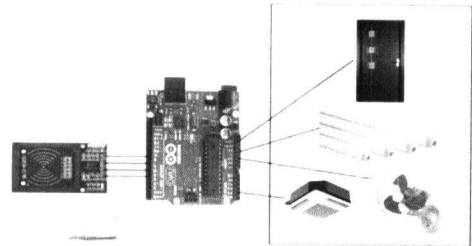


Figure 3: Input, Controller and Output

In Figure 3, the proposed system with three stages which are includes of input, controller and output for the system. In the first stage, the classroom energy management system will be used RFID tagging as an input containing the students and lecturer details. The RFID reader will read the data and kept them in Arduino controller. The second stage is the controller which controls the overall process in the system. Recorded data will be processed in the controller before proceed to the next stage. After all data have been processed in the controller, it will produced output in such way of lock and unlock the door, keeping students time in and data out and activating power supply so that all the electrical appliances in classroom will be turned on. Input and controller functions simultaneously to produce a systematic output.

### 2. Database module

Database module used in this system is Laboratory Virtual Instrument Engineering Workbench (LabVIEW) software. The LabVIEW is interface to Arduino to acquire data from the Arduino microcontroller and process it in the LabVIEW software.



Figure 4: Block Diagram of Interfacing Arduino and LabVIEW

Figure 4 shows a block diagram of Arduino interfacing to LabVIEW. An RFID unique code identification will be programmed into Arduino. Arduino will process the RFID identification code in order for LabVIEW to detect the specific code as require by user and keep the data.

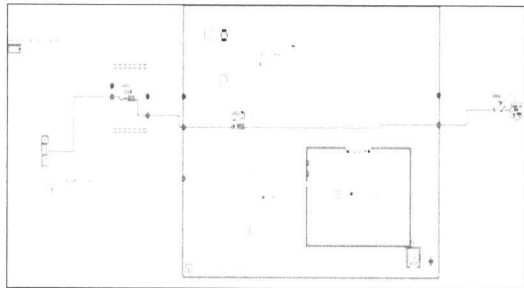


Figure 5: Circuit Simulation in LabVIEW

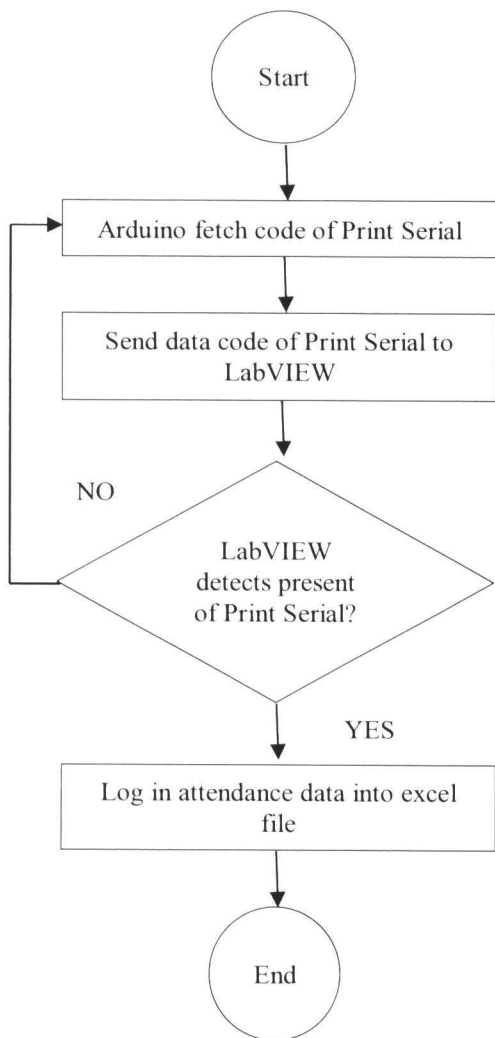


Figure 6: Flowchart of data being transfer from Arduino to Excel file

Figure 6 shows the data being fetched from the Arduino controller into LabVIEW, and the recorded attendance data will be displayed in excel file. First, Arduino will fetch code of Print Serial that have been programmed. After fetch all the Print Serial code, it will send those code into LabVIEW. If LabVIEW detect the code of Print Serial that provided by Arduino then it will transfer the log data into excel file but if LabVIEW do not detect any Print Serial code, it will refer back into Arduino controller.

*D. System Implementation (hardware architecture)*

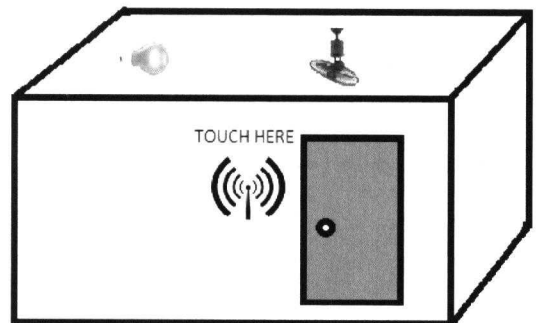


Figure 7: Classroom Prototype

Figure 7 shows that design of classroom prototype to be present. It shows that the location of student card will be tag at outside of the classroom and beside the door.

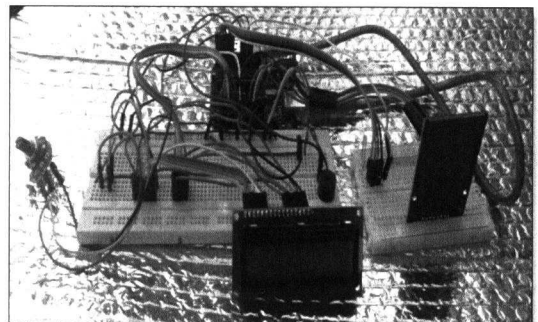


Figure 8: Circuit Implementation

Figure 8 shows the circuit implementation for Smart Classroom Energy Management System and Attendance System.

### III. DISCUSSION AND RESULT

#### A. Energy Management

Energy management is the process of monitoring, controlling, and conserving energy in a building which means effort of reducing the use of electrical in daily life. Thus, with the installation of Smart Classroom Energy Management system it is estimated to reduce energy consumption about 50% per month.

TABLE I. COMMERCIAL TARIFF BY TENAGA NASIONAL BERHAD (TNB)

| TARIFF CATEGORY                               | CURRENT RATES |
|---|---------------|
| MEDIUM VOLTAGE GENERAL                        | (1 JAN 2014)  |
| For each kilowatt of maximum demand per month | 30.3RM/kWh    |
| For all kWh                                   | 36.5sen/kWh   |
| The minimum monthly charge is RM600           |               |

TNB have specified that higher education institutions are categorized under the commercial consumer with pricing and tariff as shown in Table 1 [10]. Electricity tariff also known as electricity pricing that varies for different categories of consumers. This is because several reasons that contribute for differences in electricity tariff. There are some factors which differentiate electricity tariff such as type and market price of the fuel used, government subsidies, and government regulation.

TABLE II. CALCULATION OF ESTIMATION ELECTRICAL BILL FOR FACULTY OF ELECTRICAL ENGINEERING UiTM SHAH ALAM

|   |  |
|---|--|
| Total Consumption (kWh)                             | 350000 kWh                                 |
| Maximum demand (kW)                                 | 3500 kW                                    |
| Total days  | 22 days                                    |
| Total hours   | 12 hours                                   |
| Energy consumption charge                           | 350000 kWh x 0.365sen/kWh<br>RM 127,750.00 |
| Maximum Demand charge                               | 3500 kW x RM 30.30/kW<br>RM 106,050.00     |
| Faculty of Electrical Engineering UiTM monthly bill | RM 233,800.00                              |

Table 2, tabulates situations of electricity usage in faculty of electrical engineering for a month. For an example the class is unlock from 7 a.m. and lock back at 7 p.m. In average, a class is use for only 6 hours per day. Without any automated system, students may forget to turn off the lamp, aircond, projector, and fan for the whole day which results in a high electricity usage because all those appliances are left for 12 hours per day. With this system, the faculty could save the electricity because it only allows electricity to be used when there is a student in the classroom whereby in this case all the classes will only be used an average of 6 hours per day. It is estimated that the faculty will save up to 50% usage of electricity which is from 12 hours per day to only 6 hours per day. If the electricity bill for an each level which consists of 12 classes is about RM60000 per month then the faculty should be able to save up RM30000 by implementing this system. Hence, if the faculty bill is roughly about RM240000 per month including all level then the faculty could reduce their electricity usage by at least 50% which is RM120000 per month.

#### B. Automatic Attendance

| ID | NOR. ALAM | NAMA                  | PROG | IPKON | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|----|-----------|-----------------------|------|-------|---|---|---|---|---|---|---|---|---|----|----|----|
| 1  | 000001    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 2  | 000002    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 3  | 000003    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 4  | 000004    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 5  | 000005    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 6  | 000006    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 7  | 000007    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 8  | 000008    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 9  | 000009    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 10 | 000010    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 11 | 000011    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |
| 12 | 000012    | ABDULLAH BIN ABDULLAH | EE24 |       |   |   |   |   |   |   |   |   |   |    |    |    |

Figure 9: Conventional Attendance Method

| STUDENT ATTENDANCE               |
|----------------------------------|
| Wednesday, 18 May, 2016 10:57 PM |
| ATTENDANCE YANA RECORDED         |
| Wednesday, 18 May, 2016 11:02 PM |
| ATTENDANCE AJ RECORDED           |
| Wednesday, 18 May, 2016 11:03 PM |
| ATTENDANCE YANA RECORDED         |
| Wednesday, 18 May, 2016 11:07 PM |
| ATTENDANCE AJ RECORDED           |

Figure 10: Automatic Attendance Method

Figure 8 and figure 9 shows conventional attendance method record and automatic attendance method record respectively.

Automatic system offers several improvement in processing method and material usage. As an example it is not environmental friendly. This is because this system uses paper as a tool to record attendance. Paper might be lost or damage due to unexpected situation. Automatic system for recording student's attendance eliminates and save cost on paper usage. A lecturer uses at least four to five sheet of paper to record attendance in a semester. There are 60 lecturers in Faculty of Electrical UiTM Shah Alam. Hence, if each lecturer uses five sheet of paper per semester, then  $60 \times 5$  equals to 300 paper per semester that will be wasted per semester. Moreover by using the conventional method the lecturer cannot monitor what time students come in to class and what time they leave the class because they only sign once for a day. As an alternative to the problems, this system will offer a solution to the problem. Thus, system will decide either they satisfied or not with their students' attendance auto – connected to HEA for further action to the particular student who has problem with their attendance. In addition this automatic attendance system encourage students to bring the student card anywhere there go while they are in campus. Hence without bring their student card, attendance will not be record. This is because this automatic attendance system require student card in order to tag at classroom and will indicate as student attendance.

#### IV. CONCLUSION

In conclusion, saving energy means decreasing the amount of energy used which has a benefit of reducing electricity bill. By designing classroom energy management system, all power supply

consumptions are automatically under control. Hence, there will be reduction in electricity waste and can avoid high usage of electricity that lead to high cost of electricity charge. This system also provide systematic attendance recording system control. Therefore, this system will ease the process of attendance record. Hence, the smart classroom system have benefits of reducing overall energy consumption and electricity bill, introduce systematic energy management system and automatic attendance record. Hence, with the combination of saving energy consumption, and reducing the electricity's cost of bill, and automatic student's attendance may be one convenient system in UiTM that can ease all students, lecturers and staffs.

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