SMART CLASSROOM

A Product Oriented Mini Project work submitted in partial fulfillment of the
The requirement for the award of the degree of

BACHELOR OF TECHNOLOGY
In
ELECTRONICS & COMMUNICATION ENGINEERING

By

M. VENKATA AKHIL (16211A04D3)
N. PRADEEP (16211A04D6)
M. RAMA SAI KAUSHIK (16211A04E7)

Under the esteemed guidance of
Dr. R. Balaji
Associate Professor

B. V. Raju Institute of Technology
Department of Electronics and Communication Engineering Vishnupur,
Narsapur, Medak. (Dist.) - 502313

2019 – 2020

B. V. Raju Institute of Technology
Vishnupur, Narsapur, Medak. (Dt) Pin: 502313
(Affiliated to JNTU, Hyderabad)
Ph:08458-222000, 222001 Fax:08458-222002
Department of Electronics & Communication Engineering

CERTIFICATE

This is to certify that the Mini Project work entitled on the SMART CLASSROOM is being submitted by Mr. M. Venkata Akhil (16211A04D3), Mr. N. Pradeep (16211A04D6), Mr. M. Rama Sai Kaushik (16211A04E7) in partial fulfillment of the requirement for the award of the degree of **B.Tech. in Electronics & Communication Engineering**, by Jawaharlal Nehru Technological University Hyderabad is a record of bonafide work carried out by them under my guidance and supervision from 2019 to 2020.

The results presented in this project have been verified and are found to be satisfactory.

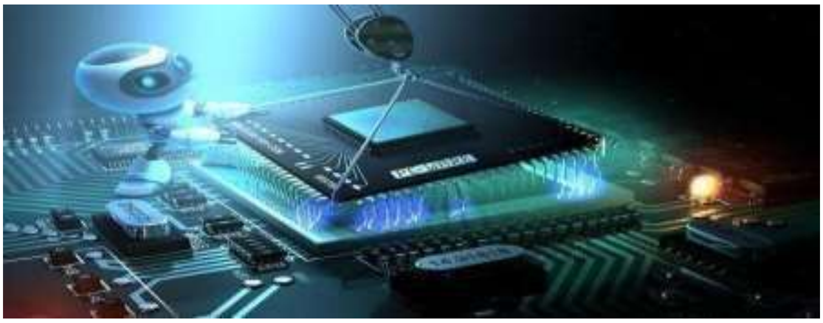
Dr. R. Balaji
Associate Professor
(INTERNAL GUIDE)

Dr. I. A. Pasha
M.E, PhD, Post Doc., MISTE, MIEEE.
Professor & HOD, Dept. of ECE

EXTERNAL EXAMINER

Dept. of Electronics and Communications Engineering

Centre for Embedded Systems Design



CERTIFICATE

This is to certify that Mr./Ms. M. Venkata Akhil, N. Pradeep, M. Rama Sai Kaushik bearing Roll Nos. 16211A04D3, 16211A04D6, 16211A04E7 has successfully completed his/her training on Embedded systems and Implemented a Project titled **“SMART CLASSROOM”** in Centre for Embedded Systems Laboratory, B.V. Raju Institute of Technology from **2019** to **2020**.

Coordinator   Head of the Department

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We take the opportunity to express our indebted gratitude to the persons who contributed to our work, for being our inspiration and guide, which led to the successful completion of the project.

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By
M. VENKATA AKHIL (16211A04D3)
N. PRADEEP (16211A04D6)
M. RAMA SAI KAUSHIK (16211A04E7)

DECLARATION

We hereby declare that the project entitled **"A CLASSROOM SCHEDULING SERVICE FOR SMART CLASSES"** submitted to B V. Raju Institute of Technology, affiliated to Jawaharlal Nehru Technological University, Hyderabad for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering is a result of original project work done by us.

It is further declared that the project report on any part, therefore, has not been previously submitted to any University or Institute for the award of degree or diploma.

ABSTRACT

Smart products have infiltrated the market with the intention to make our lives easier- at home, in the workplace, everywhere. Technology benefited us in every aspect of our life right from communication to education. It is a new vision in education. The use of technology can bring a huge change in education. The smart learning approach provides learners of all ages and walks of life with a framework and a host of smart thinking tools that motivate higher levels of understanding.

The education system of countries like India has made students follow a stereotyped method of learning. Students are practiced to take notes on continuous lectures. This has eventually decreased the listening capability of students and also students who absent themselves to classes find it difficult to follow-up the portions. This system proposes to develop a method in which the lectures are taken as notes automatically; students just need to listen to classes. Teachers respective to all the departments will be identified using an RFID reader and notes are maintained as a database. At the end of the day, the notes will be sent as mail to students who are absent from classes.

Thereby by the concept of the smart classroom, we can emphasize learning the concepts which result in innovative and interactive learning sessions ultimately enhancing the performance of students.

PREFACE

As a part of the B.Tech curriculum and in order to gain practical knowledge in the field of electronics and communication, we are required to make a project report on "**SMART CLASSROOM**". The report is prepared with the view to include all the details regarding the project that I carried out. The basic objective behind doing this project report is to get knowledge of different software tools and hardware components used.

In this project, we have included various concepts, technology, and implementation regarding Smart classroom. Subject to the limitation of time efforts and resources every possible attempt has been made to study the problem deeply.

Doing this project report helped us to enhance our knowledge regarding the work. Through this report, we come to know about the importance of teamwork and the role of devotion towards the work.

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1.1 Introduction to Embedded Systems:

An embedded system can be defined as a computing device that does a specific focused job. Appliances such as the air-conditioner, VCD player, DVD player, printer, fax machine, mobile phone, etc. are examples of embedded systems. Each of these appliances will have a processor and special hardware to meet the specific requirement of the application along with the embedded software that is executed by the processor for meeting that specific requirement. The embedded software is also called “firmware”. The desktop/laptop computer is a general-purpose computer. You can use it for a variety of applications such as playing games, word processing, accounting, software development and so on. In contrast, the software in the embedded systems is always fixed listed below:

Embedded systems do a very specific task, they cannot be programmed to do different things. Embedded systems have very limited resources, particularly memory. Generally, they do not have secondary storage devices such as the CDROM or the floppy disk. Embedded systems have to work against some deadlines. A specific job has to be completed within a specific time. In some embedded systems, called real-time systems, the deadlines are stringent. Missing a deadline may cause a catastrophe-loss of life or damage to property. Embedded systems are constrained for power. As many embedded systems operate through a battery, the power consumption has to be very low.

Some embedded systems have to operate in extreme environmental conditions such as very high temperatures and humidity.

1.1.1 Overview of Embedded System Architecture

Every embedded system consists of custom-built hardware built around a Central Processing Unit (CPU). This hardware also contains memory chips onto which the software is loaded. The software residing on the memory chip is also called the ‘firmware’. The embedded system architecture can be represented as a layered architecture as shown in Fig.

The operating system runs above the hardware, and the application software runs above the operating system. The same architecture is applicable to any computer including a desktop computer. However, there are significant differences. It is not compulsory to have an operating system in every embedded system. For small appliances such as remote control units, air conditioners, toys etc., there is no need for an operating system and you can write only the software specific to that application. For applications involving complex processing, it is advisable to have an operating system. In such a case, you need to integrate the application software with the operating system and then transfer the entire software on to the memory chip. Once the software is transferred to the memory chip, the software will continue to run for a long time you don't need to reload new software.

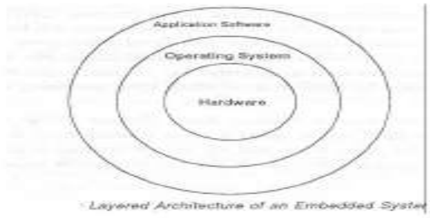


Figure 1 Layered Arcitrcture of embedded system

Now, let us see the details of the various building blocks of the hardware of an embedded system. As shown in Fig. the building blocks are;

· Central Processing Unit (CPU)

· Memory (Read-only Memory and Random Access Memory)

· Input Devices

· Output devices

· Communication interfaces

· Application-specific circuitry

Central Processing Unit (CPU):

The Central Processing Unit (processor, in short) can be any of the following: microcontroller, microprocessor or Digital Signal Processor (DSP). A micro-controller is a low-cost processor. Its main attraction is that on the chip itself, there will be many other components such as memory, serial communication interface, analog-to-digital converter etc. So, for small applications, a micro-controller is the best choice as the number of external components required will be very less. On the other hand, microprocessors are more powerful, but you need to use any external components with them. D5P is used mainly for applications in which signal processing is involved such as audio and video processing

Memory:

The memory is categorized as Random Access 11emory (RAM) and Read-Only Memory

(ROM). The contents of the RAM will be erased if power is switched off to the chip, whereas ROM retains the contents even if the power is switched off. So, the firmware is stored in the ROM. When power is switched on, the processor reads the ROM; the program is executed.

Input devices:

Unlike the desktops, the input devices to an embedded system have very limited capability. There will be no keyboard or a mouse, and hence interacting with the embedded system is no easy task. Many embedded systems will have a small keypad-you press one key to give a specific command. A keypad may be used to input only the digits. Many embedded systems used in process control do not have any input device for user interaction; they take inputs from sensors or transducers 1’fnd produce electrical signals that are in turn fed to other systems.

Output devices:

The output devices of the embedded systems also have very limited capability. Some embedded systems will have a few Light Emitting Diodes (LEDs) to indicate the health status of the system modules, or for visual indication of alarms. A small Liquid Crystal Display (LCD) may also be used to display some important parameters.

Communication interfaces:

The embedded systems may need to, interact with other embedded systems as they may have to transmit data to a desktop. To facilitate this, the embedded systems are provided with one or a few communication interfaces such as RS232, RS422, RS485, Universal Serial Bus (USB), IEEE 1394, Ethernet etc.

Application-specific circuitry:

Sensors, transducers, special processing, and control circuitry may be required fat an embedded system, depending on its application. This circuitry interacts with the processor to carry out the necessary work. The entire hardware has to be given power supply either through the 230 volts main supply or through a battery. The hardware has to design in such a way that the power consumption is minimized.

1.1.2 Why embedded systems are attractive?

1) **Autonomous:** That means you can build a system specific to a particular application. For instance, some standard peripherals and a specialized program can turn a microcontroller unit into a washing machine controller or an oven controller. Also, embedded systems can be built specifically for the requirement. Unlike a PC that you can not work with without a monitor, an embedded system may not mandatorily need a display unit.

2) **Low Cost:** The cost of the microcontroller unit is a magnitude scale lower than a full-fledged computer.
3) **Low Space:** An embedded system takes way too little space when you compare it with even the sleekest of laptops. So you can put such a system in your hardware system quite efficiently.
4) **Low power:** Most of the common microcontrollers out there which are popular choices for embedded systems operate at 5V and often need 5v regulated power supply which can be provided through a simple 9v standard battery with voltage regulator or directly from main by using a voltage rectifier with filter circuit.
There are many other factors that include I/O speed and cost, energy consumption par instruction and so on.

1.1.3 Application Areas

Nearly 99 percent of the processors manufactured to end up in embedded systems. The embedded system market is one of the highest growth areas as these systems are used in every market segment- consumer electronics, office automation, industrial automation, biomedical engineering, wireless communication, data communication, telecommunications, transportation, military and so on.
Consumer appliances:
At home, we use a number of embedded systems which include a digital camera, digital diary, DVD player, electronic toys, microwave oven, remote controls for TV and air-conditioner, VCO player, video game consoles, video recorders etc. Today’s high-tech car has about 20 embedded systems for transmission control, engine spark control, air-conditioning, navigation etc. Even wristwatches are now becoming embedded systems. The palmtops are powerful embedded systems using which we can carry out many general-purpose tasks such as playing games and word processing.
Office automation: The office automation products using em embedded systems are copying machines, fax machines, key telephones, modem, printer, scanner etc.
Industrial automation: Today a lot of industries use embedded systems for process control. These include pharmaceutical, cement, oil exploration, nuclear energy, electricity generation, and transmission. The embedded systems for industrial use are designed to carry out specific tasks such as monitoring the temperature, pressure, humidity, voltage, current etc., and then take appropriate action based on the monitored levels to control other devices or to send information to a centralized monitoring station. In the hazardous industrial environment, where human presence has to be avoided, robots are used, which are programmed to do specific jobs.

Medical electronics: Almost every medical equipment in the hospital is an embedded system. These types of equipment include diagnostic aids such as ECG, EEG, blood pressure measuring devices, X-ray scanners; equipment used in blood analysis, radiation, colonoscopy, endoscopy etc. Developments in medical electronics have paved the way for a more accurate diagnosis of diseases.

Computer networking: Computer networking products such as bridges, routers, Integrated Services Digital Networks (ISDN), Asynchronous Transfer Mode (ATM), X.25 and frame relay switches are embedded systems which implement the necessary data communication protocols. For example, a router interconnects two networks. The two networks may be running different protocol stacks. The router's function is to obtain the data packets from incoming pores, analyze the packets and send them towards the destination after doing necessary protocol conversion. Most networking equipment, other than the end systems (desktop computers) we use to access the networks, are embedded systems

Telecommunications: In the field of telecommunications, embedded systems can be categorized as subscriber terminals and network equipment. The subscriber terminals such as key telephones, ISDN phones, terminal adapters, web cameras are embedded systems. The network equipment includes multiplexers, multiple access systems, Packet Assemblers Dissemblers (PADs), sate11ite modems, etc. IP phone, IP gateway, IP gatekeeper etc. are the latest embedded systems that provide very low-cost voice communication over the Internet.

Wireless technologies: Advances in mobile communications are paving way for many interesting applications using embedded systems. The mobile phone is one of the marvels of the last decade of the 20'h century. It is a very powerful embedded system that provides voice communication while we are on the move. The Personal Digital Assistants and the palmtops can now be used to access multimedia services over the Internet. Mobile communication infrastructure such as base station controllers, mobile switching centers is also powerful embedded systems.

Insemination: Testing and measurement are the fundamental requirements in all scientific and engineering activities. The measuring equipment we use in laboratories to measure parameters such as weight, temperature, pressure, humidity, voltage, current, etc. are all embedded systems. Test equipment such as oscilloscope, spectrum analyzer, logic analyzer, protocol analyzer, radio communication test set etc. are embedded systems built around powerful processors. Thank miniaturization, the test and measuring equipment are now becoming portable facilitating easy testing and measurement in the field by field-personnel.

Security: Security of persons and information has always been a major issue. We need to protect our homes and offices; and also the information we transmit and store. Developing embedded systems for security applications is one of the most lucrative businesses nowadays. Security devices at homes, offices, airports, etc. for authentication and verification are embedded systems. Encryption devices are nearly 99 percent of the processors that are manufactured end up in~ embedded systems. Embedded systems find applications in every industrial segment- consumer electronics, transportation, avionics, biomedical engineering, manufacturing, process control and industrial automation, data communication, telecommunication, defense, security etc. Used to encrypt the data/voice being transmitted on communication links such as telephone lines. Biometric systems using fingerprint and face recognition are now being extensively used for user authentication in banking applications as well as for access control in high-security buildings.

Finance: Financial dealing through cash and cheques are now slowly paving way for transactions using smart cards and ATM (Automatic Teller Machine, also expanded as Any Time Money) machines. The smart card, of the size of a credit card, has a small micro-controller and memory; and it interacts with the smart card reader! ATM machine and acts as an electronic wallet. Smart card technology has the capability of ushering in a cashless society. Well, the list goes on. It is no exaggeration to say that eyes wherever you go, you can see, or at least feel, the work of an embedded system!

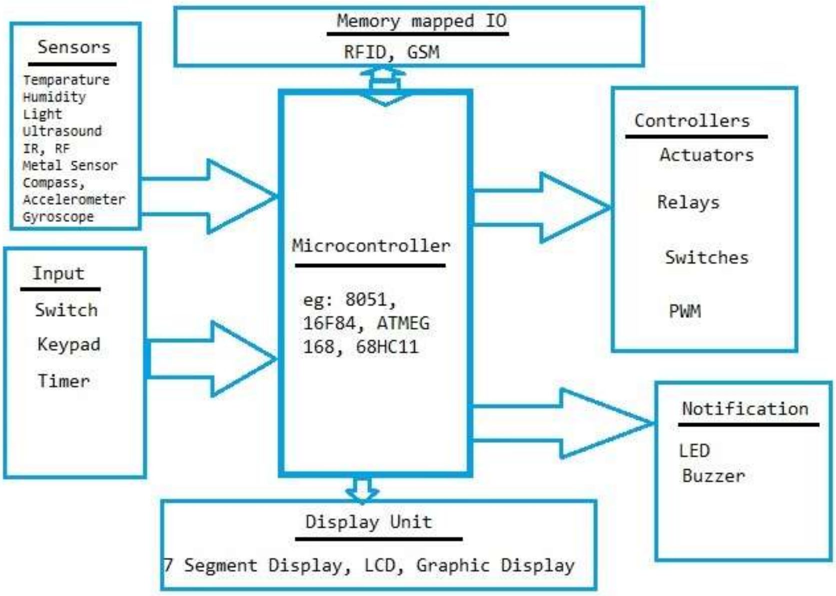


Figure 2 Basic Embedded System

1.2 Introduction to the Internet of Things (IoT)

The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. So the Internet of Things or IoT basically is connecting Embedded System to the internet. Having understood what an embedded system is and what a modern embedded board is all about it is not too difficult to perceive the idea of IoT.

Consider the following schematic of a temperature sensor being connected to Arduino

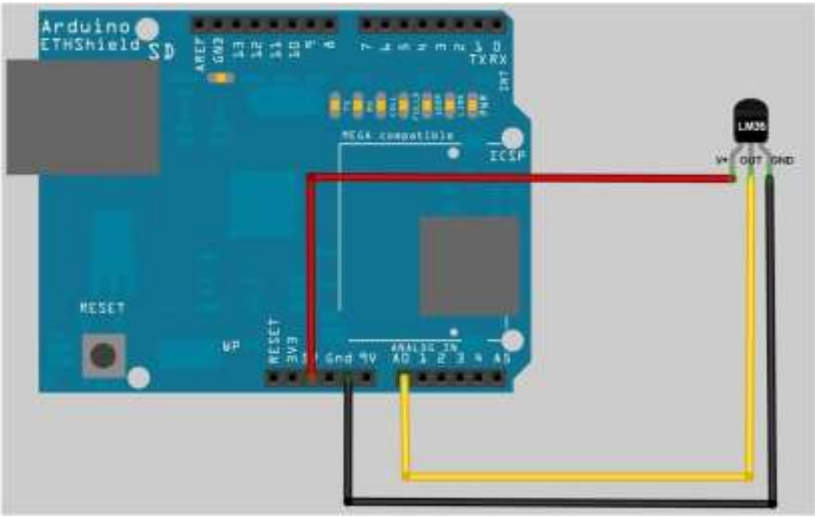


Figure 3 Temperature sensor LM-35 Connection with Arduino

How about getting the temperature information in your mobile phone? or Getting the temperature as a tweet after a certain interval?

Doesn't the scheme look attractive? Yes, it surely does. If you can connect your embedded device into the internet, you can get sensor information online which can be viewed in a wide range of devices including your tablet and mobiles. You can also control devices over the internet. You can actually have several home appliances connected to your embedded system and the embedded system being connected to the internet with a unique IP address. Then you can actually instruct the device to turn on or off certain peripheral devices by generating the instruction online.

So the Internet of Things or IoT is an architecture that comprises specialized hardware boards, Software systems, web APIs, protocols that together create a seamless environment that allows smart embedded devices to be connected to the internet such that sensory data can be accessed and control system can be triggered over internet.

Also, devices could be connected to the internet using various means like WiFi, Ethernet and so on. Furthermore, devices may not be needed to be connected to the internet independently.

Rather a cluster of devices could be created (for example a sensor network) and the base station or the cluster head could be connected to the internet. This leads to more abstract architecture for communication protocols which range from high level to low level.

The following diagram explains what is IoT all about.

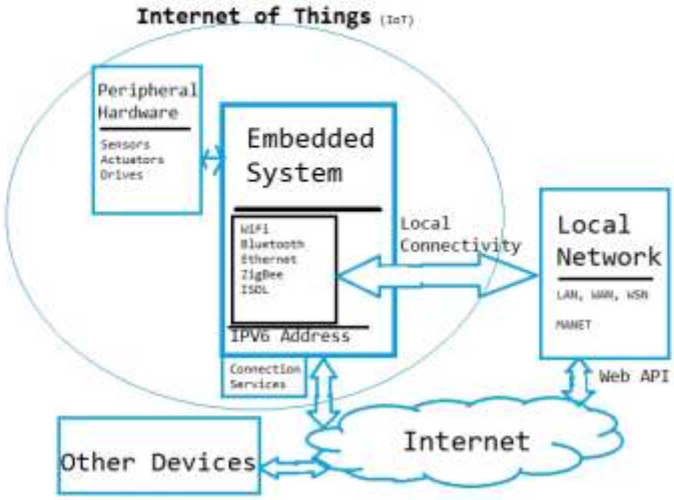


Figure 4 Internet of Things (IoT) basic Architecture

Most interestingly, these devices must be uniquely discovered. For the unique discovery of the devices in a network, they need to have a unique IP address. As a number of IoT devices online is expected to suppress 20 billion marks and that IPv4 can only support up to 4Billion unique addresses, IoT devices essentially have IPv6 addressing scheme. All these devices have either fixed or Subnet masked IP addresses of type v6.

Unique IP addresses make IoT devices discoverable on the internet as an independent node. This is the most important concept to have in mind to understand IoT.

1.2.1 - Cloud Platform for IoT

Let's re-discuss the possibilities to beverage vending machines once more in terms of sheer possibilities. In the conventional vending machine you need to press a button or put a coin to trigger the process of liquid flow, which stops after a certain quantity. Now how about integrating PayPal or Google money with the vending machine? How about a customer discovering the vending machine as "website" along with its location and then pays online for a glass of beverage. Once payment is successful he gets an access token. He can pass the token to the machine through NFC and bingo he gets his drink.

Now, this logical possibility is very important for understanding IoT and IoT really can bring several services (like online payment gateway), several hardware platforms (like the embedded board of the vending machine) and smart objects and data like NFC, GPS into a seamless environment.

Now if you can integrate online payment into a beverage vending machine, why not in for a community washing machine? If you are using location service for the beverage machine, then why not utilize the location and payment service for the toll gate? Why not get the data of a medical diagnosis like ECG (acquired through another embedded board pertaining to medical electronics) into cloud such that several doctors can view it and form a comprehensive opinion about the patient's state?

Well, in fact, all of them are possible. A little understanding of web and software design would take your mind towards cloud. Just like Web of Machines, in a Machine to Machine (M2M) or Machine to Objects (M2O) or any similar communication several modules will be common and several modules demand data be available for sharing. Cloud APIs come in handy in this regard.

For instance, when you have to make a device discoverable on the web, you have to assign a fixed IP address, maintain a router and follow several networking skills. You might not have the knowledge and infrastructure needed for maintaining a commercial sophisticated network for IoT.

Yale is a great example of what services and cloud can bring to the table. This provides connection as a service such that your device is easily discoverable and communicable over the web without much hassle and take care of underneath security.

OpenIoT is an open-source IoT platform that provides out of other services a unique Sensing as a Service.

Google has already integrated location services with it's a cloud. Location extracted from your devices is silently put in your status updates on Facebook and Twitter and is also used for more personalized searches.

So cloud APIs have a great potential in IoT in all levels of architecture starting from firmware to hardware to more top-level architecture.

Figure 5 IOT Arcitecture

1.3 Motivation

The education system of countries like India has made students follow a stereotyped method of learning. Students are practiced to take notes on continuous lectures. This has eventually decreased the listening capability of students. Also, students, who are absent from classes find it difficult to follow-up the portions. This system proposes to develop a method in which the lectures are taken as notes automatically and students just need to listen to classes. Notes are maintained as a database and at the end of the day, the notes will be sent as mail to students who are absent to classes.

Thus the students can now emphasize learning the concepts that motivate higher levels of understanding resulting in innovative and interactive learning sessions, ultimately, enhancing the performance of students.

1.4 Objective

The main objective of this project is to introduce a system, which can overcome the stereotype method of learning where the students are practiced to take notes on continuous lectures. And also to develop a method such that the students who are absent to classes and find it difficult to follow-up the portions can now easily access the lecture notes of that class.

Chapter 2
LITERATURE SURVEY

Our literature review for analysis of the smart classroom system's requirements focused preferentially on the development of pedagogies. In other words, the literature review was conducted with a focus on smart pedagogies—which are novel teaching and learning methods developed and promoted according to changes in the educational environment.

2.1 SMART CLASS, NOV 2016:

By,

Dr. V.K. Maheshwari,

Former Principal, K.L.D.A.V. (P.G) College, Roorkee, India.

Until now, education has mainly relied on instructor-centered approaches in which knowledge is delivered one-sidedly from instructors to learners. The face of education is changing with the development and maturity of educational culture. No explanation of learner-centered learning would be complete without a discussion of constructive learning. In constructive learning, teachers are encouraged to help their students have a better understanding of given information and work out new things—or transform old things—using smart class models, where, there will be computers, projectors, internet connectivity and other multimedia devices such as home theatre, etc being employed as teaching aids. We observe that the role of a teacher may be modified in such a new environment, but the students are still practiced to take notes on continuous lectures.[4]

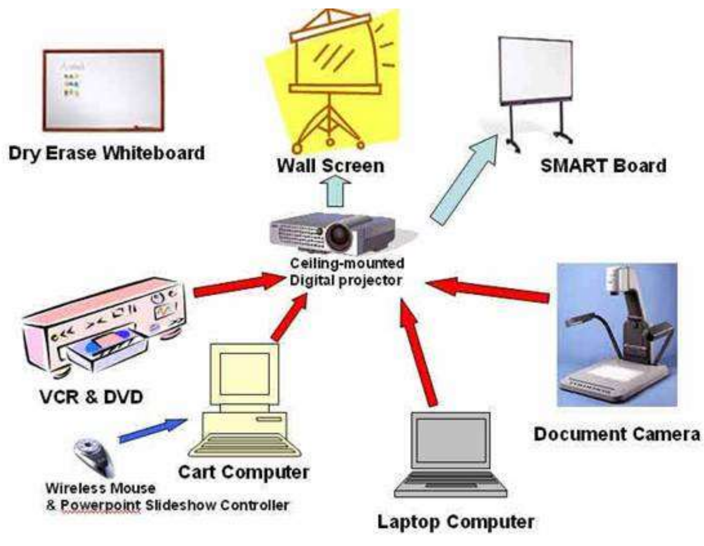


Figure 6 Model proposed by Dr. V.k. Maheswari

2.2 FUTURE CLASSROOMS, OCT 2018.

By,

Johnston, Professor,

Indiana University.

In the proposed system by Julie Johnston, In the class, students waiting in the hallway receive, just-in-time information about that day's lecture (e.g., group assignments, exams, etc.) in the form of a message. Here only the information about what the class is going to be is shared, also the problem that students need to take notes during the lecture still exists.

The goal of Indiana University's Future Classroom project is to build a learning environment that anticipates and automates common classroom tasks to make better use of faculty and student instructional time. They believe that many emerging technologies can positively affect the experience of students and faculty in classrooms in a variety of ways, including efficiency, learning experience, and comfort. The smart classroom will offer faculty and students a technology-rich space, reduce complexity and minimize support requirements.[2]

To achieve these goals, we have investigated smart solutions that will:

- Untether instructors from the room's podium, allowing them control from anywhere in the room;
- Streamline the start of class, including biometric login to the room's technology, behind-the-scenes routing of course content to room displays, control of lights and automatic attendance taking;
- Offer whiteboards that can be captured routed to different displays in the room and saved for future viewing and editing;
- Provide small-group collaboration displays and the ability to easily route content to and from these displays; and
- Deliver these features through a simple, user-friendly and reliable room/technology interface.

Chapter 3
SYSTEM DESIGN

3.1 Block Diagram

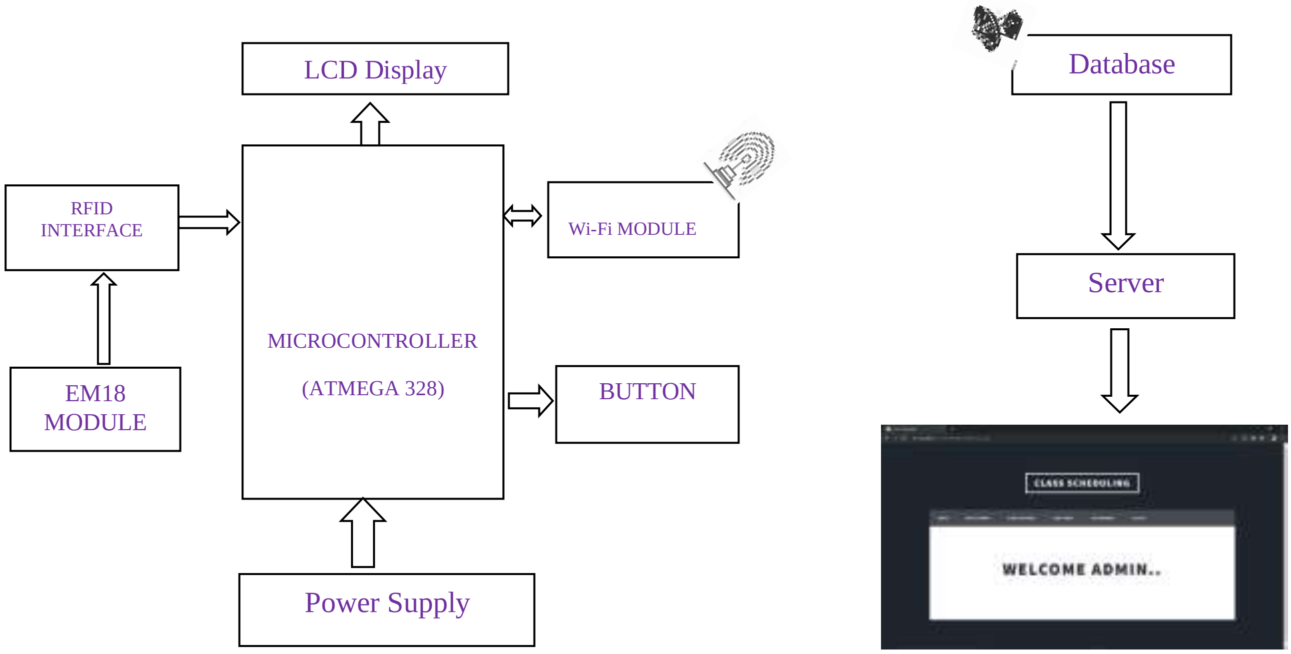


Figure 7 Block Diagram of prototype

This proposed system consists of two sections as shown in the block diagram.

1. Transmitter section
2. Receiver section.

Various blocks are integrated with the transmitter section each of which is discussed below. The power supply section is used to power up the entire setup. The kit is turned on using the button provided. The EM-18 RFID Reader module, an inexpensive solution for your RFID based application, is where the student is required to show your card within the reading distance and the card number is thrown at the output, which is also displayed on the LCD display. Using the interface module, the data captured using the reader module is sent to the microcontroller. The status of all the processes is displayed on the LCD screen. The wifi module used in the transmitter section is used to transmit the data to the server end.

The receiver section consists of a cloud where the data sent by the wifi module at the transmission section is stored. Then set up the server page, login into the manager app to access the application page.

3.2 HARDWARE COMPONENTS

3.2.1 POWER SUPPLY:

The input to the circuit is applied from the regulated power supply. The a.c. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

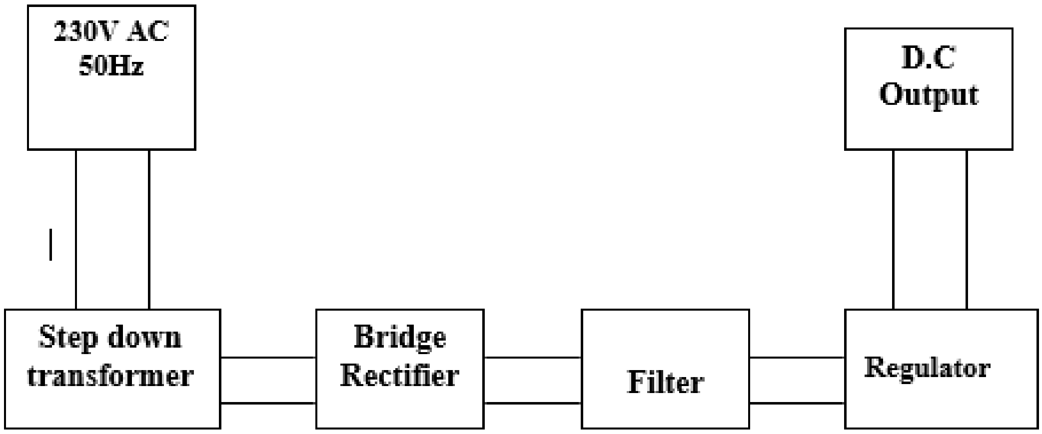


Figure 8 12v Power supply

3.2.1.1 Transformer:

Usually, DC voltages are required to operate various electronic equipment and these voltages are 5V, 9V or 12V. But these voltages cannot be obtained directly. Thus the a.c input available at the mains supply i.e., 230V is to be brought down to the required voltage level. This is done by a transformer. Thus, a step-down transformer is employed to decrease the voltage to a required level.

A transformer is an electrical device that transfers energy from one circuit to another by magnetic coupling with no moving parts. A transformer comprises two or more coupled windings, or a single tapped winding and, in most cases, a magnetic core to concentrate magnetic flux. A changing current in one winding creates a time-varying magnetic flux in the

Basic Principle:

A simple transformer consists of two electrical conductors called the primary winding and the secondary winding. Energy is coupled between the windings by the time-varying magnetic flux that passes through (links) both primary and secondary windings. Whenever the amount of current in a coil changes (including when the current is switched on or off), a voltage is induced in the neighboring coil. The effect, called mutual inductance, is an example of electromagnetic induction.

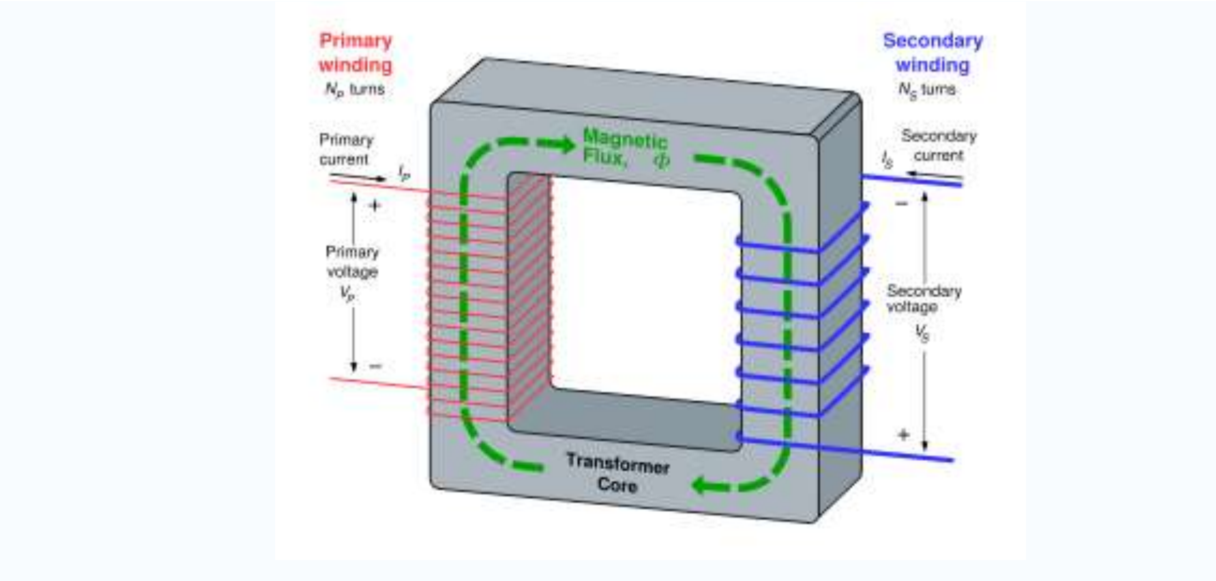


Figure 9 Step Down Transformer

If a time-varying voltage v_P is applied to the primary winding of N_P turns, a current will flow in it producing a magnetomotive force (MMF). Just as an electromotive force (EMF) drives current around an electric circuit, so MMF tries to drive magnetic flux through a magnetic circuit. The primary MMF produces a varying magnetic flux Φ_P in the core, and, with an open circuit secondary winding, induces a back electromotive force (EMF) in opposition to v_P. In accordance with Faraday's law of induction, the voltage induced across the primary winding is proportional to the rate of change of flux:

$$v_P = N_P \frac{d\Phi_P}{dt} \quad \text{and} \quad v_S = N_S \frac{d\Phi_S}{dt}$$

where

V_P and v_S are the voltages across the primary winding and secondary winding,

N_P and N_S are the numbers of turns in the primary winding and secondary winding,

$d\Phi_P$ / dt and $d\Phi_S$ / dt are the derivatives of the flux with respect to time of the primary and secondary windings.

Saying that the primary and secondary windings are perfectly coupled is equivalent to saying that $\Phi_P = \Phi_S$.

$$\frac{v_P}{v_S} = \frac{N_P}{N_S}$$

where

v_p and v_s are voltages across primary and secondary,

N_p and N_s are the numbers of turns in the primary and secondary, respectively.

Hence in an ideal transformer, the ratio of the primary and secondary voltages is equal to the ratio of the number of turns in their windings, or alternatively, the voltage per turn is the same for both windings.

Transformer losses arise from:

Winding resistance

Current flowing through the windings causes resistive heating of the conductors (I^2 R loss). At higher frequencies, skin effect and proximity effect create additional winding resistance and losses.

Eddy currents

Induced eddy currents circulate within the core, causing resistive heating. Silicon is added to the steel to help in controlling eddy currents. Adding silicon also has the advantage of stopping the aging of the electrical steel that was a problem years ago.

Hysteresis losses

Each time the magnetic field is reversed, a small amount of energy is lost to hysteresis within the magnetic core. The amount of hysteresis is a function of the particular core material.

Magnetostriction

Magnetic flux in the core causes it to physically expand and contract slightly with the alternating magnetic field, an effect known as magnetostriction. This, in turn, causes losses due to frictional heating in susceptible ferromagnetic cores.

Mechanical losses

In addition to magnetostriction, the alternating magnetic field causes fluctuating electromagnetic forces between the primary and secondary windings. These incite vibrations within nearby metalwork, creating a familiar humming or buzzing noise, and consuming a small amount of power.

Not all the magnetic field produced by the primary is intercepted by the secondary. A portion of the leakage flux may induce eddy currents within nearby conductive objects.

3.2.1.2 Rectifier:

The output from the transformer is fed to the rectifier. It converts A.C. into pulsating D.C. The rectifier may be a half-wave or a full-wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability and full-wave rectification.

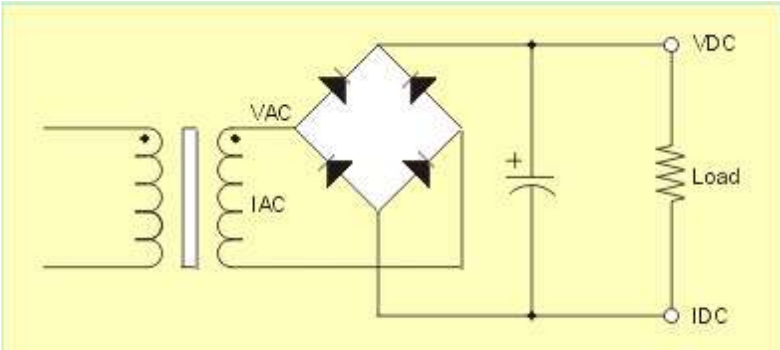


Figure 10 Bridge Rectifier

The Bridge rectifier is a circuit, which converts an ac voltage to dc voltage using both half cycles of the input ac voltage. The Bridge rectifier circuit is shown in the figure. The circuit has four diodes connected to form a bridge. The ac input voltage is applied to the diagonally opposite ends of the bridge. The load resistance is connected between the other two ends of the bridge.

Figure 11 Bridge rectifier

For the positive half cycle of the input ac voltage, diodes D1 and D3 conduct, whereas diodes D2 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance R_L and hence the load current flows through R_L.

For the negative half cycle of the input ac voltage, diodes D2 and D4 conduct whereas, D1 and D3 remain OFF. The conducting diodes D2 and D4 will be in series with the load resistance R_L and hence the current flows through R_L in the same direction as in the previous half-cycle. Thus a bi-directional wave is converted into a unidirectional wave.

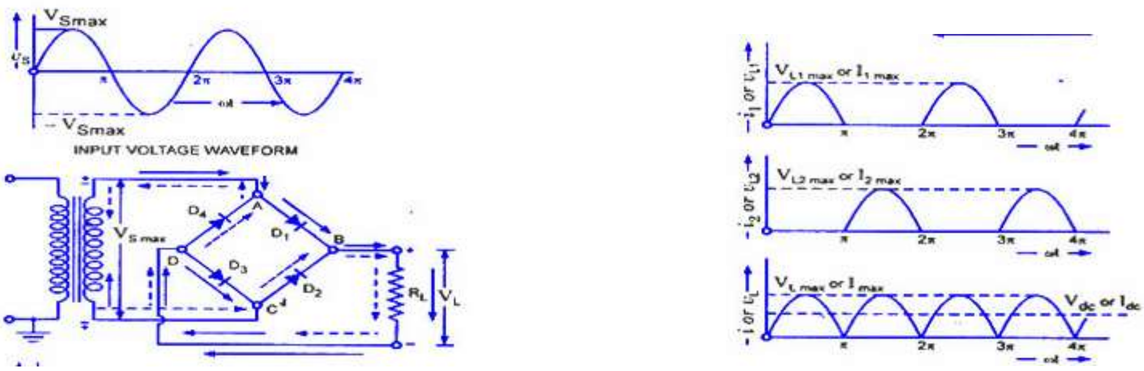


Figure 12 IC-W10M (Bridge Full Wave Rectifier)

3.2.1.3 Filter:

The capacitive filter is used in this project. It removes the ripples from the output of the rectifier and smoothens D.C. Output received from this filter is constant until the mains voltage and load is maintained constant. However, if either of the two is varied, D.C. voltage received at this point changes. Therefore a regulator is applied at the output stage.

Figure 13 1000µF capacitor (Used as Filter)

3.2.1.4 Voltage regulator:

As the name itself implies, it regulates the input applied to it. A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, the power supply of 5V and 12V is required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used. The first number 78 represents positive supply and the numbers 05, 12 represent the required output voltage levels. The L78xx series of three-terminal positive regulators is available in TO-220, TO-220FP, TO-3, D2PAK, and DPAK packages and several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single-point regulation. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.

Figure 14 voltage regulator

In the prototype developed this IC is used to the power LCD display, Atmega 328 and RFID module.

1117 voltage regulator:

The IRU1117-33 is a low dropout three-terminal fixed output regulator with a minimum of 800mA output current capability. This product is specifically designed to provide a well-regulated supply for low voltage IC applications such as VGA, sound & DVD cards. The wifi module used at the transmitter end works at a voltage of 3.3V. In order to provide 3.3 V to this module 1117 voltage regulator IC is used. This IC is used to generate a 3.3V output signal from the given input signal of 5V which is generated using the 7805 IC.

Figure 15- 1117 voltage regulator

PIN#	PIN SYMBOL	PIN DESCRIPTION
1	Gnd	Ground pin. This pin must be connected to ground plane using a low inductance short connection.
2	V_{OUT}	The output of the regulator. This pin is also connected to the tab of the package. An output capacitor must be connected to this pin to insure stability of the regulator.
3	V_{IN}	Input pin of the regulator. Typically a large storage capacitor is connected from this pin to ground to insure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be 1.3V higher than V_{OUT} in order for the device to regulate properly.

3.2.2Microcontroller

Arduino Microcontroller

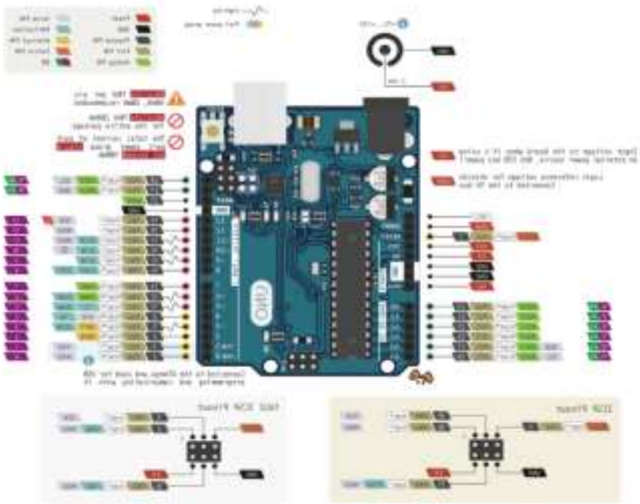


Figure 16 Arduino Uno R3

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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 an AC-to-DC adapter or battery to get started.

Features:

1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In the future, shields will be compatible both with the board that uses the AVR, which operate with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin, that is reserved for future purposes.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Summary

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)

PIN DIAGRAM:

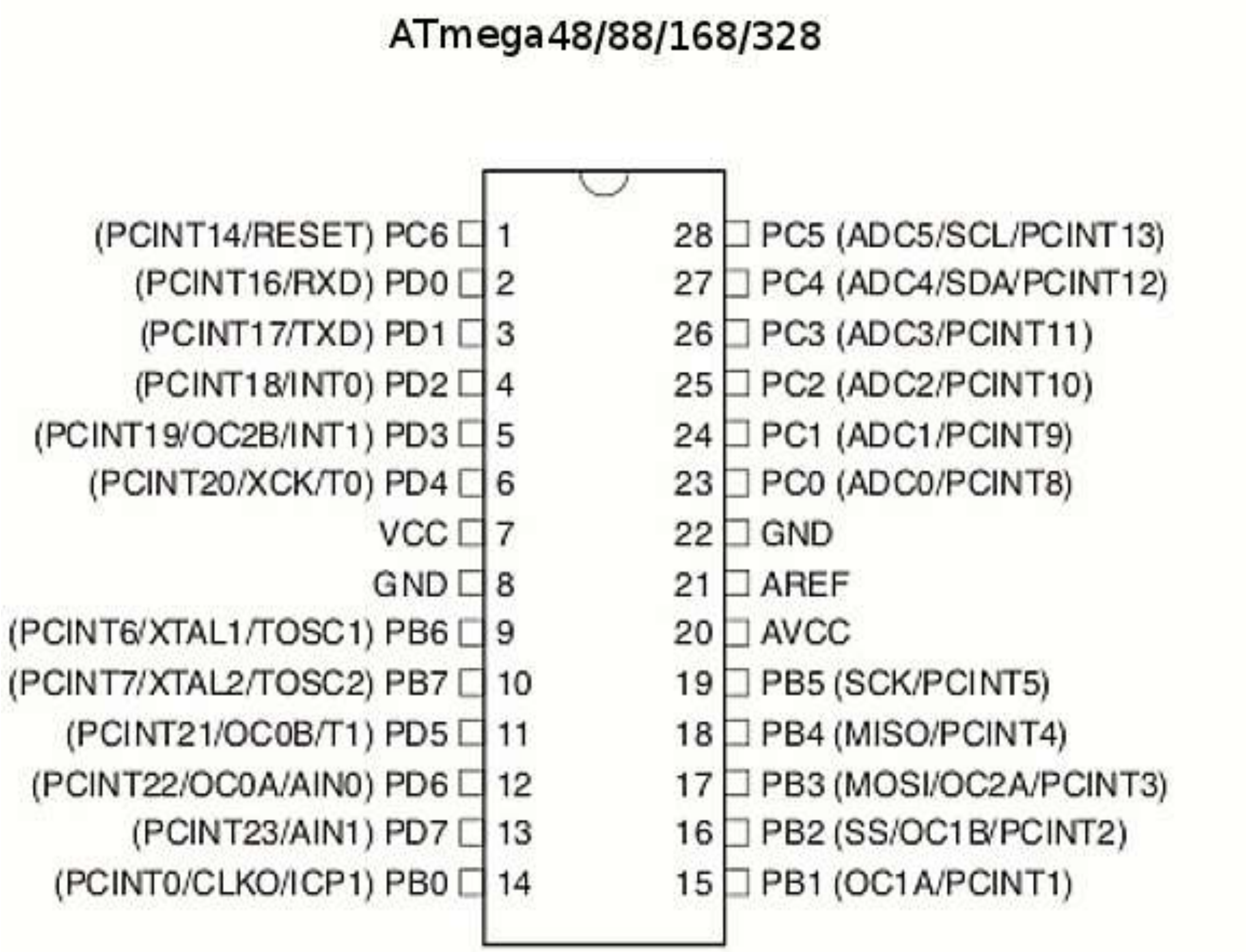


Figure 17 AT mega 328 pin diagram

Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power sources). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

3V3. A 3.3 volt supply generated by the on-board regulator. The maximum current draw is 50 mA.

GND. Ground pins

Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library.

Pin Descriptions

VCC: Digital supply voltage
GND: Ground
Port B (PB7:0) XTAL1/XTAL2/TOSC1/TOSC2

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier.

If the Internal Calibrated RC Oscillator is used as a chip clock source, PB7.6 is used as TOSC2.1 input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

Port C (PC5:0)

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC5..0 output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

PC6/RESET

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C. If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running.

Port D (PD7:0)

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

AVCC

AVCC is the supply voltage pin for the A/D Converter, PC3:0, and ADC7:6. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC6..4 uses digital supply voltage, VCC.

AREF

AREF is the analog reference pin for the A/D Converter.

ADC7:6 (TQFP and QFN/MLF Package Only)

In the TQFP and QFN/MLF package, ADC7:6 serves as analog inputs to the A/D converter.

These pins are powered from the analog supply and serve as 10-bit ADC channels.

Communication

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A Software Serial library allows for serial communication on any of the Uno's digital pins.

The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify the use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nano farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the boot loader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the boot loader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives a one-time configuration or other data when it first starts, make sure that the software with which it communicates waits for a second after opening the connection and before sending this data.

The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110-ohm resistor from 5V to the reset line; see this forum thread for details.

USB Overcurrent Protection

The Arduino Uno has a resettable polyfuse that protects your computer's USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

3.2.3 RF MODULE

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of the carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK).

Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long-range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency, unlike IR signals which are affected by other IR emitting sources. This RF module comprises an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter [5]. The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while the reception is decoded by a decoder. HT12E-HT12D, HT640-HT648, etc. are some commonly used encoder/decoder pair ICs.

SPECIFICATIONS

Transmitter:

Working voltage: 3V - 12V for max. power use 12V Working

Current: max Less than 40mA max , and min 9mA

Resonance mode: (SAW)

Modulation mode: ASK

Working frequency: Eve 315MHz Or 433MHz

Transmission power: 25mW (315MHz at 12V)

Frequency error: +150kHz (max)

Velocity: less than 10Kbps

So this module will transmit up to 90m in open area .

Receiver:

Working voltage: 5.0VDC +0.5V

Working current:≤5.5mA max

Working method: OOK/ASK

Working frequency: 315MHz-433.92MHz

Bandwidth: 2MHz

Sensitivity: excel –100dBm (50Ω)

Transmitting velocity: <9.6Kbps (at 315MHz and -95dBm)

RF Transmitter

An RF transmitter module is a small size PCB capable of transferring a radio wave and modulating radio waves to carry data. RF transmitter modules are usually applied along with a microcontroller, which will offer data to the module which can be transmitted. These transmitters are usually subject to controlling requirements that command the maximum acceptable transmitter power o/p, band edge, and harmonics requirements.

RF Receiver

An RF receiver module takes the modulated RF signal to demodulate it. There are two kinds of RF receiver modules, namely the super-regenerative receivers and super-heterodyne receivers. Usually, super-regenerative modules are low power designs and low cost using a series of amplifiers to remove modulated data from a carrier wave. These modules vary, generally inaccurate as their operation of a frequency significantly with power supply voltage and temperature. The main advantage of Superheterodyne receiver modules is a high performance over super-regenerative. They offer increased stability and accuracy over a large temperature and voltage range. This stability comes from a stable crystal design which in turn leads to a relatively more expensive product.

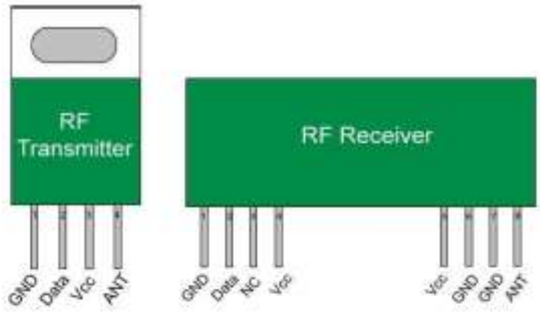


Figure 18 RFtrasmitter& reciever

RFID Cards

RFID tagging is an ID system for identification and tracking purposes that uses radio frequency identification devices. An RFID tagging system consists of the tag, a read/write or only read device, and a system application for data collection, processing, and transmission. RFID tags consist of a minimum of two parts: an integrated circuit and an antenna for receiving and transmitting the signal. The tag information is stored in a non-volatile memory

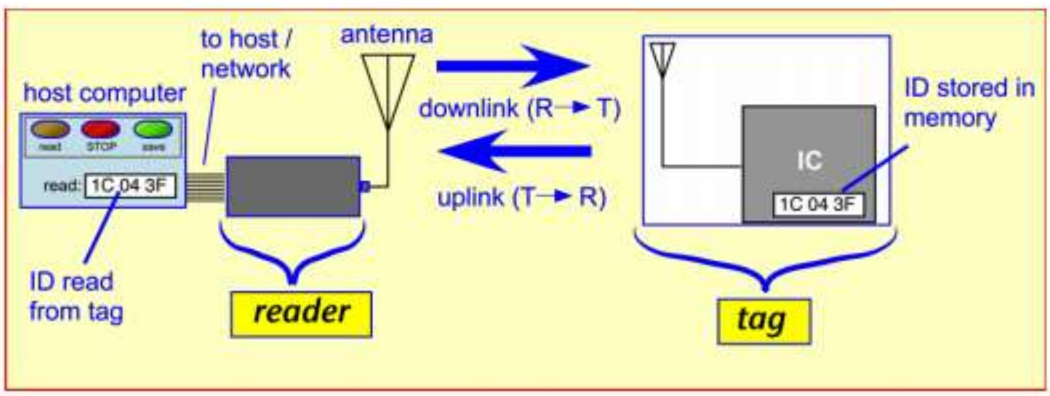


Figure 19 RF ID cards

RFID Tag Types Tag's material and structure are different depending on the end application and environment There are three main categories known for RFID Tags. Inlay Tags occupy 70% of the market. This type of Tag is mainly used in clothing and merchandise management and can be replaced by bar code. They are low cost and easy to use but can be employed only in metal-free and normal temperatures. Composite tags occupy 20% of the market. This type of tag is mainly applied in storage and pipeline management. They can be used in a metal environment but have poor performance. Ceramic Tags occupy 10% of the market. This type of Tag is used in medical equipment, oil and gas pipeline, and drilling management which relate to the harsh environment. They are small, high temperature and high pressure resistant. However, they have a narrow bandwidth and long manufacturing cycles.

RFID Tag can not be completely wrapped by metal. At least one side should be exposed to non-metal material to be used for signal transmission. The top side of the tag can be covered by not metal housing. Along with the increase of dielectric constant, the thickness increases and the frequency decreases. RFID Tag is attached to a metal surface, the frequency will increase along with the increase of metal surface. RFID Tag cannot radiate signal if it is in the liquid or when the surface is covered by liquid. Either the earth or human could absorb radiation signal of the Tag. The surrounding area of the Tag should not have any other strong radiating device with

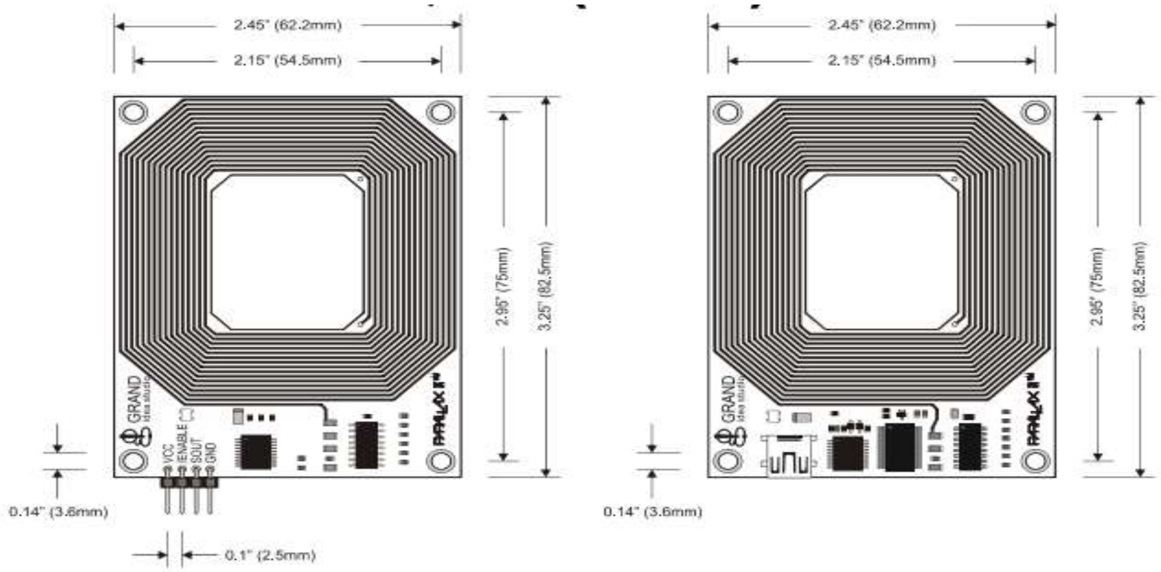


Figure 20 RFID Tag

RFID Reader

The EM-18 RFID Reader module operating at 125kHz is an inexpensive solution for your RFID based application. The Reader module comes with an on-chip antenna and can be powered up with a 5V power supply. Power-up the module and connect the transmit pin of the module to receive the pin of your microcontroller. Show your card within the reading distance and the card number is thrown at the output. Optionally the module can be configured for also a Weigand output.

Figure 21 RF module

Typical Applications

e-Payment

e-Toll Road Pricing

e-Ticketing for Events

e-Ticketing for Public Transport

Access Control

PC Access

Authentication

Printer / Production Equipment

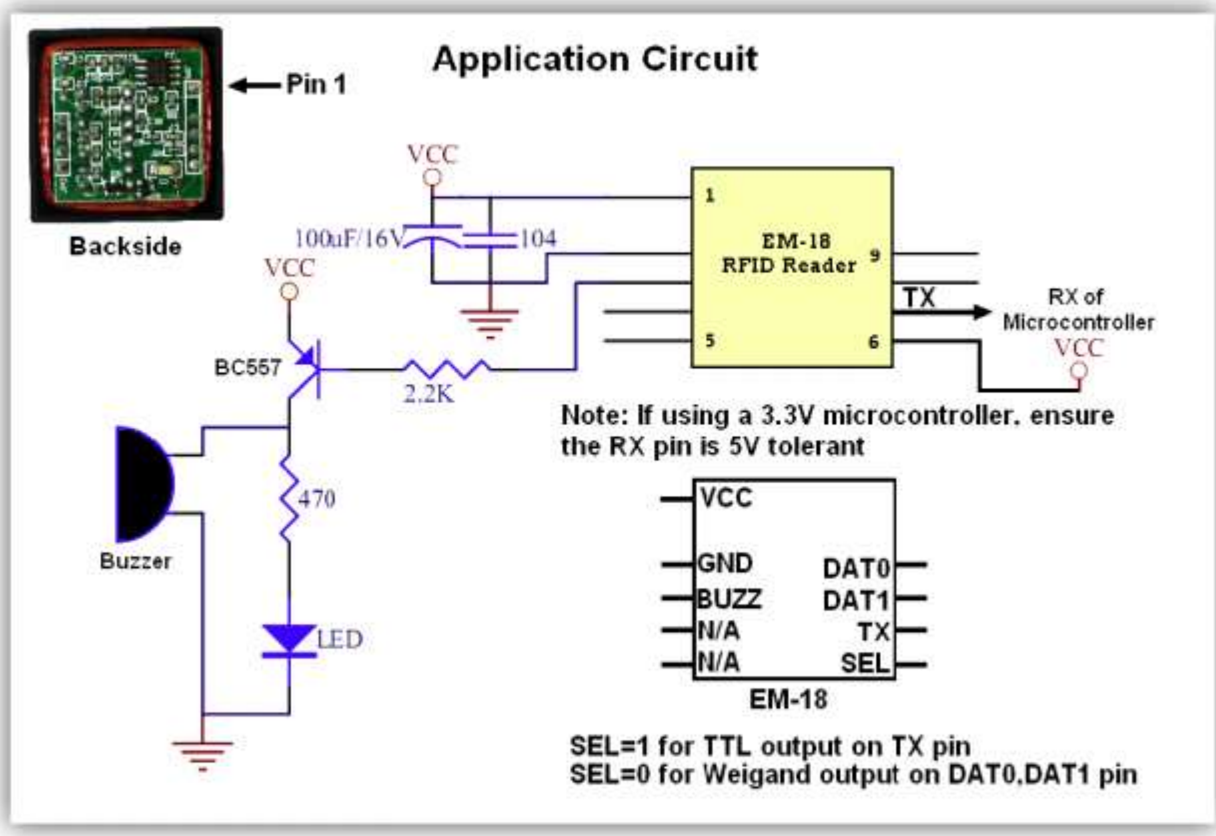


Figure 22 RFID Application circuit

3.2.4 Wifi module

ESP8266 is a complete and self-contained Wi-Fi network solution that can carry software applications, or through Another application, processor uninstalls all Wi-Fi networking capabilities.ESP8266 when the device is mounted and as the only application of the application processor, the flash memory can be started directly from an

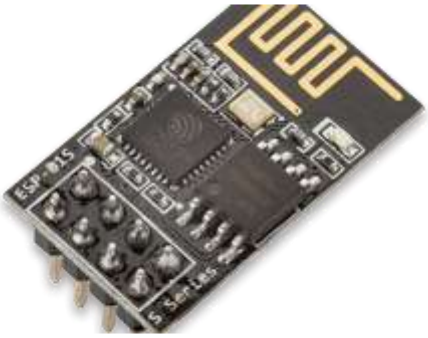


Figure 23 wifi module

external Move. Built-in cache memory will help improve system performance and reduce memory requirements. Another situation is when wireless Internet access assumes the task of a Wi-Fi adapter, you can add it to any microcontroller-based design, the connection is simple, just by SPI / SDIO interface or central processor AHB bridge interface. Processing and storage capacity on ESP8266 powerful piece, it can be integrated via GPIO ports sensors and other applications specific equipment to achieve the lowest early in the development and operation of at least occupy system resources. The ESP8266 highly integrated chip, including antenna switch balun, power management converter, so with minimal external circuitry, and includes the front-end module, including the entire solution designed to minimize the space occupied by PCB. The system is equipped with ESP8266 manifested leading features are: energy saving VoIP quickly switch between the sleep/wake patterns, with low-power operation adaptive radio bias, front-end signal processing functions, troubleshooting and radio systems coexist characteristics eliminate cellular / Bluetooth / DDR / LVDS / LCD interference

Characteristics

802.11 b / g / n

Wi-Fi Direct (P2P), soft-AP

Built-in TCP / IP protocol stack

Built-in TR switch, balun, LNA, power amplifier and matching network

Built-in PLL, voltage regulator, and power management components

802.11b mode + 19.5dBm output power

Built-in temperature sensor

Support antenna diversity

off leakage current is less than 10uA Built-in low-power 32-bit CPU: can double as an application processor SDIO 2.0, SPI, UARTSTBC, 1x1 MIMO, 2x1 MIMO A-MPDU, A-MSDU aggregation and the 0.4 Within wake 2ms, connect and transfer data packets

standby power consumption of less than 1.0mW (DTIM3)

Ultra-low-power technology.

Power

The following data are based on a 3.3V power supply, ambient temperature 25C and use the internal regulator measured. [1] All measurements are made in the absence of the SAW filter, the antenna interface is completed. [2] all transmit data based on a 90% duty cycle, continuous transmission mode in the measured.

Description	Min	Typical	Max	Units
Input Frequency	2412		2484	MHz
Input resistance		50		Ω
Input reflection			-10	dB
At 72.2Mbps, PA output power	14	15	16	dBm
11b mode, PA output power	17.5	18.5	19.5	dBm
Sensitivity				
CCK, 1Mbps		-98		dBm
CCK, 11Mbps		-91		dBm
6Mbps (1/2 BPSK)		-93		dBm
54Mbps (3/4 64-QAM)		-75		dBm
HT20, MCS7 (65Mbps, 72.2Mbps)		-71		dBm
Adjacent suppression				
OFDM, 6Mbps		37		dB
OFDM,54Mbps		21		dB
HT20,MCS0		37		dB
HT20,MCS7		20		dB

ESP8266 specifically for mobile devices, wearable electronics and networking applications design and make the machine to achieve the lowest energy consumption, together with several other patented technology. This energy-efficient construction in three modes: active mode, sleep mode, and deep sleep mode type. When ESP8266 using high-end power management technology and logic systems to reduce non-essential functions of the power conversion regulate sleep patterns and work modes, in sleep mode, it consumes less than the current 12uA, is connected, it consumes less power to 1.0mW (DTIM = 3) or 0.5mW (DTIM = 10). Sleep mode, only calibrated real-time clock and watchdog in working condition. The real-time clock can be programmed to wake ESP8266 within a specific period of time. Through programming, ESP8266 will automatically wake up when detected certain to happen. ESP8266 automatic wake-up in the shortest time, this feature can be applied to the SOC for mobile devices, so before you turn Wi-Fi SOC are in a low-power standby mode. To meet the power requirements of mobile devices and wearable electronics products, ESP8266 at close range when the PA output power can be reduced through software programming to reduce overall power consumption in order to adapt to different applications. Maximum integration ESP8266 integrates the most critical components on the board, including power management components, TR switch, RF balun, a peak power of + 25dBm of PA, therefore, ESP8266 only guarantee the lowest BOM cost, and easy to be embedded in any system. ESP8266 BOM is the only external resistors, capacitors, and crystal.

3.2.5 LIQUID CRYSTAL DISPLAY

LCD stands for Liquid Crystal Display. LCD is finding widespread use of replacing LEDs (seven-segment LEDs or other multi-segment LEDs) because of the following reasons:

1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.
3. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data.
4. Ease of programming for characters and graphics.

These components are “specialized” for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two

Figure 24 LCD Display

lines with 16 characters each. It d s, mathematical symbols, etc. In addition, it is possible to display symbols that the user makes up on its own. Automatic shifting message on display (shift left and right), the appearance of the pointer, backlight, etc. are considered as useful characteristics.

Pins Functions

There are pins along one side of the small printed board used for connection to the microcontroller. There is a total of 14 pins marked with numbers (16 in case the background light is built-in). Their function is described in the table below:

Function	**Pin Number**	**Name**	**Logic State**	**Description**
Ground	1	Vss	-	0V
Power supply	2	Vdd	-	+5V
Contrast	3	Vee	-	0 - Vdd
	4	RS	0 1	D0 – D7 are interpreted as commands D0 – D7 are interpreted as data
Control of operating	5	R/W	0 1	Write data (from the controller to LCD) Read data (from LCD to controller)
	6	E	0 1 From 1 to 0	Access to LCD disabled Normal operating Data/commands are transferred to LCD
	7	D0	0/1	Bit 0 LSB
	8	D1	0/1	Bit 1
	9	D2	0/1	Bit 2
Data / commands	10	D3	0/1	Bit 3
	11	D4	0/1	Bit 4
	12	D5	0/1	Bit 5
	13	D6	0/1	Bit 6
	14	D7	0/1	Bit 7 MSB

LCD screen: LCD screen consists of two lines with 16 characters each. Each character consists of a 5x7 dot matrix. The contrast on display depends on the power supply voltage and whether messages are displayed in one or two lines. For that reason, variable voltage 0-Vdd is applied on pin marked as Vee. Trimmer potentiometer is usually used for that purpose. Some versions of displays have a built-in backlight (blue or green diodes). When used during operating, a resistor for current limitation should be used (like with any LE diode).

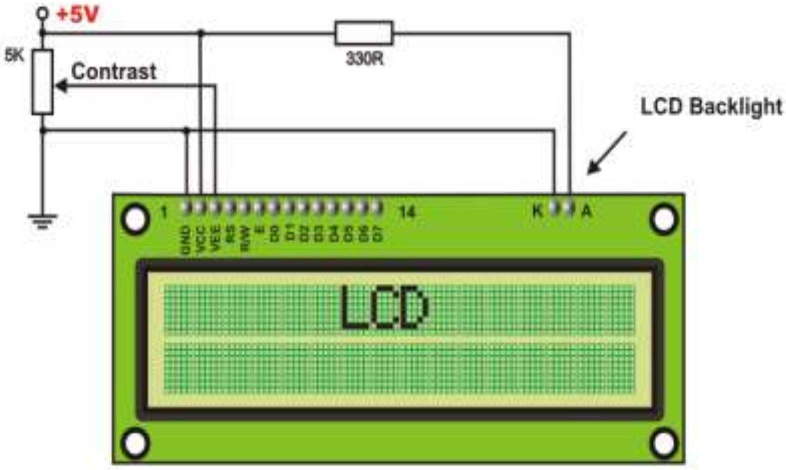


Figure 25 LCD display circuit

LCD Basic Commands

All data transferred to LCD through outputs D0-D7 will be interpreted as commands or as data, which depends on a logic state on pin RS:

RS = 1 - Bits D0 - D7 are the addresses of characters that should be displayed. The built-in processor addresses the built-in “map of characters” and displays corresponding symbols. Displaying position is determined by the DDRAM address. This address is either previously defined or the address of previously transferred character is automatically incremented.

RS = 0 - Bits D0 - D7 are commands which determine display mode. List of commands which LCD recognizes are given in the table below:

LCD Connection

Depending on how many lines are used for connection to the microcontroller, there are 8-bit and 4-bit LCD modes. The appropriate mode is determined at the beginning of the process in a phase called “initialization”. In the first case, the data are transferred through outputs D0-D7 as it has been already explained. In the case of 4-bit LED mode, for the sake of saving valuable I/O pins of the microcontroller, there are only 4 higher bits (D4-D7) used for communication, while others may be left unconnected.

Consequently, each data is sent to LCD in two steps: four higher bits are sent first (that normally would be sent through lines D4-D7), four lower bits are sent afterward. With the help of initialization, LCD will correctly connect and interpret each data received. Besides, with regards to the fact that data are rarely read from LCD (data mainly are transferred from microcontroller to LCD) one more I/O pin may be saved by simply connecting R/W pin to the Ground. Such saving has its price. Even though message displaying will be normally performed, it will not be possible to read from the busy flag since it is not possible to read from the display.

Command	**RS**	**RW**	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Execution Time**
Clear display	0	0	0	0	0	0	0	0	0	1	1.64mS
Cursor home	0	0	0	0	0	0	0	0	1	x	1.64mS
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	40uS
Display on/off control	0	0	0	0	0	0	1	D	U	B	40uS
Cursor/Display Shift	0	0	0	0	0	1	D/C	R/L	x	x	40uS
Function set	0	0	0	0	1	DL	N	F	x	x	40uS
Set CGRAM address	0	0	0	1	CGRAM address						40uS
Set DDRAM address	0	0	1	DDRAM address							40uS
Read "BUSY" flag (BF)	0	1	BF	DDRAM address							-
Write to CGRAM or DDRAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	40uS
Read from CGRAM or DDRAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	40uS

3.2.6 Potentiometer

A **potentiometer** is defined as a 3 terminal variable resistor in which the resistance is manually varied to control the flow of electric current. A potentiometer acts as an adjustable voltage divider.

A potentiometer is a passive electronic component. Potentiometers work by varying the position of a sliding contact across a uniform resistance. In a potentiometer, the entire input voltage is applied across the whole length of the resistor, and the output voltage is the voltage drop between the fixed and sliding contact as shown below.

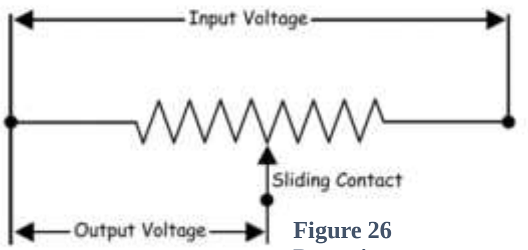


Figure 26
Potentiometer

A potentiometer has the two terminals of the input source fixed to the end of the resistor. To adjust the output voltage the sliding contact gets moved along the resistor on the output side. This is different to a rheostat, where here one end is fixed and the sliding terminal is connected to the circuit, as shown below.

This is a very basic instrument used for comparing the emf of two cells and for calibrating ammeter, voltmeter, and watt-meter. The basic **working principle of a potentiometer** is quite simple. Suppose we have connected two batteries in parallel through a galvanometer. The negative battery terminals are connected together and positive battery terminals are also connected together through a galvanometer as shown in the figure below.

Here, if the electric potential of both battery cells is exactly the same, there is no circulating current in the circuit and hence the galvanometer shows null deflection. The **working principle of potentiometer** depends upon this phenomenon.

Now let’s think about another circuit, where a battery is connected across a resistor via a switch and a rheostat as shown in the figure below.

The resistor has the uniform electrical resistance per unit length throughout its length. Hence, the voltage drop per unit length of the resistor is equal throughout its length. Suppose, by adjusting the rheostat we get v volt voltage drop appearing per unit length of the resistor.

Now, the positive terminal of a standard cell is connected to point A on the resistor and the negative terminal of the same is connected with a galvanometer. The other end of the galvanometer is in contact with the resistor via a sliding contact as shown in the figure above. By adjusting this sliding end, a point like B is found where there is no current through the galvanometer, hence no deflection in the galvanometer.

That means emf of the standard cell is just balanced by the voltage appearing in the resistor across points A and B. Now if the distance between points A and B is L, then we can write emf of standard cell E = Lv volt.

This is how a potentiometer measures the voltage between two points (here between A and B) without taking any current component from the circuit. This is the specialty of a potentiometer, it can measure voltage most accurately.

3.2.7 Crystal oscillator

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators, but other piezoelectric materials including polycrystalline ceramics are used in similar circuits.

A crystal oscillator, particularly one using a quartz crystal, works by distorting the crystal with an electric field when voltage is applied to an electrode near or on the crystal. This property is known as electrostriction or inverse piezoelectricity. When the field is removed, the quartz - which oscillates in a precise frequency - generates an electric field as it returns to its previous shape, and this can generate a voltage. The result is that a quartz crystal behaves like an RLC circuit, but with a much higher Q.

Figure 27 crystal oscillator

Quartz crystals are manufactured for frequencies from a few tens of kilohertz to hundreds of megahertz. More than two billion crystals are manufactured annually. Most are used for consumer devices such as wristwatches, clocks, radios, computers, and cellphones. Quartz crystals are also found inside test and measurement equipment, such as counters, signal generators, and oscilloscopes

Chapter 4
SOFTWARE USED:

4.1 ARDUINO SOFTWARE:

The Arduino integrated development environment (IDE) is a cross-platform application written in Java and derives from the IDE for the Processing programming language and the Wiring projects.

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 is capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a "sketch".

Arduino programs are written in C or C++. The Arduino IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. The users need only to define two functions to make an executable cyclic executive program.

Figure 28 Arduino Sketch

4.2 Java :

Java is a general-purpose programming language that is class-based, object-oriented, and designed to have as few implementation dependencies as possible. It is intended to let application developers write once, run anywhere (WORA),[15] meaning that compiled Java code can run on all platforms that support Java without the need for recompilation.[16] Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture.

Java was originally developed by James Gosling at Sun Microsystems (which has since been acquired by Oracle) and released in 1995 as a core component of Sun Microsystems' Java platform. The original and reference implementation Java compilers, virtual machines, and class libraries were originally released by Sun under proprietary licenses.

Java can be used to create complete applications that may run on a single computer or be distributed among servers and clients in a network.

The software application for the admin is created using java language.

Chapter 5
IMPLEMENTATION

5.1 SCHEMATIC DIAGRAM

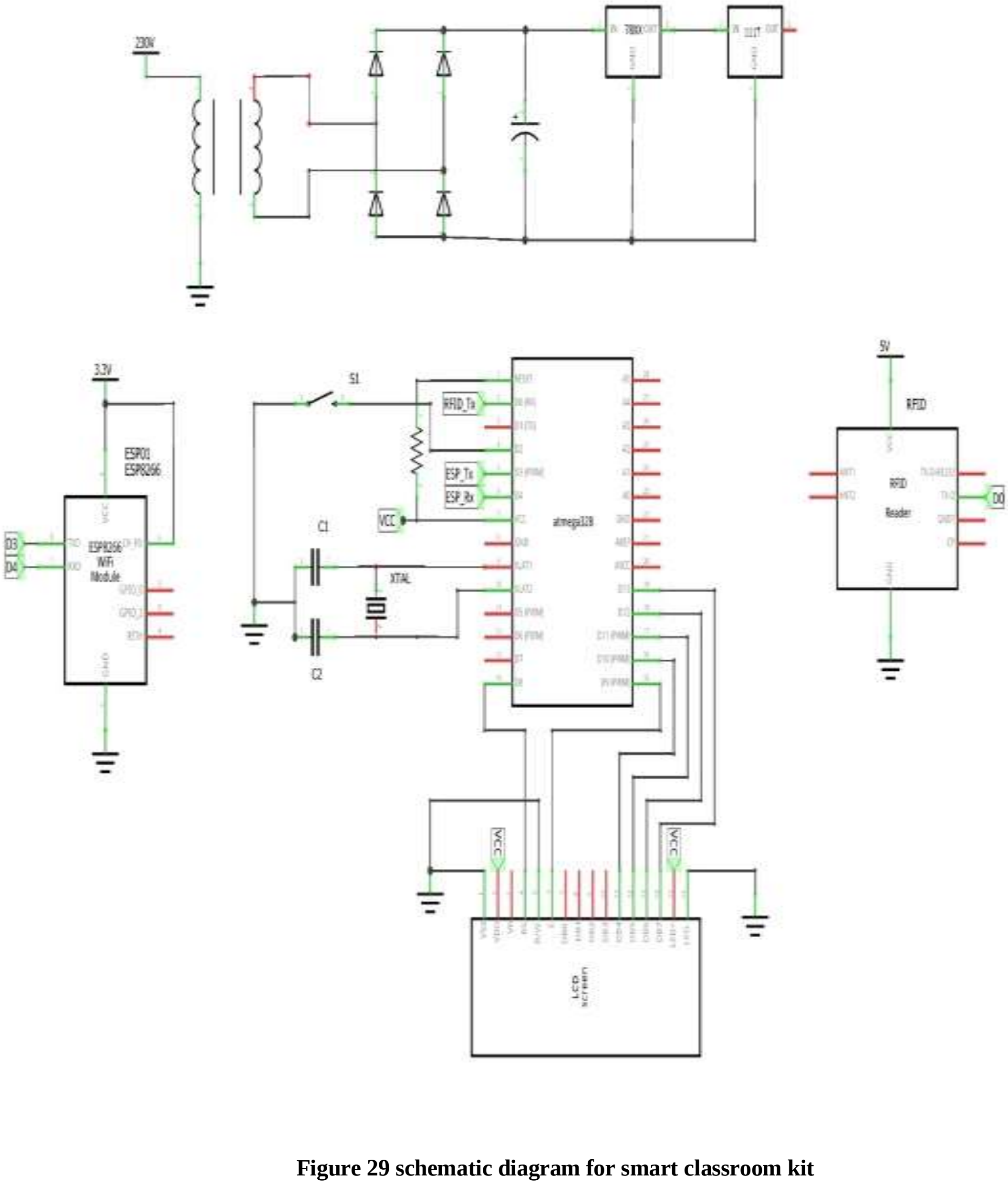


Figure 29 schematic diagram for smart classroom kit

5.2 Flow Chart

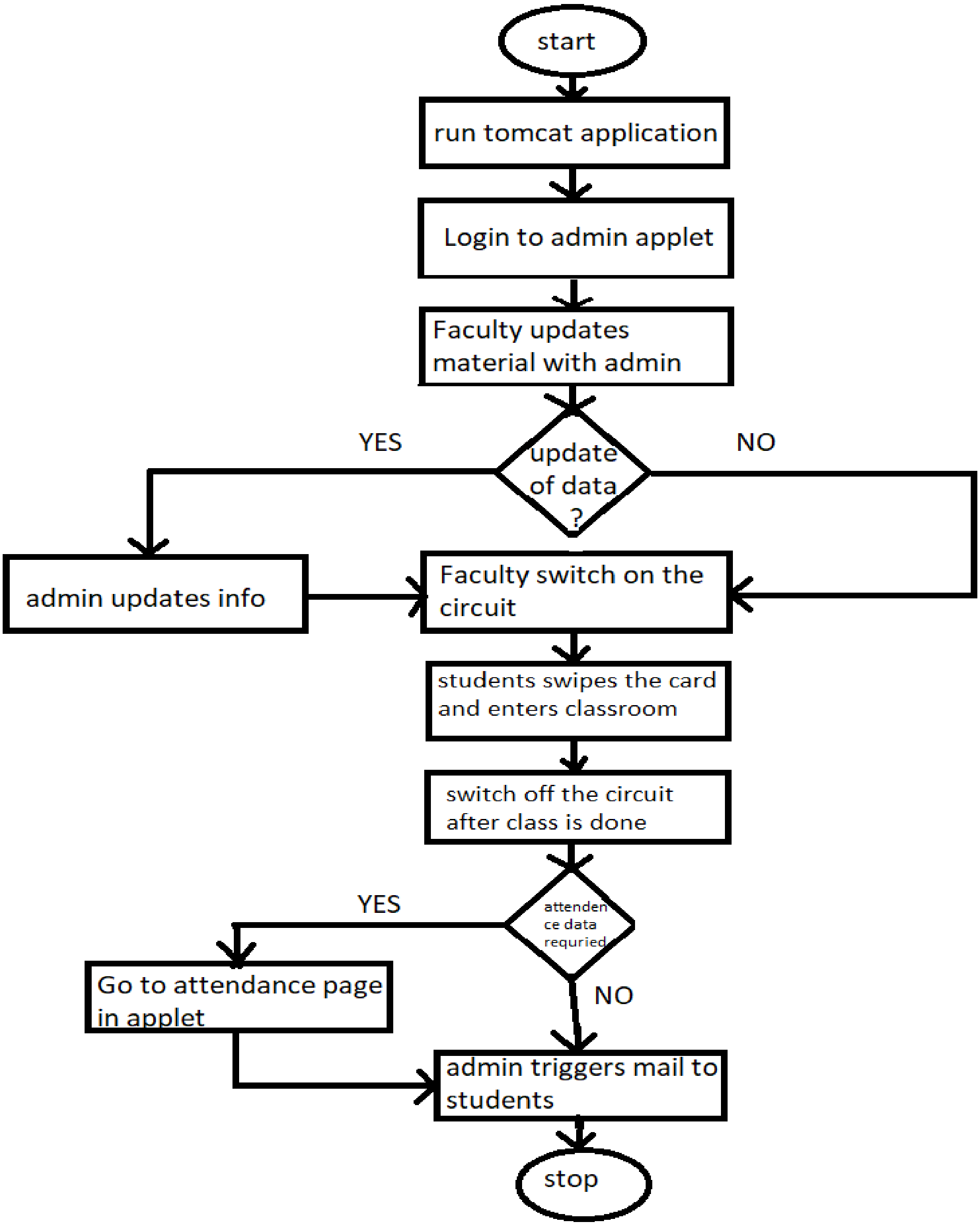


Figure 30 Flowchart for working of smart classroom apparatus

5.3 Working:

Working on the project starts from connecting the wi-fi module to a hotspot and then set up the Tomcat server. Admin then has to open the browser and then open the link- localhost:2019 and then get the server page displayed on the monitor. Admin no need to enter credentials after opening the manager app. Open the application page in order to perform the required operation. Admin can now update the data if required using the add student feature.

Faculty once enters the class need to turn on the hardware setup at the door using the button. Once the kit is turned on students can simply register themselves to class by placing an RFID card across the RFID reader module. Once the message student registered appears on the LCD display he can enter the classroom. Thereby all the students can register themselves to the class and enter the lecture hall. Faculty can switch off the kit whenever he wishes to, which is when the attendance is closed.

All the entries are updated in the database the moment kit is turned off. Faculty can now monitor the attendance through the Attendance feature provided. Admin can trigger a mail to the students attaching the lecture notes of that class provided to him through the send email feature provided on the application page. Thereby, after the end of class, the students who were absent can receive the lecture notes of the class held on that day.

5.4 Advantages

- Smart learning without any mental stress.
- More practical knowledge is gained.
- The listening capability of students is increased.
- The difficulty of understanding concepts for slow learners is reduced.
- No need of taking the attendance physically in classrooms.
- At the end of the day, notes will be sent as mail to students who are absent from classes.
- Ease of accessibility.

Chapter 6
RESULTS

6.1 Hardware Results

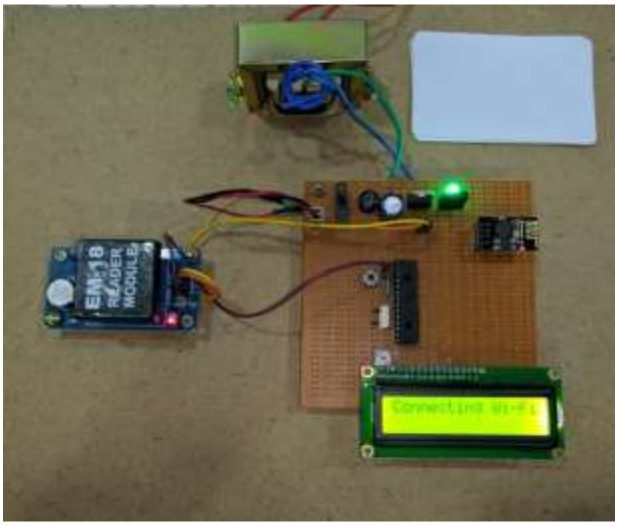


Figure 31 Hardware Result

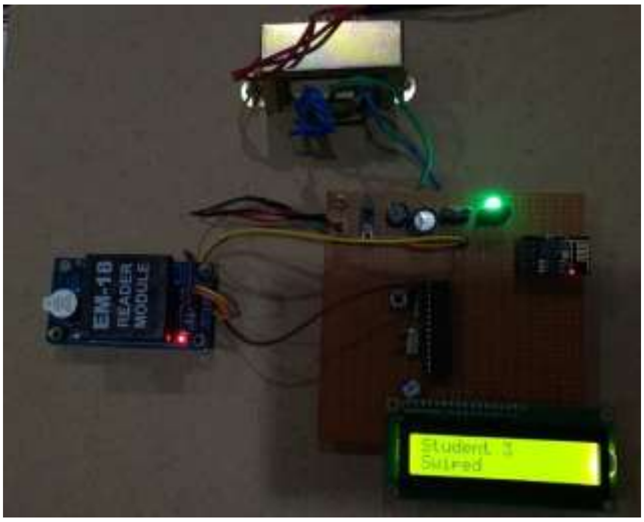


Figure 32.1 Hardware Result

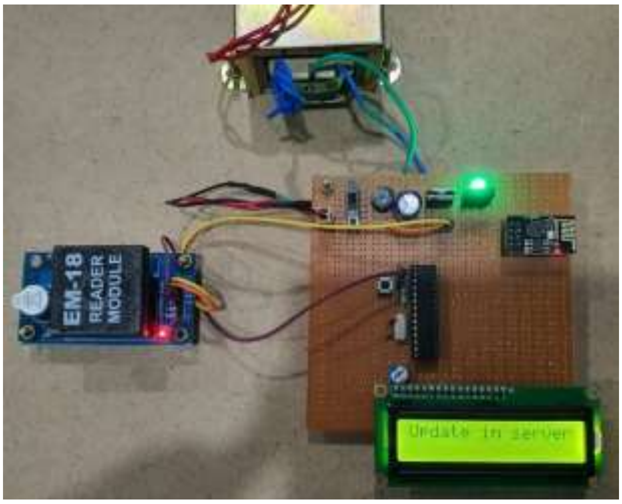


Figure 33.2 Hardware Result

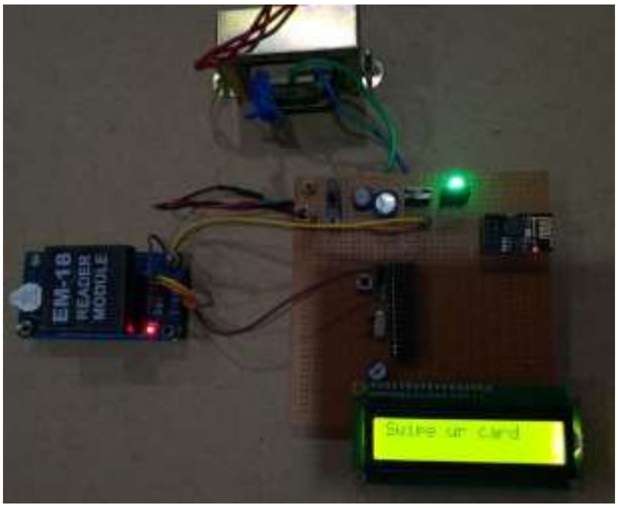


Figure 34.3 Hardware Result

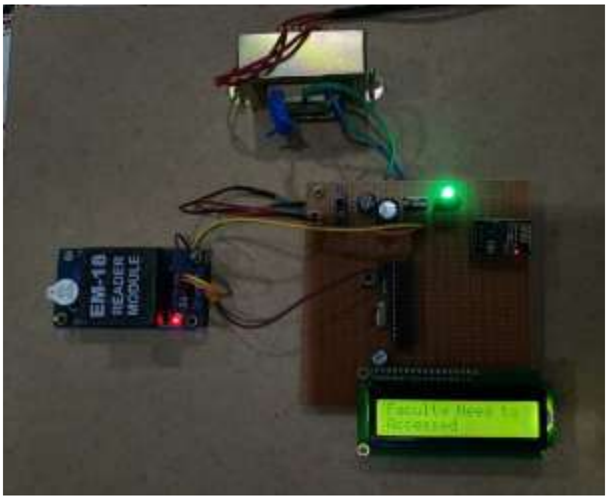


Figure 35.4 Hardware Result

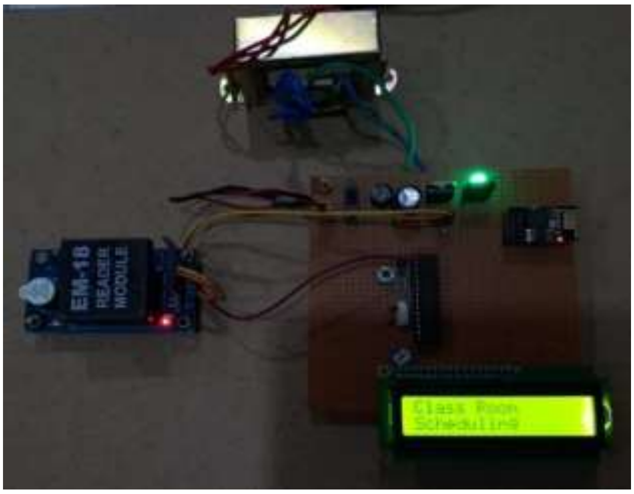


Figure 36.5 Hardware Result

6.2 Software Results

Figure 37 Software Result

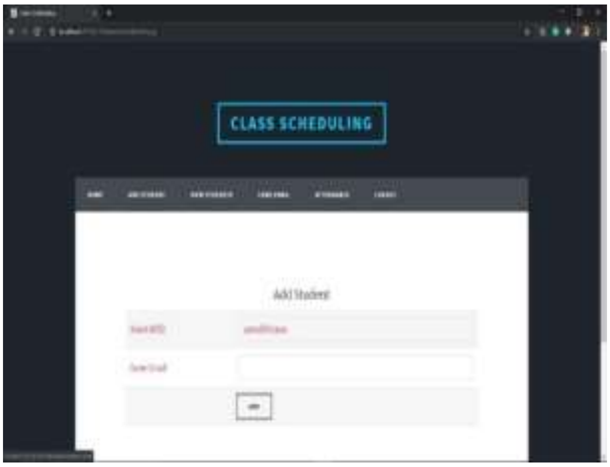
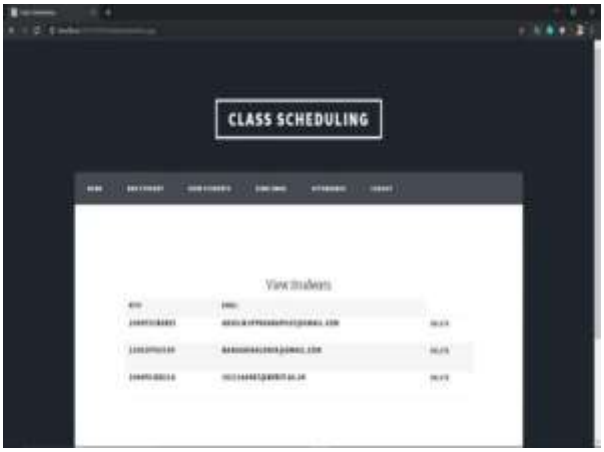


Figure 38.1 Software Result



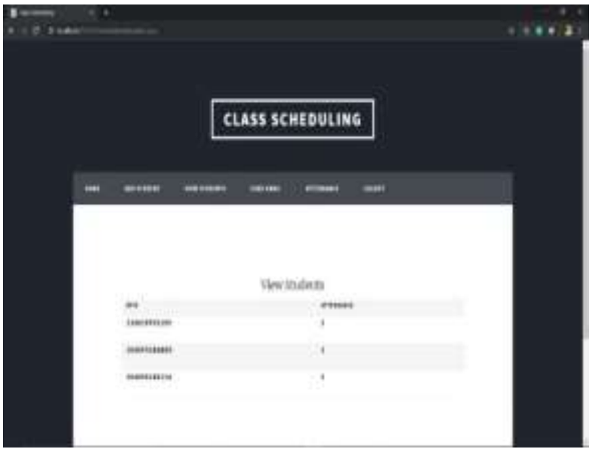


Figure 39.2 Software Result **Figure 40.3 Software Result**

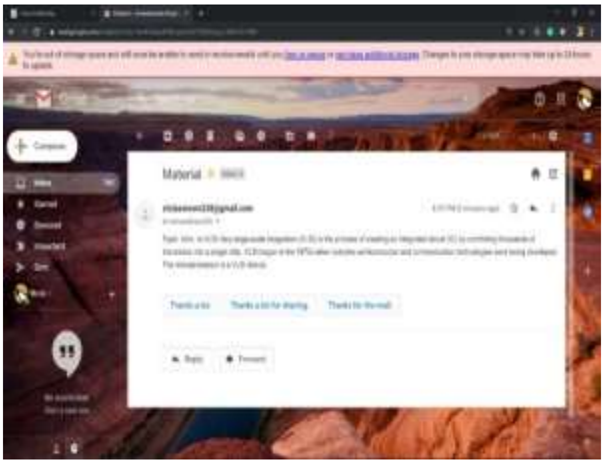


Figure 41.4 Software Result **Figure 42.5 Software Result**

Chapter 7
CONCLUSION AND FUTURE SCOPE

7.1 Conclusion

In state-of-the-art digital conference rooms equipped with a smart classroom system, an exact and convenient manner and information can be communicated more clearly via the real-time on-screen transmission and additional description of materials. When used in a multimedia room, the smart classroom system helps learners improve their understanding of and familiarity with lessons by allowing them to use a wealth of multimedia materials. As an optimal learning environment is created by the use of diverse multimedia equipment, the smart classroom system promotes learners' concentration and engagement in class.

Smart classes thus help in improving the conceptual understanding of the subjects by increasing learners' creativity and cooperativeness and help them to further concentrate on learning and are also helpful in automating the academic procedures in the institution.

7.2 Future Scope

Our proposed system can be extended to

->As of now, the mail is triggered only to the absentees, we can enhance it in such a way that the material can be sent to all the students of the class.

->All the other services like library access and other student monitoring formalities can be embedded into one application

->Scheduling of classes depending upon the faculty availability and other factors can be achieved

REFERENCES

[1] Saket Khandelwal, An Innovative Approach of Classroom Scheduling Second International Conference on Advances in Electronics, Computers, and Communications (ICAECC),2018.

[2] Julie Johnston, Professor, Indiana University,FUTURE CLASSROOMS, Collective brainstorming at Indiana University's Smart Classroom Summit, OCT 2018.

[3] Chao Wang, Xi Li, Aili Wang, Xuehai Zhou, A Classroom Scheduling Service for Smart Classes, IEEE Transactions on Services Computing (Volume: 10, Issue: 2, March-April 1 2017)

[4] Dr. V.K.Maheshwari, M.A (Socio, Phil) B.Sc. M. Ed, Ph.D.,The Concept of SMART CLASSROOM, Philosophical commentary on issues of today, nov 30,2016.

[5] Puchong Subpratatsavee, TanabataPromjun, Wichian Siriprom, Worasitti Sriboon, Attendance System Using NFC Technology and Embedded Camera Device, International Conference on Information Science & Applications (ICISA),2014.

APPENDIX

Project code

```
#include <LiquidCrystal.h>
#include <SoftwareSerial.h>
        #define button 2
        SoftwareSerial esp(3, 4);
LiquidCrystal lcd(8, 9, 10, 11, 12, 13);
        int count,check;
String c1="21001FF65199";
String c2="2000F5CB8B95";
String c3="2000F62EE21A";
char input[12];
String rfid;
String ssid = "class";
String password = "class123";
        void setup()
{
  esp.begin(9600);
```

```
  pinMode(button,INPUT_PULLUP);
  lcd.begin(16, 2);
  lcd.setCursor(0, 0);
  lcd.print("Class Room");
  lcd.setCursor(0, 1);
  lcd.print("Scheduling");
  delay(2000);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Connecting Wi-Fi");
  if(connectwifi())
  {
   lcd.setCursor(0,1);
   lcd.print("Connected");
   delay(2000);
  }
}
        void loop()
{
  int std1,std2,std3;
  std1=std2=std3=0;
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Faculty Need to");
  lcd.setCursor(0,1);
  lcd.print("Accessed");
  while(digitalRead(button)==1);
  check=1;
  delay(500);
  while(check==1)
  {
   lcd.clear();
   lcd.home();
   lcd.print("Swipe ur card");
   if(digitalRead(button)==0)
   check=0;
   while(Serial.available() && count < 12)
   {
    input[count]=Serial.read();
    count++;
    delay(5);
    if (count==12)
    {
     count = 0;
     rfid=input;
    }
   }
   if(c1.equals(rfid))
   {
    std1 = 1;
    lcd.clear();
```

```
      lcd.setCursor(0, 0);
      lcd.print("Student 1");
      lcd.setCursor(0, 1);
      lcd.print("Swiped");
      rfid.remove(0);
      delay(1000);
    }
    else  if(c2.equals(rfid))
    {
      std2 = 1;
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("Student 2");
      lcd.setCursor(0, 1);
      lcd.print("Swiped");
      rfid.remove(0);
      delay(1000);
    }
    else if(c3.equals(rfid))
    {
      std3 = 1;
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print("Student 3");
      lcd.setCursor(0, 1);
      lcd.print("Swiped");
      rfid.remove(0);
      delay(1000);
    }
    delay(1000);
  }
  lcd.clear();
  lcd.home();
  lcd.print("Update in server");
  delay(200);
  post(String(std1),String(std2),String(std3));
  delay(1000);

}

void post(String val1, String val2, String val3)
{
  String server = "www.ctcorphyd.com";
  String cmd = "AT+CIPSTART=\"TCP\",\"";
  cmd += server;
  cmd += "\",80";
  esp.println(cmd);
  delay(500);
  String uri;
  uri ="/CRSchedule/iot.php?a=";
  uri += val1;
```

```
  uri +="&b=";
  uri += val2;
  uri +="&c=";
  uri +=val3;
  uri +="&d=1";
  String getStr = "GET " + uri + " HTTP/1.0\r\n" + "Host: " + server + "\r\n" + "Connection: 
close\r\n\r\n";
   String str = "AT+CIPSEND=";
  str += String(getStr.length());
  esp.println(str);
  delay(100);
  if(esp.find(">"))
  {
    esp.println(getStr);
  }
  delay(1000);
}
        int connectwifi()
{
  String cmd ="AT+CWJAP=\"" + ssid + "\",\"" + password + "\"";
  esp.println(cmd);
   delay(5000);
  if(esp.find("OK"))
  {
    return 1;
  }
  else
  {
    connectwifi();
   }
}
```