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A SMART CLASSROOM

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Abstract:. "SMART CLASSROOM" is a classroom where energy can be saved by using renewable energy. In this class classroom solar panel has been used to supply the power to the entire classroom. Students have to punch their RFID card to get access into their classroom. Fans and lights will be automatically turned on and off. When the class will start it will be automatically turned on and when it will end it will be automatically turned off. Now a days parents are very much concerned about their children whether they are attending the class or not. That is why this classroom has additional feature, if any student will miss the class an automatic message will be sent to their parent's phone number. Gate will be locked until the class ends and teacher will have a special id that can be used in any emergency cases.

I. INTRODUCTION

Classrooms are the most basic component s of an educational institution. From the elementary school to the medical colleges or Engineering universities, classroom is the most important infrastructure of an educational institute. A classroom is a learning space, a room in which classes are held. Classrooms are found in educational institutions of all kinds, from preschools to universities, and may also be found in other places where education or training is provided, such as corporations and religious and humanitarian organizations In this age of massive digitalization of our country, classrooms are the most needed structures to be digitalized. If this happens, this would be the biggest evolution of our road to Vision 2021. Smart classrooms are the classrooms enhanced with technological equipment's and support for the purpose of greener environment and better teaching and learning experience. In a smart classroom, the electrical power used is enhanced from the solar energy and battery. In a smart class room we will time to save time and energy also. RFID based auto attendance system will allow us to save the time needed to take the attendance of students by the teacher. Auto door lock system will allow us to make sure that no student can leave the classroom in class time. The student's database and parents messaging system will allow us to inform the parents whether the students bunk the school or not. If a student is absent in a class, an SMS will automatically be sent to his/her parents cell phone number. The home automation system will allow us to save energy while there is no one in the room. Solar power system in collaboration with a DC battery will make our classroom less dependent on grid power, thus make the environment greener.

There are a number of similar kind of projects can be found. In spite of that, the smart class room is not an exact adaption or upgrade of any previously done project. There are many projects done that matches the features of it. In [1]. GSM based solar tracking system the whole automated system with self-decision making capability. The decision making part will be carried out by the Microcontroller and GSM. The solar tracking system will help in capturing maximum sunlight from the sun. This energy will be stored in a DC Battery. On another project related to ours [2] RFID based attendance system there are some work explained how they can count attendance automatically by using RFID cards. RFID Technology (Radio Frequency Identification and Detection) is commonly used in schools, colleges, office and stations for various purposes to automatically keep a track of people. [3] Automatic Attendance Marking and Parent Alerting System Using RFID and GSM and [5] RFID based Employee Attendance & Database Management System are the projects on similar kind of interest. In the later one they wanted to maintain a record of attendance of the employees in an industry. Most of the industries use manual attendance system. They have used RFID hardware to take the attendance of an employee. Each employee will be given an individual RFID tags and its record will be maintained in a database. When he will place the tag for first time in a day, time will be fetched and will be stored as in time.

The main difference between our project and the projects mentioned above is that our project is multidimensional. In our project we have tried to deal with both use of advanced technology and energy saving at the same time. Our project is not only about automatic attendance system. Use of renewable source (solar) and automated power system is introduced here in order to reduce the dependency over grid power in order to promote greener world. Moreover the SMS forwarding feature adds a surplus in terms of social value .A digital LED display will be added to make the environment of the classroom technologically advanced and it will add a flavor of smartness.

Recently terrorists had attack in Dhaka. University students were involved in it. After few days we came to know that those students were absent in class more than 6 months and parents were not notified. Our smart attendance system is a great solution for the parents who were really concern about their children whether they are attending the class or not. Who bunk their class in regular basis their parents will be notified by our smart classroom. It also saves energy because our whole system will run by solar system and we have also light fan automation system who will also save energy. We have built a smart classroom which is very necessary in these days. It will count attendance automatically. It runs by solar panel which is

cost effective and using renewable energy will decrease the use of electricity .Our project is better just because we are not using electricity class will run by solar system or windmill which is very much cost effective as well as it will reduce the use of electricity.

Our project has an option to send message to the absent student's parents so that their parents gets notification whether their child are attending or not in the class regularly. It has a display outside of the class which shows how many students are present and how many are absent. It has a very nice auto door lock system which will open in an appropriate time. Student will get access to enter their class from that specific time and when the class will start the door lock start working automatically which is tremendous. It is better just because it will save energy like classroom has light fan automation system. Light and fan will turn on when the class begins and it will turn off exactly in time when the class ends that will save energy a lot. Our smart attendance system will reduce class teacher's work. So overall it is very much helpful for teacher students and their parent as well as it saves energy.

2. Related Works

2.1. GSM Based Smart Agriculture System with Auto Solar Tracking

This is a whole automated system with self decision making capability. The decision making part will be carried out by the Microcontroller and GSM. The solar tracking system will help in capturing maximum sunlight from the sun. This energy will be stored in a DC Battery. The stored power will be used to drive the irrigation pump. Here the system will be a sensor based one where the pump will start only when there is the need of water to the land. The control of the irrigation pump will be made through a mobile phone from any remote location or auto decision using sensors.

We will use normal solar panel as a renewable free source of energy it will not have tracking system like that project but it will be used to supply electricity for light fan automation and LCD display . This energy will be stored in a Battery. We will use GSM module for network connection and send message to the absent student's parents

2.2. RFID Based Attendance System

In this RFID based Attendance System project, explained how they can count attendance automatically by using RFID cards. RFID Technology (Radio Frequency Identification and Detection) is commonly used in schools, colleges, office and stations for various purposes to automatically keep a track of people.

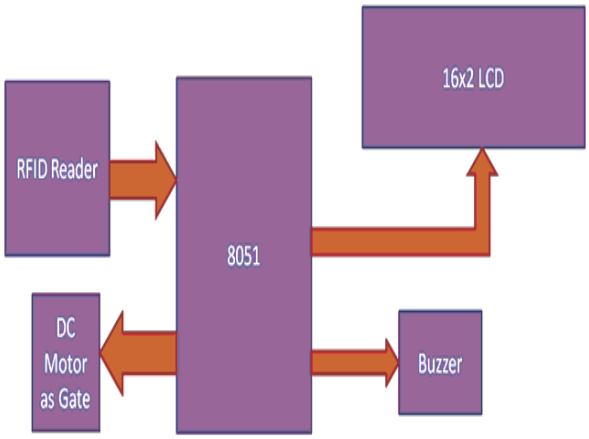

Figure 2.1: RFID based attendance system

Our project is similar kind of that but it has an extra feature and that is it has auto door lock system. If the class starts at 9.00am it will wait next 10minute and after that it will automatically lock the door. But teacher will have different RFID to enter the class at any time and within the class time no one will enter or go outside.

2.3 Reader Section

This section contains a RFID, which is an electronics device which has two parts - one is RFID Reader and other is RFID tag or Card. When someone put RFID tag near to the RFID reader, it reads tag data serially.

Control Section: 8051 microcontroller is used for controlling the complete process of this project.

Display section: A 16x2 LCD is used in this project for displaying messages on it.

Driver section: This section has a motor driver L293D for opening gate and a buzzer with a BC547 NPN transistor for indications.

2.4 Automatic Attendance Marking and Parent Alerting System Using RFID and GSM

The project was assumed to have 3 classes with 15 students and 3 faculties. The 15 students is distributed into 3 batches each of 10 students. Any one of the 3 classes is selected. Whenever the student shows his RFID card the data on the card is displayed on the LCD and the door of the class opens, if the RFID card matches with the database, student enters the class and the door closes. This repeats till the faculty enters by showing the corresponding RFID card, once the faculty entered the class the door is locked and no student is allowed to come in or to go out. The system checks the absentees and sends the message to the parents, class admin using the GSM modem. The parents are alerted that their son/daughter is absent for the selected class and the class admin will mark the absentees on the attendance sheet. This system can be

implemented at each and every gate of the college so that we can know the status of the student.

In our project the RFID tag which can be used as the identity card has the student details and this variable data is displayed and is sent through the short message service to the parents and this project has extra feature that admin will also get notification if someone is absent. Another difference is in our project door will be automatically locked if anyone cannot come within 10 minutes and he/ she will be counted as an absent student. In our project we will work with fan light automation system that facility is not available in this project.

2.5 BUILDING AUTOMATION SYSTEM USING SOLAR POWER

They made a building automation system using solar power. The solar panel status and other parameters such as water level in overhead tank are registered and auxiliary units are run based on these signals. This way unnecessary wastage of energy can be curbed and intelligent homes with low energy consumption can be built.

They used PIR based motion detector to sense movement of people, animals, or other objects. The system is usually designed such that if no motion is being detected, the relay contact is closed—a 'normally closed' (NC) relay. If motion is detected, the relay opens, triggering the alarm. But in our project we will not use any motion sensor .We will set a time slot to switch on the fan and light

2.6 RFID based Employee Attendance & Database Management System

In this project they wanted to maintain a record of attendance of the employees in an industry. Most of the industries use manual attendance system. They have used RFID hardware to take the attendance of an employee. Each employee will be given an individual RFID tags and its record will be maintained in an database. When he will place the tag for first time in a day, time will be fetched and will be stored as in time. When he leaves he has to place the tag again and this time it will be noted as out time. Thus maintaining the record when the employee enters and leave the premises. The authority of accessing the records will be limited. Username and password will be given who will be called ADMIN. Here he can make new entries, modify them and even search based on a particular field.

In that project Admin can view employees attendance date wise and calculate their working hours. But in our project system can only detect the absent student from the database and send a text to their parents if they are absent. It doesn't have auto door lock system and it has option to go outside but in our project once a student entered into the class he/she cannot go outside within that time period.

Smart Classroom Component List

3.1 Hardware List

This chapter deals with the necessary equipment needed for building a Smart Classroom. The minimum requirement for designing a Smart Classroom includes Arduino Microcontroller, GSM Module, Motor Driver (L239D), LCD display, RFID system, Auto door lock

3.1.1 Arduino Microcontroller:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on processing. In our project, we have used ARDUINO MEGA 2560.

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Figure 3.1: Arduino Mega 2560

Table 3.1: Technical specifications of Arduino Mega

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA

Flash Memory	32 KB (ATmega328P)
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	53.4 mm
Width	53.4 mm
Weight	25 g

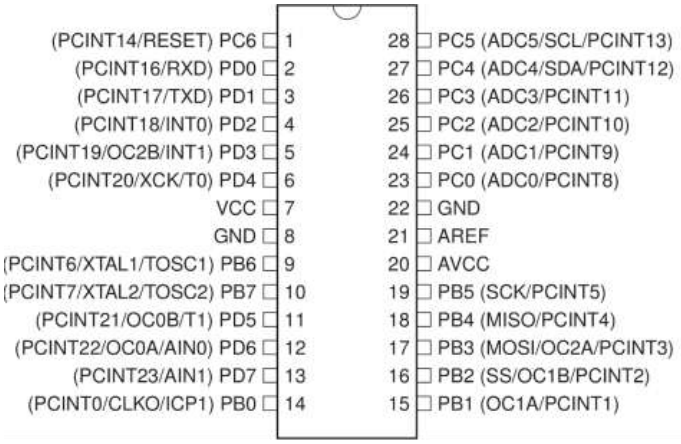

Fig 3.2: Pin configuration of Arduino Mega

3.1.2 GSM Module:

GSM module is used to establish communication between a computer and a GSM system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces for computer. The MODEM is the soul of such modules. In our project we have used GSM SIM900A

Figure 3.3: GSM module

Table 3.2: Behavior of GSM module with respect to on and off time

Status	GSM behavior
Off	GSM is not running
64ms On/ 800ms Off	GSM is not registered to the network
64ms On/ 3000ms Off	GSM is registered to the network
64ms On/ 300ms Off	GPRS communication is established

3.1.3 Motor Driver (L293D):

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction.

Figure 3.4: Motor driver

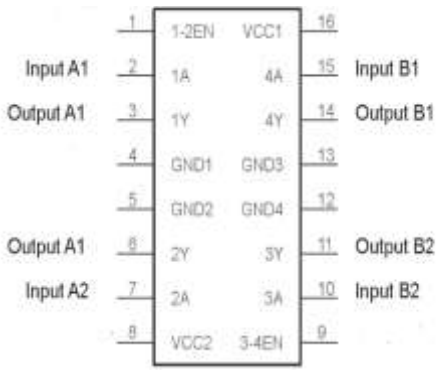

Fig 3.5: Pin configuration of motor driver

3.1.4 LCD display:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are

economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

Figure 3.6: LCD display

3.1.5 RFID system:

In a basic RFID system, tags are attached to all items that are to be tracked. These tags are made from a tiny tag-chip, sometimes called an integrated circuit (IC) that is connected to an antenna that can be built into many different kinds of tags including apparel hang tags, labels, and security tags, as well as a wide variety of industrial asset tags. An RFID reader is a network connected device (fixed or mobile) with an antenna that sends power as well as data and commands to the tags. The RFID reader acts like an access point for RFID tagged items so that the tags' data can be made available to business applications.

Figure 3.7: RFID card sensor

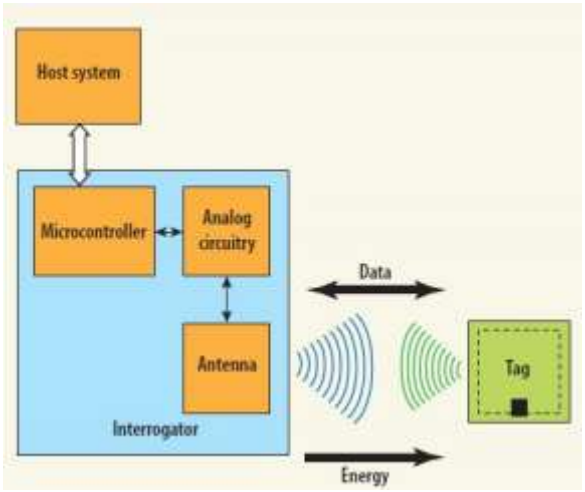

Fig 3.8: working principle of RFID

A computer picks up the data sent to it by the RFID reader. The computer may display the tag's data directly, or it may look the data up in a larger, separate database. For example, a factory uses RFID tags to keep track of car doors. When a truck delivers doors to the loading dock, a reader scans the tags and passes the information to a computer. The computer finds the tag's record in a database and marks the record as "received." When workers paint the doors, another reader scans the doors and marks their records as "painted." In this manner, the factory management can determine exactly how many doors it has, and how many are finished.

Table 3.3: Technical Specifications of RFID scanner

Working Current	13-26 mA/DC 3.3 V
Standby Current	10-13 mA/DC 3.3 V
Sleeping Current	<80 uA
Peak Current	<30 uA
Working Frequency	13.56 MHz
Card reading distance	0～60mm（mifare1 card
Protocol	SPI
Data Communication Speed	Maximum 10Mbit/s
Card types Supported	mifare1 S50、mifare1 S70、mifare UltraLight、mifare Pro、mifare Desfire
Dimension	40mm□60mm
Working Temperature Storage temperature	20—80 degree
Humidity	-40—85 degree
Max SPI Speed	10Mbit/s

There are also some other accessories like solar panel, light, fan, auto door lock used in this project. A DVD drive is used as auto door lock in order to reduce cost the whole project idea is based on a control system that will interconnect the different components of the class room's electrical system. The control system will not only interconnect the different components, but also will take actions according to the predetermined conditions. We are

using an Arduino based micro controller board in that prospect. The RFID based punch card system, automatic door lock, digital led display, solar panel, electrical power distribution system all are connected to this micro controller. We have faced a number of difficulties while working on this project. The first challenge was what we could use as the memory or brain of the system. We have chosen the arduino control board considering the cheapness and easy working principles. Then we were facing difficulties to work our RFID system properly. The RFID scanner was not reading the cards properly. So we used copper wire coils to induce, more power in to the card and thus the scanner could extract the information in the card easily.

4. Work Plan & Technical Design

4.1 Our Project Work Design:

We divided our work in three parts. They are technical part, calculation part and programming part.

Technical part- This part contains all hardware setup.

Calculation part- This part consists of all testing and measurement of hardware things.

Programming part- This part is only for Programming part.

4.2 Plan of designing SMART CLASSROOM:

We divided our classroom in 3 compartments. Each compartment resides certain parts

Figure 4.1: Front View of Smart classroom Design

4.2.1 Compartment 1:

It will reside LCD display and RFID scanner and automatic door lock system. It mainly receives input and passes to the 2nd compartment. This is the compartment of the whole system which is visible from the outside. This compartment contains the RFID scanner, LCD, and the Door Lock system. The students will be given their RFID tags with which they can access the door lock system by punching their tags in the RFID scanner. The display placed in this compartment shows the number of students present and the number of students who are absent in the class. The display also gives information about the class time, starting time of the class, ending time of the class.

Figure 4.2: Compartment 1

4.2.2 Compartment 2:

Compartment 2 contains Arduino, GSM, Motor Driver, Battery, DC power system, Transformer. This is the control room of Smart Classroom. This compartment can also be termed as the heart of the whole system. The inner part of the RFID scanner is also present in this compartment. The inner part of the RFID scanner is connected to the Arduino module and the GSM is also connected with the Arduino module. The GSM collects the information of the number of students who are absent in the class and sends a SMS to the parents of that particular child if he or she is absent in the class. Two batteries are connected together in this compartment. The Batteries are used to generate DC power to the system. Besides, the batteries are used to store the energy collected from the solar panel. A transformer is used here in this compartment. The motor driver is also placed in this part which is used to control the motor of the door lock system.. The connections of the lights and fans are placed here in this compartment

Figure 4.3: Compartment 2

4.2.3 Compartment 3:

This compartment will reside fan and light which will be turned and off automatically. This is the part where the academic activities will be held. This part consists of the lights, fans, auto door lock. The solar panel is mounted on the top of this compartment. The lights and fans will get turned on depending on the timing of the class. Auto door lock system is connected to the RFID system through the Arduino controller.

Figure 4.4: Compartment 3

4.3 Algorithm for Arduino Program:

We have made an Algorithm for Arduino program. It helps to writing our program.

Step1: Program starts at 8:48:40am

Step2: If id punches before 8:59

If yes GOTO step: 3

If no GOTO step: 4

Step3: Access denied

Step4: At 8:59am light & fan will be automatically switched on

Step5: Punch id after 8:59am

Step6: Take input

Step7: input received by RFID

Step8: If card's info matched GOTO step10, otherwsise GOTO step8

Step9: Access denied

Step10: Gate open

Step11: Display that student's name in LCD display

Step12: Gate close

Step13: At 9:00am gate close

Step14: Checks the database who are absent

Step15: At 9:00am starts to send msg to the absent student's number

Step16: At 9:01am gate open and request to leave classroom

Step16: At 9:02am gate close & light fan automatically off

4.4 Cost of Implementation:

Our total cost for implementation of the project is given below. We tried our best to implement the cheapest component and reduce the price and we think we are very much successful

Table 4.3: Total cost of the components

Equipment name	Price
Global System for Mobile Communications (GSM SIM900A)	Tk 2177
Arduino (MEGA2560)	Tk 1300
Radio Frequency Identification (RFID)	Tk 350
Transformer 12V	Tk150
Solar Panel	Tk 890
Display	Tk 399
Motor Driver	Tk 395
Battery	Tk 235
LED	Tk 20
Resistor	Tk 5
Card Board	Tk 400
RFID tags	Tk 30
Total Cost	TK 6351

5. Implementation

5.1 Overview of the Implementation:

The project works were mainly divided into two parts. Hardware and software part. We have first made a flow chart, decided the order works and started the project. The software part was worked primarily. The control board was coded. Then we connected the various hardware units according to the block diagram and the hardware specifications. We had to make significant changes in plan as some of our plan did not worked properly.

For this project we had to use following equipment - Arduino Mega Microcontroller, RFID Scanner, Motor Driver, Transformer, GSM module, LCD display, Light and Fan, Solar Panel, CD ROM

5.2 System Design of the smart classroom:

The major component of our system is the Arduino Microcontroller which is the brain of the system. All other components of the project are directly or indirectly connected with the Arduino microcontroller.

A timer is set to the system. When the time of the timer clock reaches 8:59 the system gets started. With the starting of the system the fan and light of the classroom get automatically turned on and remains on throughout the class time duration.

The access is also enabled with the timer reaches its initializing time. The RFID scanner takes the input when a card is punched into it. It reads the cards input and forwards it to the microcontroller. The microcontroller then matches the input with the existing information of the student's database. If the cards input gets matched, the microcontroller sends a signal to the door lock to open the door. This outgoing signal is amplified by the motor driver as the output signal of the microcontroller is too weak to drive the motor of the CD ROM.

After the timer reaches 9:00, the class time gets started. In this time, no one can enter the class as the door is locked. The microcontroller searches the database for the absent students. After the search operation it forwards an sms to the guardians of the absent students.

The whole system is powered two 12 volts battery. It gets charged by AC supply. A solar panel is also connected to the system.

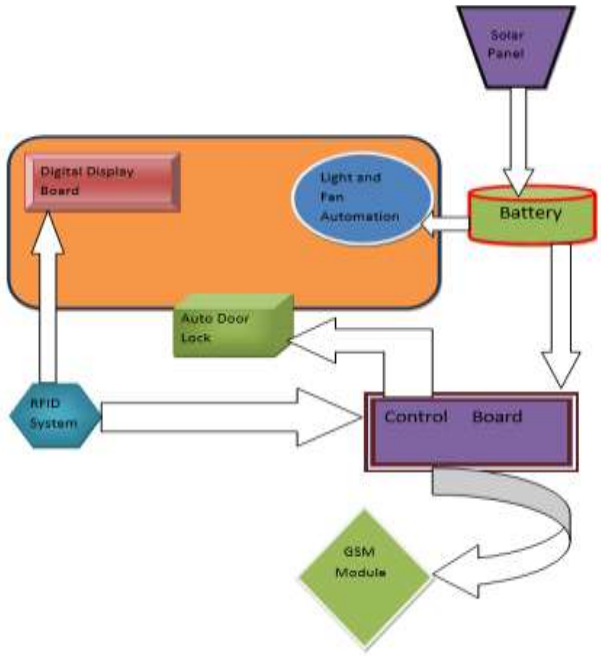

Fig 5.1 : Block diagram of smart classroom

5.3 Software Design

5.3.1 Description of the Software

Our Smart classroom is a microcontroller based design. So an IDE (Integrated Development Environment) is needed to program the Microcontroller. To control the whole system, an user interface is necessary. In this section, we discussed what programming software we have used and how we did it.

5.3.2 Programming Software:

In our Smart Classroom we used An AVR microcontroller from ATMEL has been used. The name of the microcontroller is ATMEGA 2560. Arduino microcontroller platform of ATMEGA has been used. To implement the design we have used Arduino Mega 2560 board.

Arduino programs may be written in any programming language with a compiler. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio .The Arduino project provides the Arduino integrated development environment

IDE for the Processing programming language project and the Wiring project. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one- click mechanism for compiling and loading programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

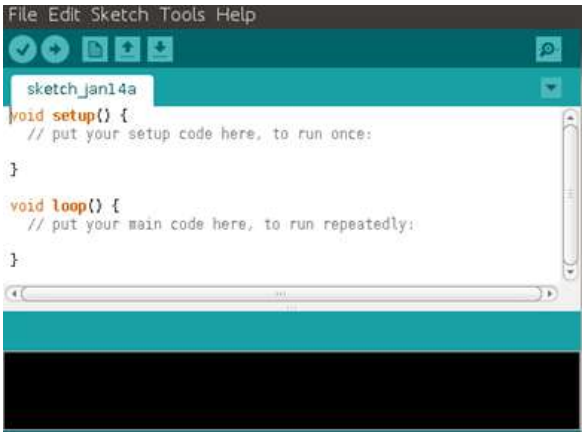

Fig 5.2: Arduino window

The Arduino IDE supports the C and C++ programming languages using special rules of code organization. The Arduino IDE supplies a software library called "Wiring" from the Wiring project, which provides many common input and output procedures.

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

a. Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems.

b. Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing

programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

c. Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR- C code directly into your Arduino programs if you want to.

d. Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

5.4 Summary:

The RFID scanner was not working properly so the device was replaced. But the problem was still existing. So we have added an extra coil in order to amplified induced power to scan the RFID cards.

The door lock and light and fans could not be connected to the control board directly. So we have used an intermediate motor driver to make them work properly.

The battery which stores the solar energy supplies a DC voltage to the circuit. But the control board can only be powered by an AC supply. We have used an inverted to supply AC power to the system.

We could not find a proper door, so we have used a DVD driver instead of that. This eventually reduced our cost.

6. Safety & Compliance

6.1 Safety:

The purpose of safety is to implement the practical safeguarding of persons during operation, installation, or maintenance of the electrical equipments of a project. Every individual electrical engineer has to stick with some rules and regulations posted by IEEE board for their own safety and for the safety of the project. We tried to maintain these rules for the betterment and safety of our project.

6.2 Safety (In terms of component)

6.2.1 Arduino Microcontroller

[2] We made sure that not to apply voltage greater than 12 volts to our board and we applied only direct current. Ardunio works only at DC (direct current). So we had to use an AC-DC transformer. If input and output pin of arduino is shorted, apply a voltage exceeding 5.5V to any I/O pin, power the Arduino through the Vin connector pin, but reverse the polarity of the Vin/GND power connection will cause over current through the circuit that will damage our micro controller.

6.2.2 GSM module

[3] Before handling the module, touch the metal part of the meter first to discharge any dangerous electrostatic charge. If the module is powered, do not touch the conductive path on the module board with metal objects. Lead the external cable of the antenna through the relevant bushing. GSM module should get proper network coverage while placing it in the system. The system should not be placed in a totally enclosed place where it will be hard to get cellular network range.

6.2.3 Power Supply

[6] Every member should inform the other members about the electric supply equipment and the associated lines safeguarding other members from making any mistakes.

6.2.4 Motor Driver

Necessary measures should be taken to safeguard the motor driver as it uses the major amount of current from the power supply. A motor driver is a little current amplifier. [4] The function of a motor driver is to take a low-current control signal and then turn it into a higher-current signal that can drive a motor. All the decisions will be made in the control board, but current coming from the Arduino output is not enough to run the lights, fans or drive the door's motor. So we have used a Motor Driver in order to amplify the current. We had to make sure if there is no short circuit or the connections are made in correct ports in order to work our system properly. All the connections points were well insulated in order to avoid short circuit.

6.2.5 RFID scanner

Using a RFID scanner was the crucial part of this project. We had to make sure that the RFID scanner works properly and accurately. The scanner was tested in terms of its range and timing. Turned coil was used to increase the range of the RFID scanner. It significantly increased its range and usability.

6.2.6 Lights

To avoid overflow of current resistors should be used so that the LED lights don't get burnt out. We have used an additional 10 k ohm resistor for our LEDs. The resistor was used so that the LED lights would remain in a good position and they don't get burnt out.

6.2.7 LCD display

LCD displays cannot run with DC voltage. It will damage the LCD. When soldering DIL pins, avoid excessive heat and

keep soldering temperature between 260℃ and 300℃ for no more than 5 seconds .Keep the temperature within range for use and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or bubble generation. When storage for a long period over 40℃ is required, the relative humidity should be kept below 60%.

Grounding of circuit equipment- [6] Cable sheaths and shields, equipment frames and cases shall be effectively grounded. Conductive material ducts and riser guards that enclose electric supply lines or are exposed to contact with open supply shall be effectively grounded.

6.3 Safety (In terms of overall project):

We have tried not to use equipment with frayed cords, damaged insulation or broken plugs. Using these kinds of components may raise the risk of electrical shock. [1] Always try to use appropriate insulated rubber gloves and goggles while working on any branch circuit or any other electrical circuit. We never tried to repair energized equipment. Always checked that it is de-energized first by using a tester. When an electric tester touches a live or hot wire, the bulb inside the tester lights up showing that an electrical current is flowing through the respective wire. We checked all the wires, the outer metallic covering of the service panel and any other hanging wires with an electrical tester before proceeding with our work. We made sure that all the resistors or wires are connected and used according to the Resistance code and wire code. Electrocution is not the only way that you can be harmed through using electricity incorrectly. Fire can be just as big a risk and can happen at much lower voltages than electrocution. Again this is a high risk with mains electricity, but you should also take this into consideration when working with lower voltage systems such as car or leisure batteries or low voltage lighting all of which are capable of providing very high currents. Fire can be caused by overheating due to overloading a plug socket, or if too high a current going through a particular component or wire. There is obviously a risk of burns whilst soldering, but there is also a risk if a component is touched after it gets hot. [6] Besides, when exposed to a flame or electric arc clothing made from the following composites should not be worn like acetate, nylon, polyester, or polypropylene. Light fittings are well known for their heat but other components such as thyristors and triacs that are switching heavy loads can also cause burns if touched. So, while working on a project it is a part of engineering ethics to make sure the safety and reliability of a system. An ethical engineer should always build a system thinking of the user's safety and comfort.

6.4 Compliance of the project with Various standards

In this part we will discuss about our project whether it meets the standards imposed by different engineering organizations. There are a few distinct standards, amongst which the IEEE standards, US standards and European standards are talked about in this part. The reason for creating and sticking to measures is to guarantee least execution, meet wellbeing prerequisites, ensure that the item/framework/procedure is reliable and repeatable, and accommodate interfacing with other standard-consistent gear and guarantee similarity.

6.5 Compliance with IEEE standard:

IEEE has some specific guidelines for materials but most of them are not the part of our project. But we took IEEE P1619, IEEE 1233 and IEEE P1913 standards which is System Requirements Specification and Security in storage. Besides, we took help from other research papers which are discussed in the related work part. These research papers were met the IEEE standards.

6.6 Compliance with European standard:

RoHS stands for Restriction of Hazardous Substances. It is also known as lead free. It was originated in EU and all products in the EU market after July 1, 2006 have to pass RoHS standard. Six substances are banned by RoHS. These banned substances are lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (CrVI), polybrominated biphenyls (PBB), polybrominated diphenyl ethers (PBDE), and four distinctive phthalates (DEHP, BBP, BBP, DIBP). RoHS specifies maximum levels for the following six restricted materials.

Table 6.1 Maximum specified level of restricted materials

Material name	Specified Maximum level
Lead (Pb)	< 1000 ppm
Cadmium (Cd)	<100 ppm
Mercury (Hg)	<100 ppm
Hexavalent Chromium (Cr VI)	<1000 ppm
Polybrominated Biphenyls (PBB)	<1000 ppm
Polybrominated Diphenyl Ethers (PBDE)	<1000 ppm
Benzyl butyl phthalate (BBP)	<1000 ppm
Dibutyl phthalate (DBP)	<1000 ppm
Diisobutyl phthalate (DIBP	<1000 ppm

As these are very much risky so RoHS restricted to use these substances. In our project we didn't use any of these substances. So, we think that we have met the RoHS standards.

WEEE stands for Waste Electrical and Electronic Equipment Directive. Waste of electrical and electronic equipment (WEEE) such as computers, TV-sets, fridges and cell phones is one the fastest growing waste streams in the EU if these happens then it will turn into a huge problem

by 2020.So WEEE encourage to reuse electrical product. Electronic products can have hazardous content and if they are not properly managed then it will be a huge environmental problem. WEEE encourages to return their electronic product free of cost so that another person can use it.

In our project we used an old DVD drive and a motor driver which was used in another project before that is why we think we are following WEEE standards.

6.7 Compliance with ISO standard:

ISO stands for International Organization for Standardization. It was founded on 23 February 1947. The headquarter of ISO is situated in Geneva, Switzerland. 163 countries are members of ISO. ISO has several standards which are followed in different fields. These standards help businesses increase productivity while minimizing errors and waste. The standards also serve to safeguard consumers and the end-users of products and services, ensuring that certified products conform to the minimum standards set internationally.

Our project is based on renewable energy. So it was very important to minimize the energy cost and develop a policy for more efficient use of energy. We had to deal with energy management. We tried to maintain [12] the ISO 50001:2011 standard which deals with Energy Management System. Besides, we also maintained [13] the ISO 14000:2015 standard which states about Environmental Management. We think that we successfully maintained these two standards imposed by ISO.

6.8 Summary

In this section we saw that our project is following all those standards which is recognized all over the world which is really pleasant. It is very much necessary to maintain these measures and we have done it perfectly

7. Design Impact

7.1 Economic Impact:

Our SMART CLASSROOM is produced in low cost. Classroom is built in such a way that normal school and college can afford it easily and use it. The whole system is low power consuming which makes it cost efficient

7.2 Environmental Impact:

Our main purpose was to make something green so that we made energy efficient smart classroom. Whole system is controlled by solar panel. Light and fan will be automatically switched on in class time and will be switched off when it will be finished which will save huge amount of energy.

7.3 Social Impact:

SMART CLASSROOM has an option to send message to the absent student's parents number so that guardian can easily know whether their children are attending the class or not. Recently terrorist have been attacked in Dhaka and varsity students were involved in it. So parents were so much concern about their children whether they are attending the class or not so this might be a good solution for them

7.4 Manufacturability:

Manufacturing of the classroom is really simple and cost effective. The parts of our project are available in the market and it is easy to build. We think the cost of our project will be reduced if it will build commercially.

8. Testing & Evaluation

8.1 RFID Testing

Testing the electrical equipment is an essential part of an electrical project. We have also tested the equipment we have used for our project. So far we have completed the Door Lock System which we have already displayed in the first part of our project. In the Door Lock System we have used a Radio Frequency Identification (RFID). The use of this RFID is to take the input of the students of the class by using a card and to decide whether the student belongs to the class or not. We have considered several ranges to see from how far the students can punch their cards. The testing results are shown in the following table,

Table8.1: Testing of RFID scanner

SL.NO	RANGE(From the RFID to the card)	RESULT
1	0 cm	Positive
2	0.5 cm	Positive
3	0.8 cm	Positive
4	1 cm	Positive
5	1.3 cm	Positive
6	1.8 cm	Positive
7	2 cm	Positive
8	2.3 cm	Positive
9	2.6 cm	Positive
10	3 cm	Positive
11	3.2 cm	Positive
12	3.7 cm	Positive
13	4.2 cm	Positive
14	4.6 cm	Positive
15	5 cm	Positive
16	5.4 cm	Positive
17	5.7 cm	Positive
18	6 cm	Positive
19	6.2 cm	Positive
20	6.6 cm	Negative
21	7.1 cm	Negative
22	7.5 cm	Negative

So, from the table and from our testing results we have seen the RFID works when the card is punched at a distance of 6.2 cm. After 6.2 cms the RFID does not work that is the RFID cannot take the input of the user.

8.2 GSM

As mentioned above we have used GSM module in our project. The GSM module is one of the essential electrical equipment of our project. We have tested the GSM module by using different SIM cards of different mobile operators. And, for all the mobile operators the GSM gave a positive output i.e. the message that was supposed to be sent to the parents of the students was sent successfully.

8.3 Door Lock System

We have also tested the Auto Door Lock System several times to ensure that it works absolutely perfectly. We have used different ID Cards and tags that were programmed in our database. We have also used some ID cards as well as some tags that were not programmed in our database. And, in all the cases the Door Lock Sytem worked perfectly.

8.4 Arduino

We have programmed our codes in the arduino. So far we have not faced any problems with our arduino.

8.5 Other Electrical Equipment

Other equipment includes Solar panel, lights, fans, display. Since this is a prototype, we have used one light, one fan, one display, one solar panel and one battery in our project. We have tested all of these thoroughly and no faults were detected.

9. Conclusion & Future Works

Our goal is to improve our class room environment and make it green as much possible as we can. Smart classroom will be user friendly and very much cost effective .Our project's main attraction is sending an automatic message to parents mobile phone who is absent for that class which is very much necessary for the parents to know that his/her son/daughter is attending the class or not. We are hoping that we will thing effectively

Population is increasing rapidly in Bangladesh but we do not have sufficient electricity energy system to provide them so that we have to think about solar energy system. Our Smart Classroom project is running by solar panel which saves the energy. Our fan and light automation system also saves energy because it will switch on exactly when the class start and will switch off when the class end. Somtimes it is very much noticeable that students do not turn off light after leaving the class our smart system do not care whether students are interested to turn it off or not. It will automatically do it by itself. After terrorist attack in Dhaka parents of University students are very concern about their children whether they are attending the class or not because maximum university students were involved in that attack. Our Smart classroom system will give them relief because if a student is absent our system will send an sms to his/her parents number. In future we can add many more features we if we want to work with it. In this digital world, Smart Classroom will become a very useful thing in our day to day life

Our project has got good some possibilities to develop for the future generation as the education system in the upcoming future will be more technology based. If we would develop our project in the near future then we would add some more effective features. The features may include technologies like running a projector or computer in the classroom with the help of renewable energy. We would like to put the idea of the need of green environment into the minds of the general mass by developing our project in the near future. Moreover, running a classroom with all its utilities by the help of renewable energy would decrease the need of fossil fuel which is already diminishing in a very high rate.

10. Bibliography

[1]Babu, Sunil, Drupad (2015, June) GSM Based Smart Agriculture System with Auto Solar Tracking .Retrieved from

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwit3dzllrLNAhXkA8AKHeWJDS0QFggcMAA&url=http%3A%2F%2Fwww.researchpublish.com%2Fdownload.php%3Ffile%3DGSM%2520Based%2520Smart%2520Agriculture%2520System%2520with%2520Auto%2520Solar%2520Tracking-1649.pdf%26act%3Dbook&usg=AFQjCNH1Pg7_ZGYmZOr5uV73eCF7WW93Tg&bvm=bv.124817099,d.ZGg

[2] (2011, August) RFID Based Attendance System .Retrieved from http://circuitdigest.com/microcontroller-projects/rfid-based-attendance-system

[3]Augusta , Gaddam Manoj, Gunda (2013,June) Automatic Attendance Marking and Parent Alerting System Using RFID And GSM, .Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwi-teWHprHNAhVFL8AKHeDlAFEQFggcMAA&url=http%3A%2F%2Fijirse.in%2Fdocs%2FApr14%2FIJIRSE140410.pdf&usg=AFQjCNFFeGqf-vzYNdIUl2it_AlSy_uP9w

[4] Rajesh, Sinchana, Suhash (2014, August) BUILDING AUTOMATION SYSTEM USING SOLAR POWER, Mehta , Majithia (2014, October)RFID based Employee Attendance & Database Management System. Retrieved from http://ismitmajithia.weebly.com/uploads/2/2/9/8/22984604/project_report_on_read_system_final.pdf

Retrieved from

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjVkcL-

n7LNAhXkJsAKHSNCDckQFggcMAA&url=http%3A%2F%2Firaj.in%2Fup_proc%2Fpdf%2F100-14097399886-8.pdf&usg=AFQjCNGqyKDjGv7nEf8BWXelWBawC5Rw0g&bvm=bv.124817099,d.ZGg

[5] M. Weiser, "The Computer for the Twenty-First Century", Scientific American, September 1991,Vol. 265, pp.66-75.

[6] S. K. S. Gupta, W. Lee, A. Purukayastha, and P. Srimani. (editorial). IEEE Personal Communications, Special Issue on Pervasive Computing, August 2001, Vol. 8, No. 4. pp. 8-9.

[7] G. Abowd and E. Mynatt, "Charting Past, Present, and Future Research in Ubiquitous Computing", ACM Trans. Computer Human Interaction, March 2000.Vol. 7, No.1, pp. 29-58. Student PDA Instructor Figure 5: Instructor is giving feedback to a student group in the Smart Classroom.9

[8] S. Yau, F. Karim, Y. Wang, B. Wang, and S. K. S. Gupta "Reconfigurable context -sensitive middleware for pervasive computing", IEEE Pervasive Computing, 1(3), July-September 2002, IEEE Computer Society Press, pp. 33-40.

[9] S. Yau, Y. Wang and F. Karim, "Development of situation-aware application software for ubiquitous computing environment", Proc. 26th Int'l Computer and Software Applications Conf. (COMPSAC 2002), August 2002, pp. 233-238.

[10] S. S. Yau and F. Karim, "Adaptive Middleware for Ubiquitous Computing Environments", Proc. Of IFIP 17th WCC, August 25-29, 2002, Vol. 219, pp. 131-140.

[11] Internet Engineering Task Force (IETF), Mobile Ad Hoc Networks Charter. URL:http://www.ietf.org/html.charters/manet-charter.html

[12] H. Abut and Y. ztrk, "Interactive Classroom for DSP/Communications Courses," Proc. of ICASSP 1997 s, April 1997, Vol. 1, pp. 15-18.

[13] C. Han, J. Gilbert, "A Smart e-School Framework", Proc. of Scuola Superiore G. Reiss Romoli (SSGRR), 2000. URL: http://www.ssgrr.it/en/ssgrr2000/papers/187.pdf

[14] C. Sun, S. Lin, "Learning collaborative design: A learning Strategy on the Internet", Proc. of 31th ASEE/IEEE Frontier in Education Conference, 2000. URL: http://citeseer.nj.nec.com/505392.html

[15] L. Kilmartin, E. Ambikairajah, "Digital Signal Processing Education in Ireland and Austrilia", Proc. of First Signal Processing Education Workshop, 2000. URL: http://citeseer.nj.nec.com/405083.html

[16] A. Chen et al., "A Support Infrastructure for Smart Kindergarten," IEEE Pervasive Computing, Vol. 1, no. 2, April–June 2002, pp. 49–57.

[17] G.D. Abowd, "Classroom 2000: An Experiment with the Instrumentation of a Living Educational Environment," IBM Systems J., October 1999, Vol. 38, no. 4, pp. 508–530.

[18] F. Chen, B. Myers and D. Yaron, "Using Handheld Devices for Tests in Classes", Carnegie Mellon University School of Computer Science Technical Report, no. CMU-CS-00-152 and Human Computer Interaction Institute Technical Report CMU-HCII-00-101, July 2000. URL:http://www2.cs.cmu.edu/~pebbles/papers/CMU-CS-00-152.pdf

[19] M.B. Tinzmann, B.F. Jones, T.F. Fennimore, J. Bakker, C. Fine, and J. Pierce, "What Is the Collaborative Classroom?", NCREL, Oak Brook, 1990. URL:http://www.ncrel.org/sdrs/areas/rpl_esys/collab.htm

[20] C. Bonwell, & J. Eison, "Active learning: Creating excitement in the classroom", ASHE-ERIC Higher Education Report No. 1, Washington, DC: George Washington University, 1991.