Major Project-II Report

on

IOT Based Smart Irrigation System

Submitted in Partial fulfillment for the award of degree of Bachelor of Engineering in Electronics and Communication Engineering

Submitted to

Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal (M.P.)

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ORIENTAL COLLEGE OF TECHNOLOGY, BHOPAL

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Affiliated to Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal (M.P.)

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the work embodied in this Major Project-II, Dissertation Report entitled as **"IOT Based smart Irrigation System"** being Submitted by **Abhishek Jain [0126EC191002], Deepak Mehra [0126EC191020], Deepali Satpute [0126EC191021], Sakshi Walke [0126EC191049], Vishal Nadekar [0126EC191060]** my in partial fulfillment of the requirement for the award of **"Bachelor of Engineering" in Electronics and communication** discipline to Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal (M.P.) during the academic year 2022-23 is a record of bonafide piece of work, carried out under my supervision and guidance in the Department of Electronics & Communication Engineering, Oriental College of Technology, Bhopal.

Approved by

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CERTIFICATE OF APPROVAL

This dissertation entitled **"IOT Based smart Irrigation System"** being Submitted by **Abhishek Jain [0126EC191002], Deepak Mehra [0126EC191020], Deepali Satpute [0126EC191021], Sakshi Walke [0126EC191049], Vishal Nadekar [0126EC191060]** has been examined by us & hereby approve for the partialfulfilment of the requirement for the award of "**Bachelor of Engineering**" in "**Electronics and Communication**" for which it has been submitted. It is understoodthat by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expresses, or conclusion draw there in, but the dissertation only for the purpose for which it has been submitted.

INTERNAL EXAMINER
Date:-

EXTERNAL EXAMINER
Date:-

CANDIDATE DECLARATION

We hereby declare that the Major Project-II report on **"**IOT Based Smart Irrigation System**"** submitted in the partial fulfilment of the requirement for the award of the degree of Bachelor of Engineering in Electronics & Communication from Oriental College of Technology is an authentic record of our own work. We have not submitted the part and partial of this report for the award of any other degree or diploma.

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Date:

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LIST OF ABBREVIATIONS

IOT	Internet of Things
SMS	Short Message Service
GSM	Global System for Mobile Communications
API	Application Programming Interface
IEEE	Institute of Electrical and Electronics Engineers
LRWAN	Low-Rate Wireless Area Network
SoC	System on a Chip
Node MCU	Node Microcontroller Unit
LED	light Emitting Diode
IC	Integrated Circuits
SPST	Single pole Single Throw
SPDT	single Pole Double Throw
DPST	Double Pole Single Throw
DPDT	Double Pole Single Throw

Chapter – 1

INTRODUCTION

INTRODUCTION

Overview:

Farming is the quality of Indian Economy. Be that as it may, for horticulture water utilization is more than precipitation consistently. Enhancing ranch yield is basic to take care of the quickly developing demand of nourishment for populace development over the world. By considering and foreseeing biological conditions, cultivate profitability can be expanded. Yield quality depends on information gathered from field, for example, soil moisture, encompassing temperature and moistness and so on. Propelled apparatuses and innovation can be utilized to expand cultivate yield. Creating IOT advances can gather vast measure of environmental and harvest presentation information. "IOT envelops numerous new astute ideas for utilizing sooner rather than later, for example, as smart home, smart city, smart transportation, and smart farming" [1]. The method can be utilized for use of exact measure of manure, water, pesticide and so on to improve efficiency and magnificence. Sensors are cheerful gadget for keen agribusiness. The ongoing ecological parameters like soil moisture level, encompassing temperature and tank water level have ceaseless effect on the product lifecycle. By shaping sensor arrange, great observing of water direction in the farming field can be accomplished. In this framework, soil moisture sensor detects the moisture level of the dirt. In the event that dirt will get dry then sensor detects low moisture level and consequently switches on the water pump to supply water to the plant. As plant get adequate water and soil get wet then sensor detects enough moisture in soil. After which the water pump willnaturally get ceased.

Essential examination is done under the accompanying stages, for example, Understandingthe current methodologies, Understanding the necessities, building up a theoretical for the structure. In this paper, soil moisture sensor, temperature and Humidity sensors put in root zone of plant and transmit data to android application. Edge estimation of soil moisturesensor that was altered into a microc

control water sum. Temperature, humidity and soil moisture regards are appeared on the android application. This paper on "Programmed Water system Framework on Detecting Soil Moisture Content" is expected to make an automiser water system instrument which turns the directing engine ON and OFF on recognizing the moistness substance of the earth. In this paper just, soil moisture esteem is considered yet proposed venture gave expansion to this existed venture by including temperature and moistness esteems [2]. Remote Checking in Horticultural Nursery Utilizing Remote Sensor and Short Message Service (SMS). In the paper they are sending information by means of SMS however proposed framework sends the qualities to versatile application [3]. This proposed paper is Arduino based remote water system framework produced for the rural estate, which is put at the remote area and required water accommodates ranch when moisture of dirt goes underneath the setpoint esteem. Be that as it may, in this we didn't mindful about the dirt moisture level so to defeat this disadvantage proposed framework included with additional component soil moisture esteem and temperature esteem which showed on the rancher portable application [4]. "Water framework Control Framework Utilizing Android and GSM for Effective Utilization of Water and Power" this system made usage of GSM to control the structure which may cost simply more so to crush that proposed system used Arduino Yun board which starting at now involve in develop Wi-Fi module [5]. "Microcontroller based Controlled Water Framework for Estate" In this paper seniority with lesser memory microcontroller is used to control the system yet proposed structure made useof Arduino Yun board which is anything but difficult to utilize and it dumps the activitieseasily [6]. "A remote utilization of spill water framework computerization maintained by soil moisture sensors" in this paper water framework is finished using soil moisture regards yetdegree fundamental and straightforward sensible equipment to the agriculturists and it send messages to their mobiles about the water level in the earth. In A Remote Measurement andControl System for Greenhouse Based on

GSM-SMS [7] the proposed system introduced a GSM-SMS remote measurement and control system for greenhouse based on PC-baseddatabase system connected with base station. Base station is developed by using a microcontroller, GSM module, sensors and actuators. In practical operation, the centralstation receives and sends messages through GSM module. Criterion value of parameters tobe measured in every base station is set by central station, and then in base stationsparameters including the air temperature, the air humidity. Indu et al. (2013) [8] mainlyfocuses on reviews in the field of remote monitoring and control, the technology used andtheir potential advantages. The paper proposes an innovative GSM/Bluetooth based remote controlled embedded system for irrigation. The system sets the irrigation time depending onthe temperature and humidity reading from sensors and type of crop and can automatically irrigate the field when unattended. Information is exchanged between far end and designedsystem via SMS on GSM network. A Bluetooth module is also interfaced with the mainmicrocontroller chip which eliminates the SMS charges when the user is within the limitedrange of few meters to the designated system. The system informs users about many conditions like status of electricity, dry running motor, increased temperature, water contentin soil and smoke via SMS on GSM network or by Bluetooth.

In [9], R.Suresh et al. (2014) mentioned about using automatic microcontroller based rain gunirrigation system in which the irrigation will take place only when there will be intense requirement of water that save a large quantity of water. These systems bring a change to management of field resource where they developed a software stack called Android is used for devices that include an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. Mobile phones have almost become an integral part of us serving multiple needs of humans. This application makes use of the GPRSfeature of mobile phone as a solution for irrigation control

system. These system covered lower range of agriculture land and not economically affordable.

In IOT SMS alarm system based on SIM900A [10], an IOT alarm system based on SIM900Amodule of SIMCOM Company was designed for greenhouse. The system can gather environmental parameters such as air temperature and air humidity. Meanwhile, with the use of AT command, this system can also realize SMS automatic sending and receiving, environmental parameters overrun alarm and insufficient balance alarm. Through the system setting, the alarm message can be sent to the user-specified mobile phone automatically no matter what the users' location is. This system as a typical application of IOT in the agriculture has got some satisfactory results in the actual operation.

Chapter – 2

PROPOSED METHODOLOGY

PROPOSED METHODOLOGY

In fact, the focus is to conduct an unbiased and detailed review of existing papers regarding IoT-based irrigation systems in order to summarize and draw a general conclusion of the current trend as well as building a platform for further research activities. Here, the following three stages have been mentioned below:

2.1 Formulation of Research Questions

Here the first step is to characterize the research questions as well as provision of the current research status on IoT-based irrigation. In this research, nine research questions are given below:

Research Questions on IoT-based irrigation

1 What are the major targeted primary publication channels for IoT-based irrigation research?

2 How has the frequency of approaches regarding IoT-based agriculture been changed in course of time?

3 What approaches are used for identifying problems in IoT based agriculture?
4 In which countries IoT-based irrigation is being used?

5 What are the issues which should be considered for irrigation?

6 What are different irrigation types? 7 Which sensors and boards are used in IoT-based irrigation?

8 Which wireless communication technologies/protocols are used in IoT-based irrigation?

9 Which IoT platforms are used in IoT-based irrigation?

2.2 Search Strategy

The second step is to search for relevant studies on the research topic. Initially, IEEE CS, Elsevier, ACM Digital Library, and ScienceDirect were targeted for searching using a set of keywords related to our research topic: ‘IoT-based irrigation’, ‘smart irrigation’, ‘smart apps’, ‘smart devices’, ‘intelligent agriculture’, ‘cloud in the agriculture’, ’moisture sensor’, ’data monitoring system’, ’cloud platform’, ’agriculture system’, ’internet-of-things, ’smart agriculture’, ’advanced agriculture practices’, ’future food expectation’, ’machine learning, ’fertility level’, ’crop prediction’, ’LoRaWAN’, ’real-time systems’, ’environmental monitoring’, ’sensor systems’, ’self-powered, ’soil measurements’ and ’analytics data in the agriculture. Besides, Google has been used as the search engine for keywords throughout our survey. In the search, the paper from the year 2016 to 2021 was emphasized, especially from Bangladesh along with some papers from other countries. The acceptability and credibility level of the papers were evaluated using the ‘Impact factor’.

2.3 Extracting information

The most relevant problems of interest were gathered and extracted from our selected papers. The extracted information depends on the initial research questions mentioned above, and it will be analyzed in the following section.

Chapter – 3

OBJECTIVE

OBJECTIVE

This project is all about a smart irrigation system. As we all know irrigation is th e application of providing controlled amounts of water to plants at needed interv als. It helps to grow agricultural crops, maintain landscapes, soil, consolidation a nd revegetate disturbed soils in dry areas and during periods of less than average rainfall. The objective of our project is to design an automated irrigation system which is cost effective and time saving using Node microcontroller. The NodeM CU (Node Microcontroller Unit) is an open-source software and hardware devel opment environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266.

The proposed system will automatically water the plants when the soil moisture sensor detects insufficient amount of moisture in soil using as the centre core. W e also aim to connect the system with internet so that it can also manually be ope rated by smartphone app from anywhere-anytime.

The concept of this project is to allow the owners of fields to control and observ e the growth of their plants in their farms. This is achieved by using a smart platf orm of IoT and solenoid valves to control the flow of water based on the moistur e of the soil and gives real time surveillance to the owners who stay far away fro m the farms. This project also allows surveillance on the personnel and their cro ps so as to not occur losses. It is easy to use for anyone with a Smartphone and d oesn’t require maintenance once set up.

This project has been designed for surveillance of irrigation systems in farms wi thout the need of manual checking of irrigation systems. For example, if you are staying in Bangalore, and have your farm in Andhra Pradesh or elsewhere and it is not possible for you to go to the farms every time to keep a tab on the plants. I nstead, this project allows you to check up on your plants using a simple IoT sys

tem. The positive part of this project is that, the node used to connect the system to your smart device, also controls the flow of water from the pump and also the timing intervals in between the irrigation cycles. In this paper we will be discuss ing all about the project as to how it is constructed and how it works.

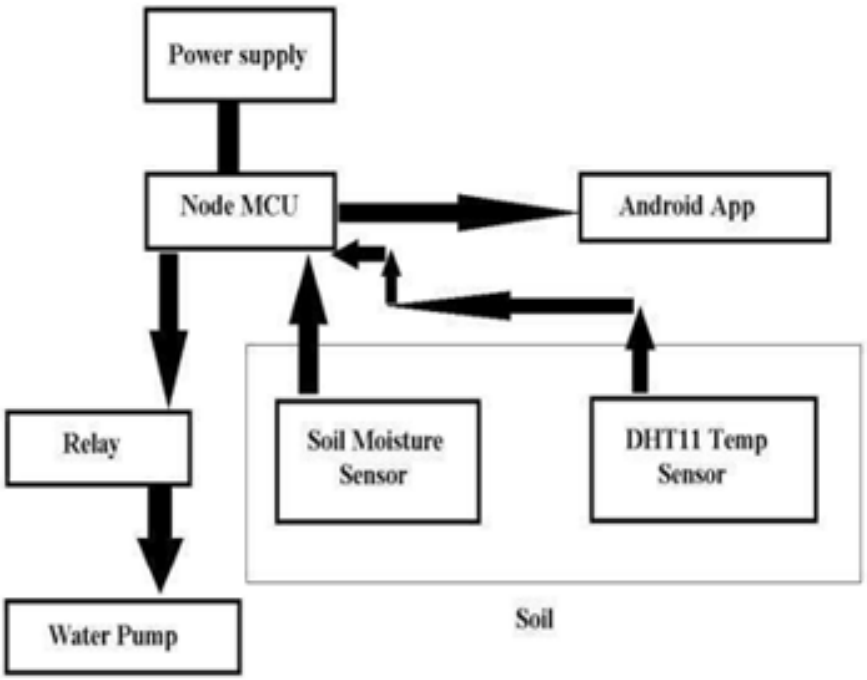
Chapter – 4

HARDWARE DESIGN

There are two functional components in this project:

1. The Sensors (Soil Moisture Sensor, Temperature and Humidity Sensor) and the Motor/Water pump. The moisture sensors measure the moisture level (water content) of the different plants. If the moisture level is found to be below the desired level, the moisture sensor sends the signal.
2. The sensors and the water pump is connected to the microcontroller Node MCU ESP8266.
3. On receiving the signal the Microcontroller triggers the Water Pump to turn ON and supply the water to respective plant. When the desired moisture level is reached, the system halts on its own and the Water Pump is turned OFF. The Temperature and Humidity Sensors measure temperature and humidity to provide data for data logging and deciding intervals for watering.

And in the last stage of the project an email is sent to the user regarding the real time state of the plant.



Chapter – 5

COMPONENTS

COMPONENTS

ELECTRICAL RESISTANCE

The electrical resistance of an electrical conductor is the opposition to the passage of an electric current through that conductor. The inverse quantity is electrical conductance, the ease with which an electric current passes. Electrical resistance shares some conceptual parallels with the mechanical notion of friction. The SI unit of electrical resistance is the ohm (Ω), while electrical conductance is measured in Siemens (S).

An object of uniform cross section has a resistance proportional to its resistivity and length and inversely proportional to its cross-sectional area. All materials show some resistance, except for superconductors, which have a resistance of zero.

The resistance (R) of an object is defined as the ratio of voltage across it (V) to current through it (I), while the conductance (G) is the inverse:

$$R = \frac{V}{I}, \qquad G = \frac{I}{V}, \qquad G = \frac{1}{R}$$

For a wide variety of materials and conditions, V and I are directly proportional to each other, and therefore R and G are constant (although they can depend on other factors like temperature or strain). This proportionality is called Ohm's law, and materials that satisfy it are called "Ohmic" materials.

In other cases, such as a diode or battery, V and I are not directly proportional, or in other words the I–V curve is not a straight line through the origin, and Ohm's law does not hold. In this case, resistance and conductance are less useful concepts, and more difficult to define. The ratio V/I is sometimes still useful,

and is referred to as a "chordal resistance" or "static resistance",[1][2] as it corresponds to the inverse slope of a chord between the origin and an I–V curve.

In other situations, the derivative $\frac{dV}{dI}$ may be most useful; this is called the "differential resistance.

Fig 5.1 Electrical Resistance

CAPACITOR

A capacitor (originally known as a condenser) is a passive two- terminal electrical component used to store energy electrostatically in an electricfield. The forms of practical capacitors vary widely, but all contain at leasttwo electrical conductors (plates) separated by a dielectric (i.e., insulator). The conductors can be thin films of metal, aluminum foil or disks, etc. The 'non conducting' dielectric acts to increase the capacitor's charge capacity. A dielectric can be glass, ceramic, plastic film, air, paper, mica, etc. Capacitors arewidely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, a capacitor does not dissipate energy. Instead, a capacitor stores energy in the form of an electrostatic field between its plates.

When there is a potential difference across the conductors (e.g., when a capacitor is attached across a battery), an electric field develops across the dielectric, causing positive charge (+Q) to collect on one plate and negative charge (-Q) to collect on the other plate. If a battery has been attached to a capacitor for a

sufficient amount of time, no current can flow through the capacitor. However, if an accelerating or alternating voltage is applied across the leads of the capacitor, a displacement current can flow.

An ideal capacitor is characterized by a single constant value for its capacitance. Capacitance is expressed as the ratio of the electric charge (Q) on each conductor to the potential difference (V) between them. The SI unit of capacitance is the farad (F), which is equal to one coulomb per volt (1 C/V). Typical capacitance values range from about 1 pF (10^{-12} F) to about 1 mF (10^{-3} F).

The capacitance is greater when there is a narrower separation between conductors and when the conductors have a larger surface area. In practice, the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, known as the breakdown voltage. The conductors and leads introduce an undesired inductance and resistance.

Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems they stabilize voltage and power flow.

Fig 5.2 Capacitor

P–n JUNCTION DIODE

A p–n junction is a boundary or interface between two types of semiconductor material, p-type and n-type, inside a single crystal of semiconductor. It is created by doping, for example by ion implantation, diffusion of dopants, or by epitaxy (growing a layer of crystal doped with one type of dopant on top of a layer of crystal doped with another type of dopant). If two separate pieces of material were used, this would introduce a grain boundary between the semiconductors that severely inhibits its utility by scattering the electrons and holes.

p–n junctions are elementary "building blocks" of most semiconductor electronic devices such as diodes, transistors, solar cells, LEDs, and integrated circuits; they are the active sites where the electronic action of the device takes place. For example, a common type of transistor, the bipolar junction transistor, consists of two p–n junctions in series, in the form n–p–n or p–n–p.

Properties of a p–n junction

The p–n junction possesses some interesting properties that have useful applications in modern electronics. A p-doped semiconductor is relatively conductive. The same is true of an n-doped semiconductor, but the junction between them can become depleted of charge carriers, and hence non-conductive, depending on the relative voltages of the two semiconductor regions. By manipulating this non-conductive layer, p–n junctions are commonly used as diodes: circuit elements that allow a flow of electricity in one direction but not in the other (opposite) direction. This property is explained in terms of forward bias and reverse bias, where the term bias refers to an application of electric voltage to the p–n junction.

PN junction operation in forward-bias mode, showing reducing depletion width. Both p and n junctions are doped at a 1e15/cm3 doping level, leading to built-in potential of ~0.59 V. Reducing depletion width can be inferred from the shrinking charge profile, as fewer dopants are exposed with increasing forward bias.

With a battery connected this way, the holes in the P-type region and the electrons in the N-type region are pushed toward the junction. This reduces the width of the depletion zone. The positive potential applied to the P-type material repels the holes, while the negative potential applied to the N-type material repels the electrons. As electrons and holes are pushed toward the junction, the distance between them decreases. This lowers the barrier in potential. With increasing forward-bias voltage, the depletion zone eventually becomes thin enough that the zone's electric field cannot counteract charge carrier motion across the p–n junction, as a consequence reducing electrical resistance. The electrons that cross the p–n junction into the P-type material (or holes that cross into the N-type material) will diffuse in the near-neutral region. Therefore, the amount of minority diffusion in the near-neutral zonesdetermines the amount of current that may flow through the diode.

Only majority carriers (electrons in N-type material or holes in P-type) can flow through a semiconductor for a macroscopic length. With this in mind, consider the flow of electrons across the junction. The forward bias causes a force on the electrons pushing them from the N side toward the P side. With forward bias, the depletion region is narrow enough that electrons can cross the junction and inject into the P-type material. However, they do not continue to flow through the P-type material indefinitely, because it is energetically favorable for them to recombine with holes. The average length an electron travels through the P-type material before recombining is called the diffusion length, and it is typically on the order of micrometers.

Although the electrons penetrate only a short distance into the P-type material, the electric current continues uninterrupted, because holes (the majority carriers) begin to flow in the opposite direction. The total current (the sum ofthe electron and hole currents) is constant in space, because any variation wouldcause charge buildup over time (this is Kirchhoff's current law). The flow of holes from the P-type region into the N-type region is exactly analogous to the flow of electrons from N to P (electrons and holes swap roles and the signs ofall currents and voltages are reversed).

Therefore, the macroscopic picture of the current flow through the diode involves electrons flowing through the N-type region toward the junction, holes flowing through the P-type region in the opposite direction toward the junction, and the two species of carriers constantly recombining in the vicinity of the junction. The electrons and holes travel in opposite directions, but they also have opposite charges, so the overall current is in the same direction on both sides of the diode, as required.

The Shockley diode equation models the forward-bias operational characteristics of a p–n junction outside the avalanche (reverse-biased conducting) region.

Reverse bias mode

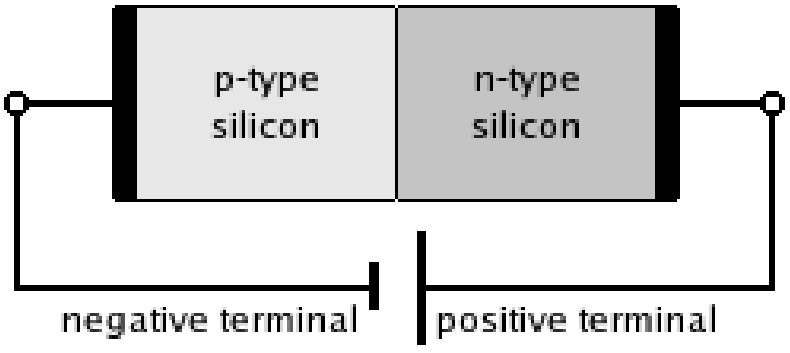


Fig 5.3 Reverse bias mode

POTENTIOMETER

A potentiometer informally a pot, is a three-terminal resistor with a sliding contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat.

A potentiometer measuring instrument is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name.

Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load.

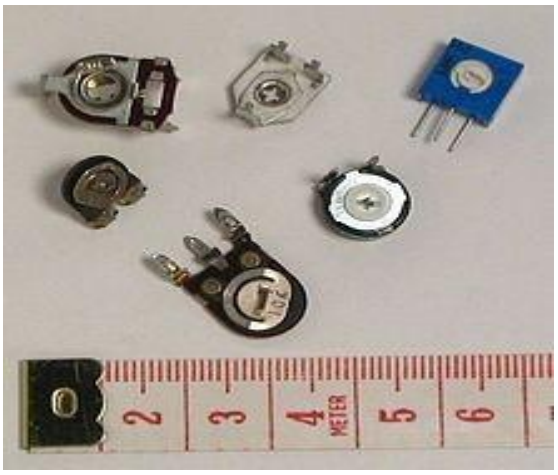


Fig 5.4 potentiometer

VOLTAGE REGULATOR IC

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltageindependent of how much power is drawn from the line.

Fig 5.5 Voltage Regulator IC

The 78xx (sometimes L78xx, LM78xx, MC78xx...) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the xx is replaced with two digits,

indicating the output voltage (for example, the 7805 has a 5 volt output, while the 7812 produces 12 volts). Thereis a related line of 79xx devices which are complementary negative voltage regulators. 78xx and 79xx ICs can be used in combination to provide positive and negative supply voltages in the same circuit.

These devices support an inputvoltage anywhere from a couple of volts over the intended output voltage, up to a maximum of 35 to 40 volts depending on the make, and typically provide 1 or 1.5 amperes of current (though smaller or larger packages may have a lower or higher currentrating).

Part Number	Output Voltage (V)	Minimum Input Voltage (V)
7805	+5	7.3
7806	+6	8.3
7808	+8	10.5
7810	+10	12.5
7812	+12	14.6
7815	+15	17.7
7818	+18	21.0
7824	+24	27.1

LIGHT EMITTING DIODE(LED)

A light-emitting diode (LED) is a two-lead semiconductor light source that resembles a basic pn-junction diode, except that an LED also emits light. When an LED's anode lead has a voltage that is more positive than its cathode lead by at least the LED's forward voltage drop, current flows. Electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

An LED is often small in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern.

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light. Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were also of low intensity, and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displays, and were commonly seen in digital clocks.

Recent developments in LEDs permit them to be used in environmental and task lighting. LEDs have many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are now used in applications as diverse as aviation lighting, automotive headlamps, advertising, general lighting,traffic signals, and camera flashes. However, LEDs powerful enough for room lighting are still relatively expensive, and require more precise

current and heat management than compact fluorescent lamp sources of comparable output.

LEDs have allowed new text, video displays, and sensors to be developed, while their high switching rates are also useful in advanced communications technology.

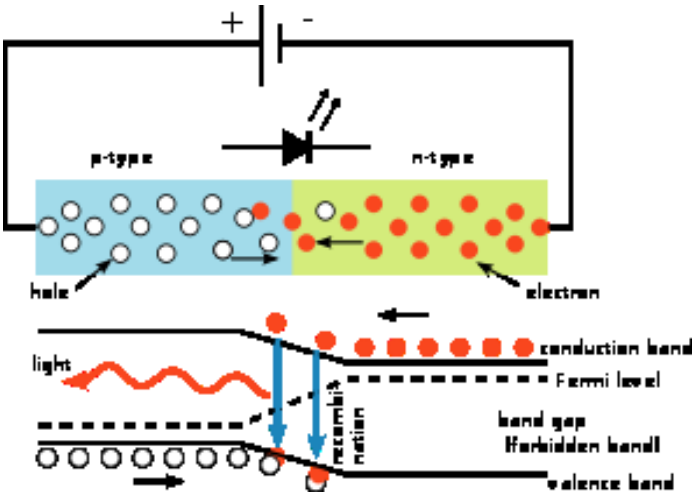


Fig 5.6 The inner workings of an LED,

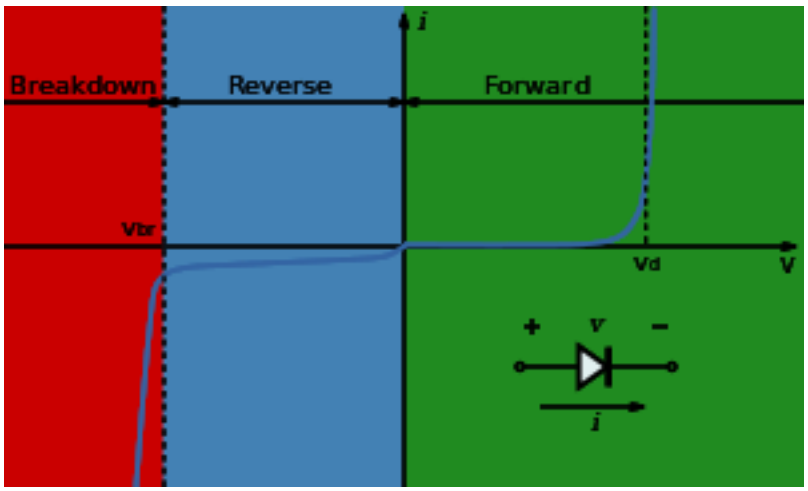


Fig 5.7 BandDiagram of LED

RELAY MODULE

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relaysare used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motoror other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power

Systems these functions are performed by digital instruments still called "protective relays".

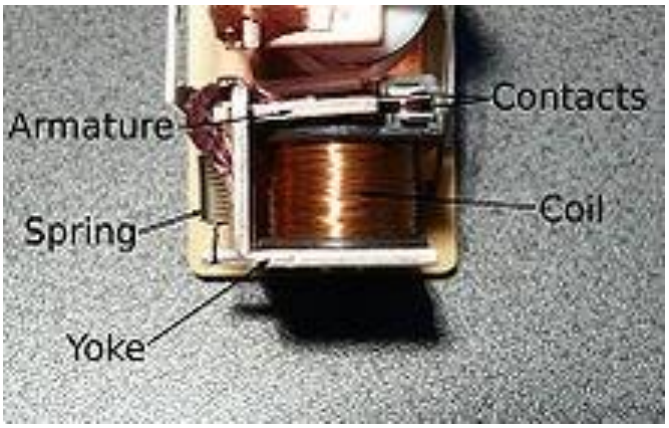


Fig 5.8 Relay Module

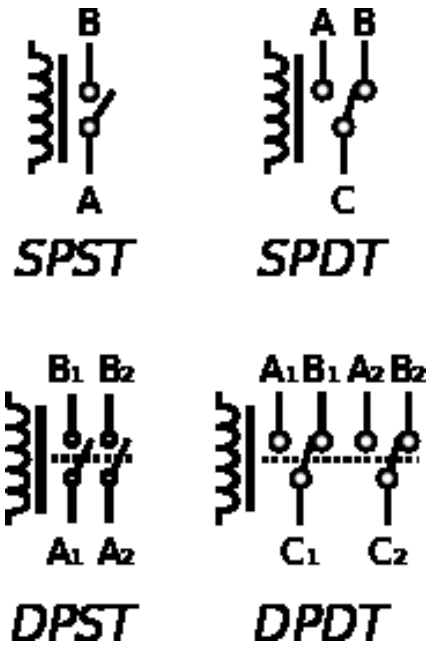


Fig 5.9 Circuit symbols of relays.

- SPST – Single Pole Single Throw. These have two terminals which can be connected or disconnected. Including two for the coil, such a relay has four terminals in total. It is ambiguous whether the pole is normally open or normally closed. The terminology"SPNO" and "SPNC" is sometimes used to resolve the ambiguity.
- SPDT – Single Pole Double Throw. A common terminal connects to either of two others. Including two for the coil, such a relay has five terminals in total.
- DPST – Double Pole Single Throw. These have two pairs of terminals. Equivalent to two SPST switches or relays actuated by a single coil. Including two for the coil, such a relay has six terminals in total. The poles may be Form A or Form B (or one of each).
- DPDT – Double Pole Double Throw. These have two rows of change-over terminals. Equivalent to two SPDT switches or relays actuated by a single coil. Such a relay has eight terminals, including the coil.

AT MEGA 328

ATmega-328 is basically an Advanced Virtual RISC (AVR) micro-controller. It supports the data up to eight (8) bits. ATmega-328 has 32KB internal builtin memory. This micro-controller has a lot of other characteristics. You should also have a look at Introduction to PIC16F877a (it's a PIC Microcontroller) and then compare functions of these two Microcontrollers.

ATmega 328 has 1KB Electrically Erasable Programmable Read Only Memory (EEPROM). This property shows if the electric supply supplied to the micro-controller is removed, even then it can store the data and can provide results after providing it with the electric supply. Moreover, ATmega-328 has 2KB Static Random Access Memory (SRAM). Othercharacteristics will be explained later. ATmega 328 has several different features which makeit the most popular device in today's market. These features consist of advanced RISC architecture, good performance, low power consumption, real timer counter having separate oscillator, 6 PWM pins, programmable Serial USART, programming lock for software security, throughput up to 20 MIPS etc. ATmega-328 is mostly used in Arduino.

The further details about ATmega 328 will be given later in this section.

- ATmega328 is an 8-bit and 28 Pins AVR Microcontroller, manufactured by Microchip,follows RISC Architecure and has a flash type program memory of 32KB.
- It has an EEPROM memory of 1KB and its SRAM memory is of 2KB.
- It has 8 Pin for ADC operations, which all combines to form PortA (PA0 – PA7).
- It also has 3 builtin Timers, two of them are 8 Bit timers while the third one is 16-BitTimer.
- You must have heard of Arduino UNO, UNO is based on atmega328 Microcontroller. It's UNO's heart.

- It operates ranging from 3.3V to 5.5V but normally we use 5V as a standard.
- Its excellent features include the cost efficiency, low power dissipation, programming lock for security purposes, real timer counter with separate oscillator.
- It's normally used in Embedded Systems applications. You should have a look atthese Real Life Examples of Embedded Systems, we can design all of them using this Microcontroller.
- The following table shows the complete features of ATmega328:

No. of Pins	28
CPU	RISC 8-Bit AVR
Operating Voltage	1.8 to 5.5 V
Program Memory	32KB
Program Memory Type	Flash
SRAM	2048 Bytes
EEPROM	1024 Bytes
ADC	10-Bit
Number of ADC Channels	8
PWM Pins	6
Comparator	1
Packages (4)	8-pin PDIP 32- lead TQFP 28-pad QFN/MLF 32-pad QFN/MLF
Oscillator	up to 20 MHz
Timer (3)	8-Bit x 2 & 16-Bit x 1

CRYSTAL OSCILLATOR

A mechanical or electronic device that works on the principles of oscillation is an oscillator. In other words, oscillator can be defined as the periodic fluctuations between two things based on changes in energy. The practical applications of oscillators include Computers, clocks, watches, radios etc. An example for simple type of mechanical oscillator is a clock pendulum. According to the oscillation within atoms, the atomic clock keeps time. In order to generate signals in computers, wireless receivers and transmitters and audio- frequency equipments, electronic oscillators are mainly used. Particularly it is used in music synthesizers. Different types of electronic oscillators are available. All the electronic oscillators operate according to the same basic principle. An oscillator always employs a sensitive amplifier, whose output signal is fed back to the input signal in phase. Hence, the signal itself regenerates and sustains. This is called as a positive feedback. Thus the oscillator uses a positive feedback for working. This is almost same to the unwanted "howling" in public-address systems. A quartz crystal determines the frequency at which an oscillator works. When a direct current is applied, these crystals vibrate at a frequency that depends on its thickness value and on the manner in which it is cut from the original mineral rock. To determine the frequency, some oscillators employ combinations of inductors, resistors, and capacitors. But, the use of quartz crystals gives the best stability (constancy of frequency) in oscillators.

In a computer the clock serves as a sort of pacemaker for the microprocessor. The clock is nothing but a specialized oscillator. The clock frequency (also called as clock speed) is usually specified in megahertz (MHz) frequency. The clock frequency is an important factor in determining the rate at which a computer can perform the execution of instructions.

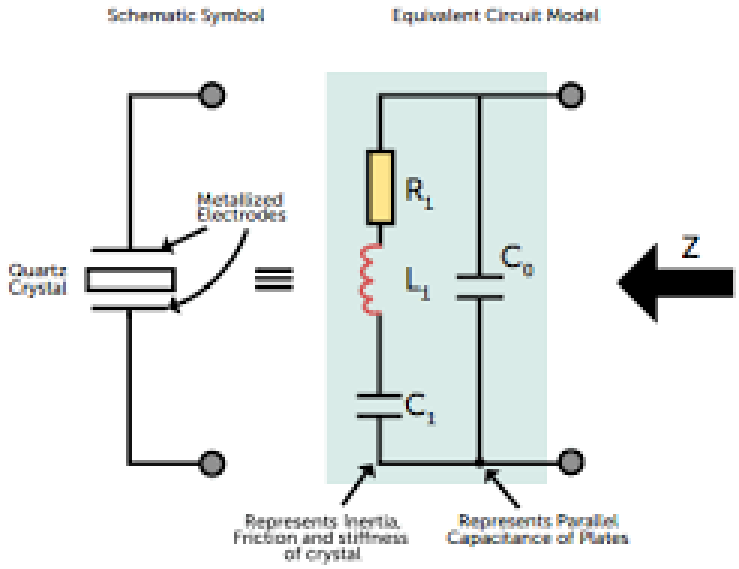


Figure 5.10 shows the equivalent electronic circuit diagram of a crystal. The equivalent diagram of a crystal consists of a resistor, an inductor and two capacitors. The two capacitors are named as C0 and C1

DHT11–TEMPERATURE AND HUMIDITY SENSOR

The **DHT11** is a commonly used **Temperature and humidity sensor.** The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers.

The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So if you are looking to measure in this range then this sensor might be the right choice for you.

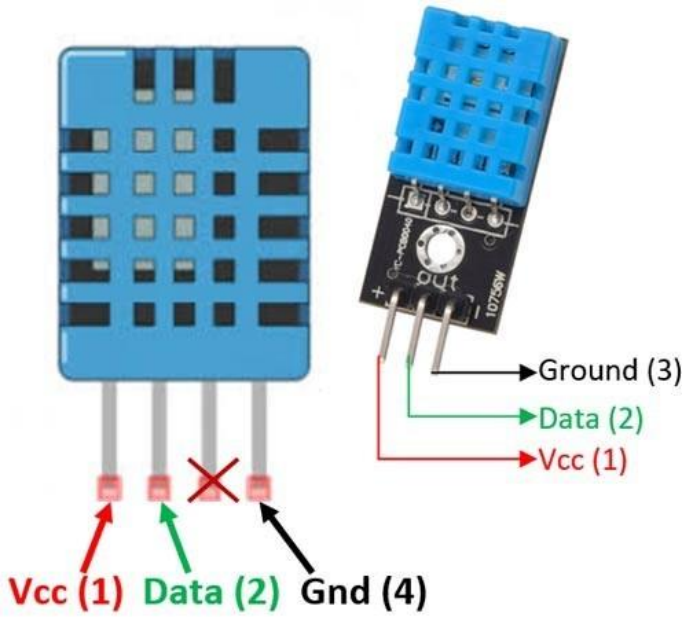


Fig 5.11 DHT11 Temperature and humidity sensor

How to use DHT11 Sensor

The DHT11 Sensor is factory calibrated and outputs serial data and hence it is highly easy to set it up. The connection diagram for this sensor is shown below.

As you can see the data pin is connected to an I/O pin of the MCU and a 5K pull-up resistoris used. This data pin outputs the value of both temperature and humidity as serial data. If youare trying to interface DHT11 with Arduino then

there are ready-made libraries for it which will give you a quick start.

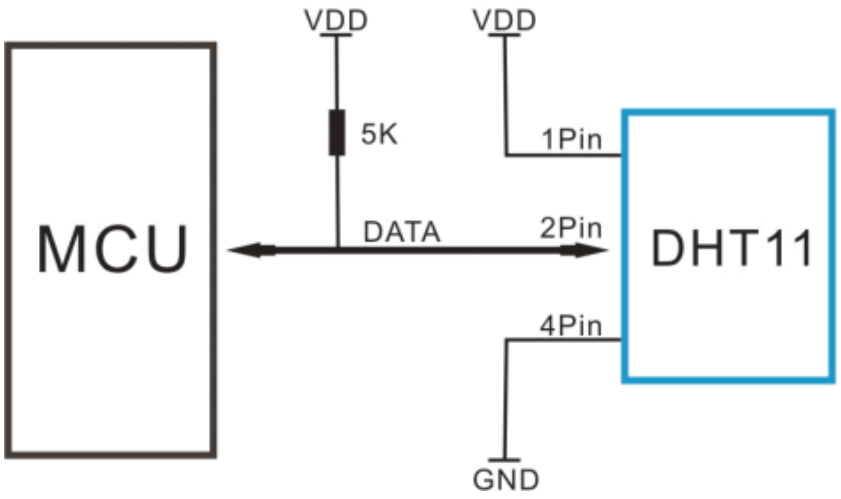


Fig 5.12 connection diagram of DHT11

If you are trying to interface it with some other MCU then the datasheet given below will come in handy. The output given out by the data pin will be in the order of 8bit humidity integer data + 8bit the Humidity decimal data +8 bit temperature integer data + 8bit fractionaltemperature data +8 bit parity bit. To request the DHT11 module to send these data the I/O pin has to be momentarily made low and then held high as shown in the timing diagrambelow

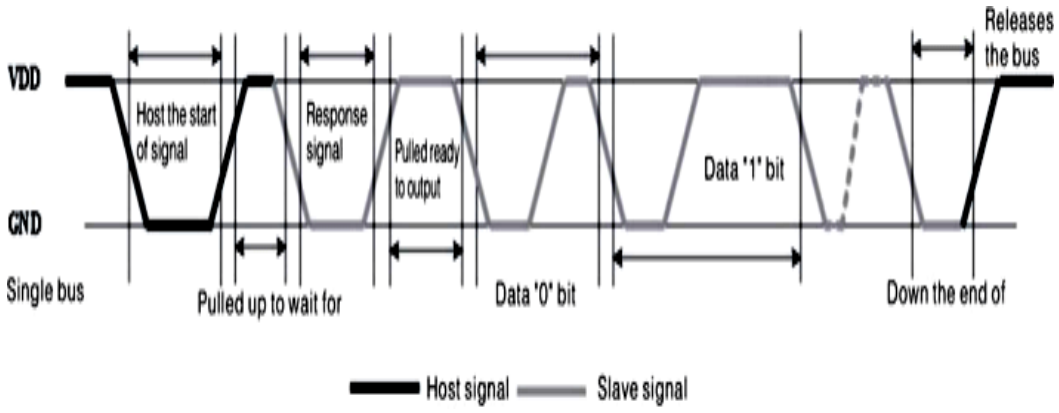


Fig 5.13 timing diagram of DHT11

Identification and Configuration:

No.	Pin Name	Description
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serialData
3	NC	No Connection and hence not used
4	Ground	Connected to the ground of the circuit
For DHT11 Sensor module		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serialData
3	Ground	Connected to the ground of the circuit

DHT11 Specifications

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±1°C and ±1%

16×2 character LCD

An LCD is an electronic display module which uses liquid crystal to produce a visible image.The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates o a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7 pixel matrix.

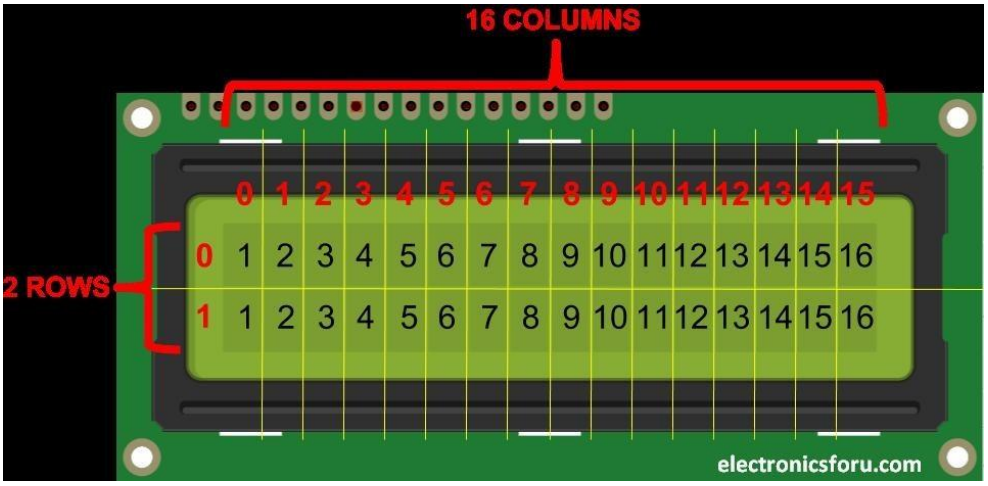


Fig 5.13 16×2 LCD Display

Pin diagram

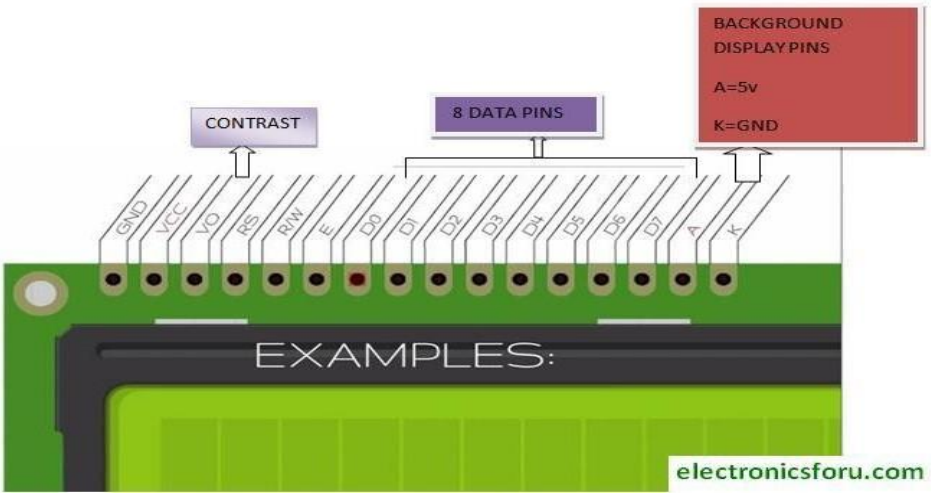


Fig 5.14 16X2 LCD pinout diagram

Displaying Custom Characters on 16X2 LCD

Generating custom characters on LCD is not very hard. It requires the knowledge about custom generated random access memory (CG-RAM) of LCD and the LCD chip controller. Most LCDs contain Hitachi HD4478 controller.

CG-RAM is the main component in making custom characters. It stores the custom characters once declared in the code. CG-RAM size is 64 byte providing the option of creating eight characters at a time. Each character is eight byte in size.

CG-RAM address starts from 0x40 (Hexadecimal) or 64 in decimal. We can generate custom characters at these addresses. Once we generate our characters at these addresses, now we canprint them on the LCD at any time by just sending simple commands to the LCD. Character addresses and printing commands are below

CG-RAM Characters	CG-RAM Address (Hexadecimal)	Commands to display Generated Characters
1st Character	0x40	0
2nd Character	0x48	1
3rd Character	0x56	2
4th Character	0x64	3
5th Character	0x72	4
6th Character	0x80	5
7th Character	0x88	6
8th Character	0x96	7

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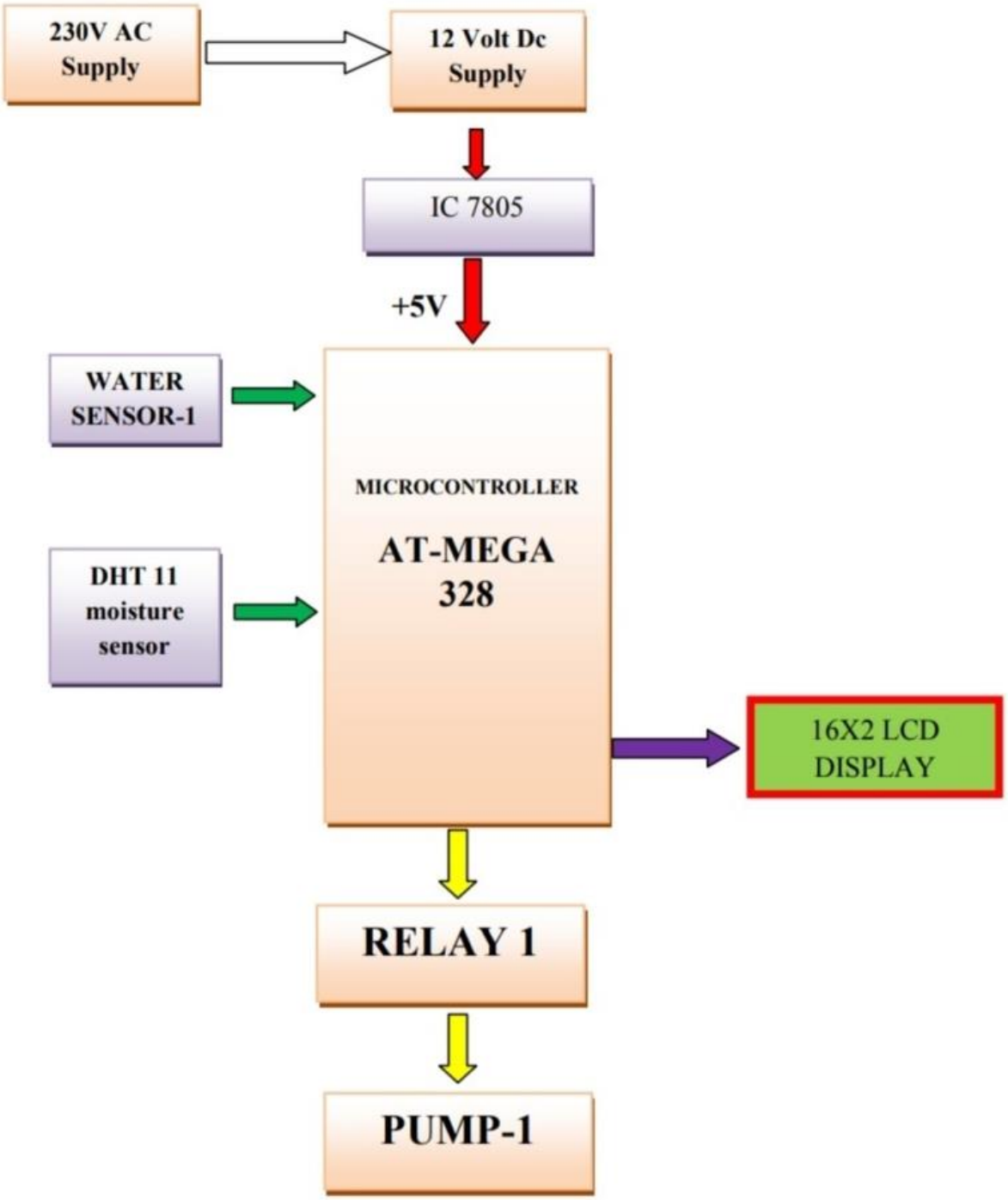
Chapter – 6

BLOCK DIAGRAM

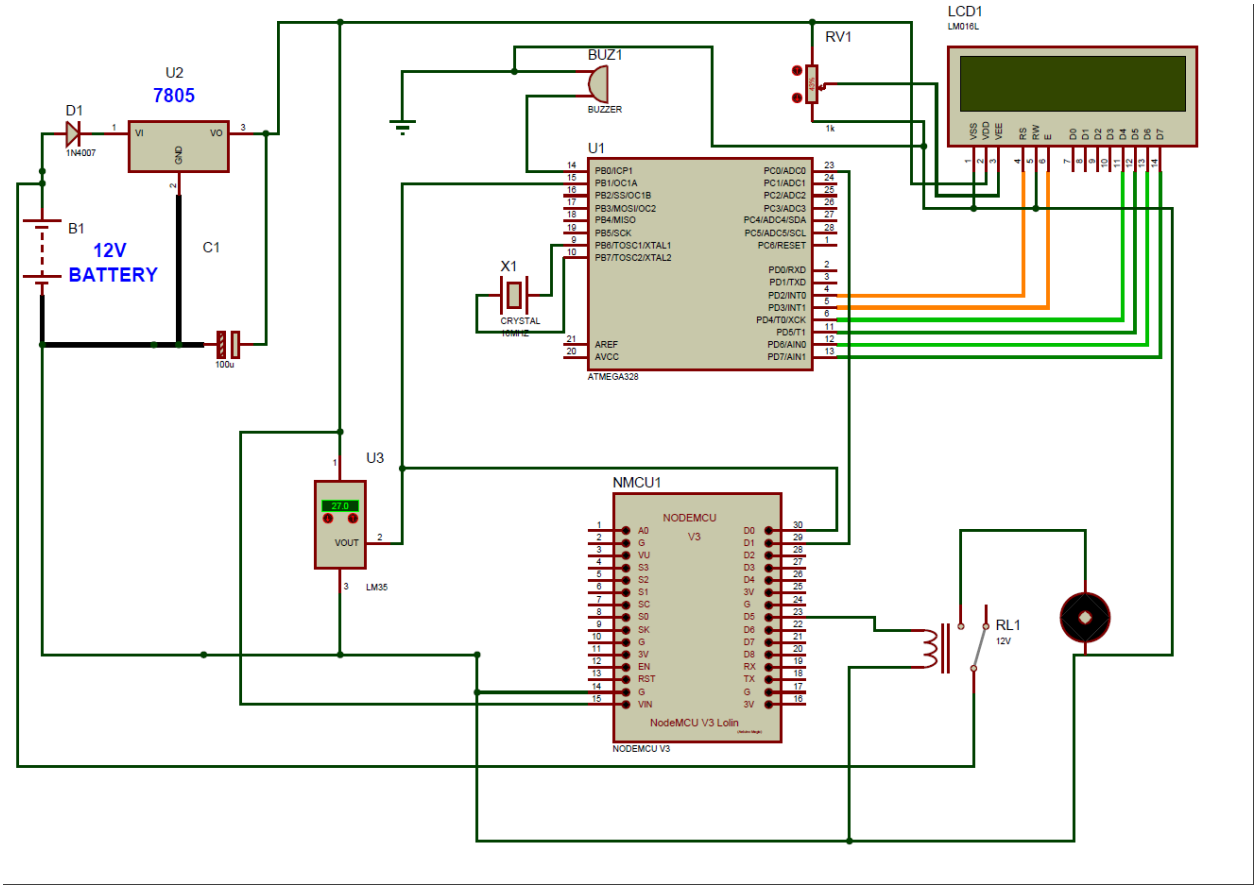
BLOCK DIAGRAM OF THE SYSTEM



Chapter – 7

CIRCUIT DIAGRAM

CIRCUIT DIAGRAM



Chapter – 8

SOFTWARE USE IN PROJECT

SOFTWARE USE IN PROJECT

SOFTWARE USED FOR CIRCUIT DESIGN

1:-PROTEUS

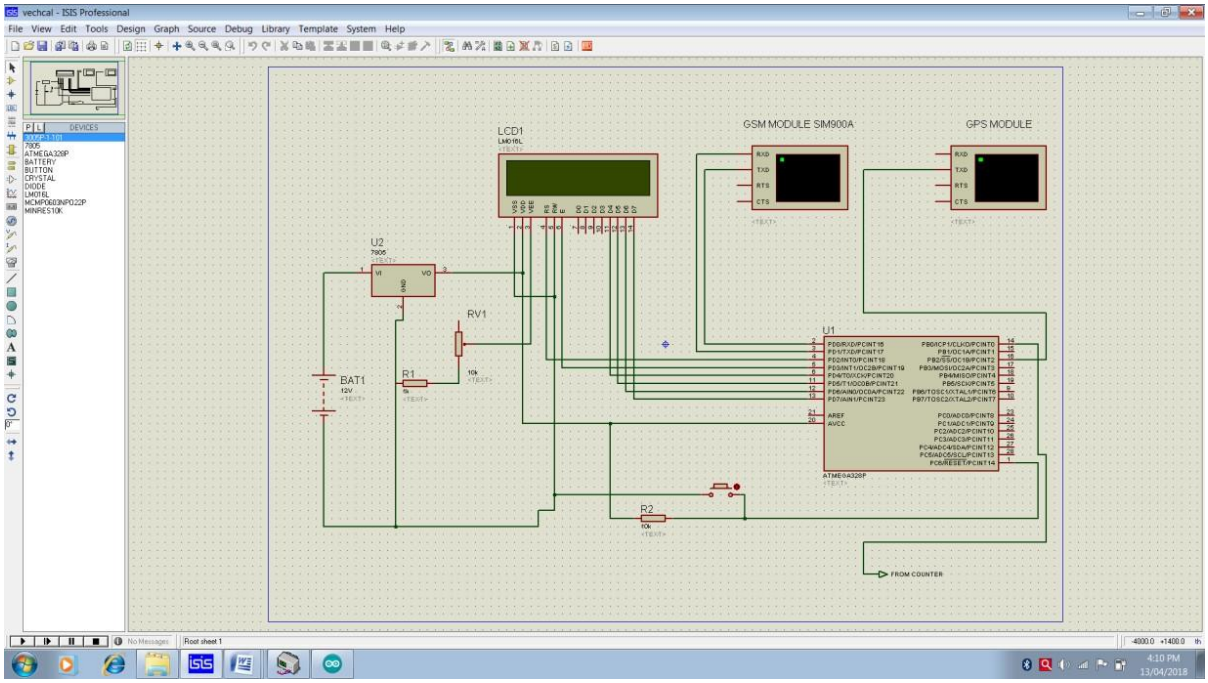
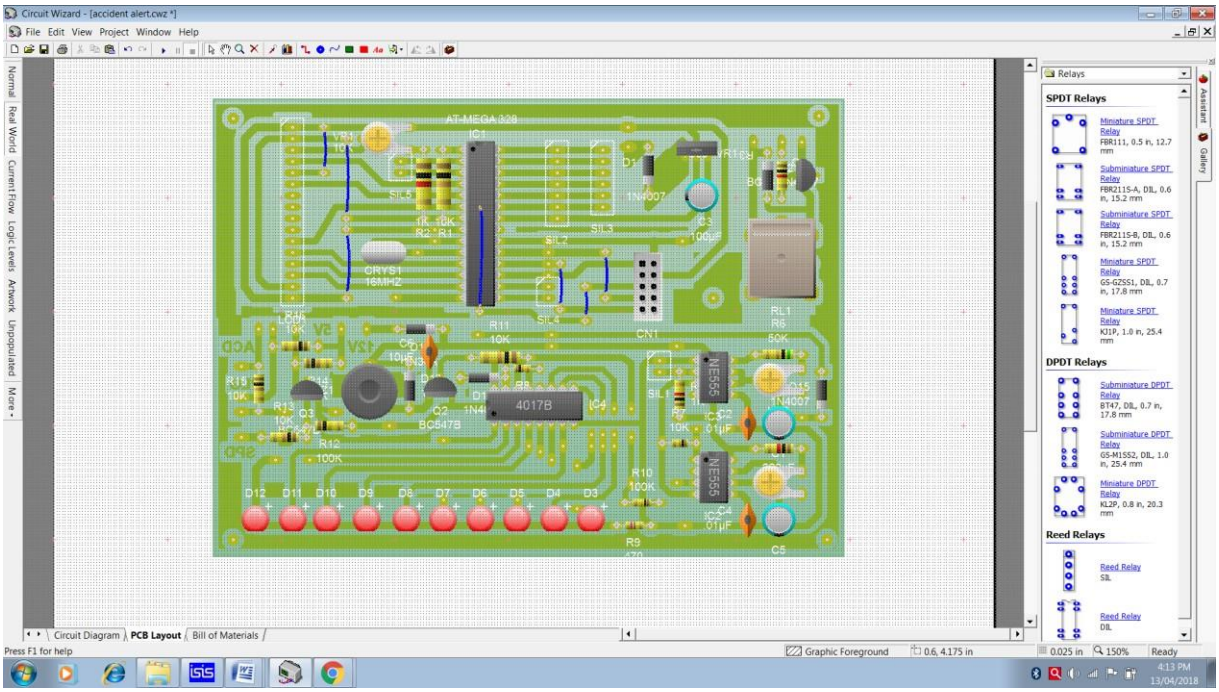


Fig 8.1 Circuit Diagram Software

SOFTWARE USED FOR PCB LAYOUT DESIGN

1: - CIRCUIT WIZARD



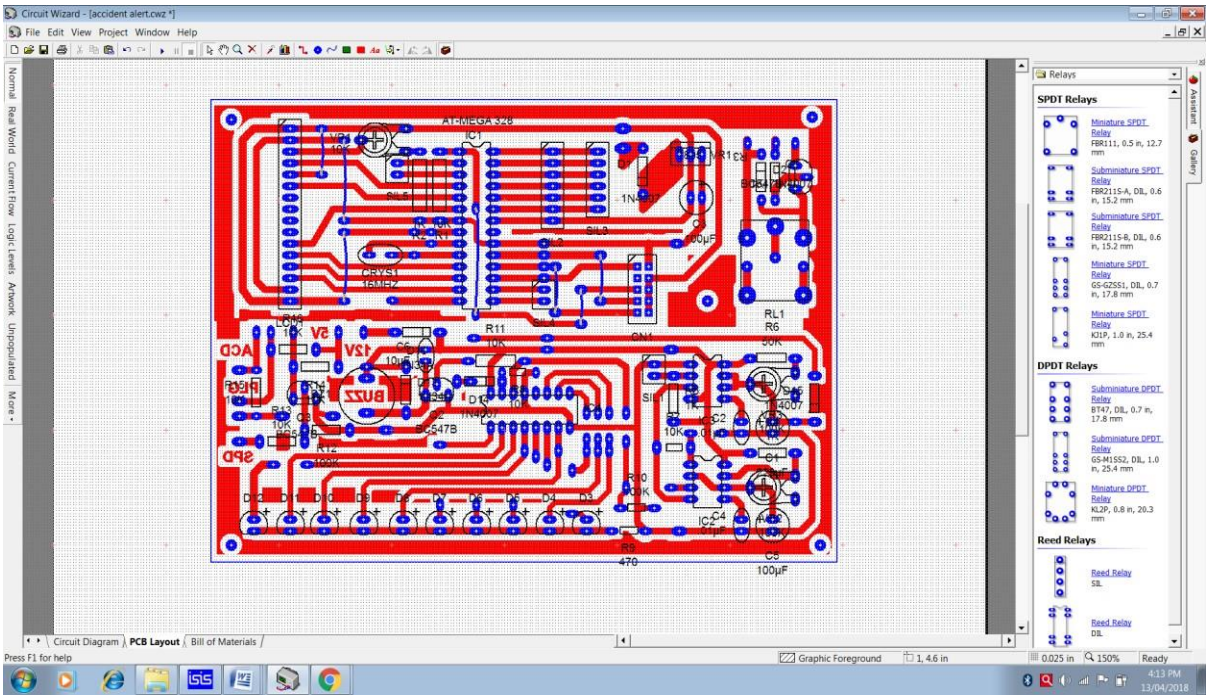
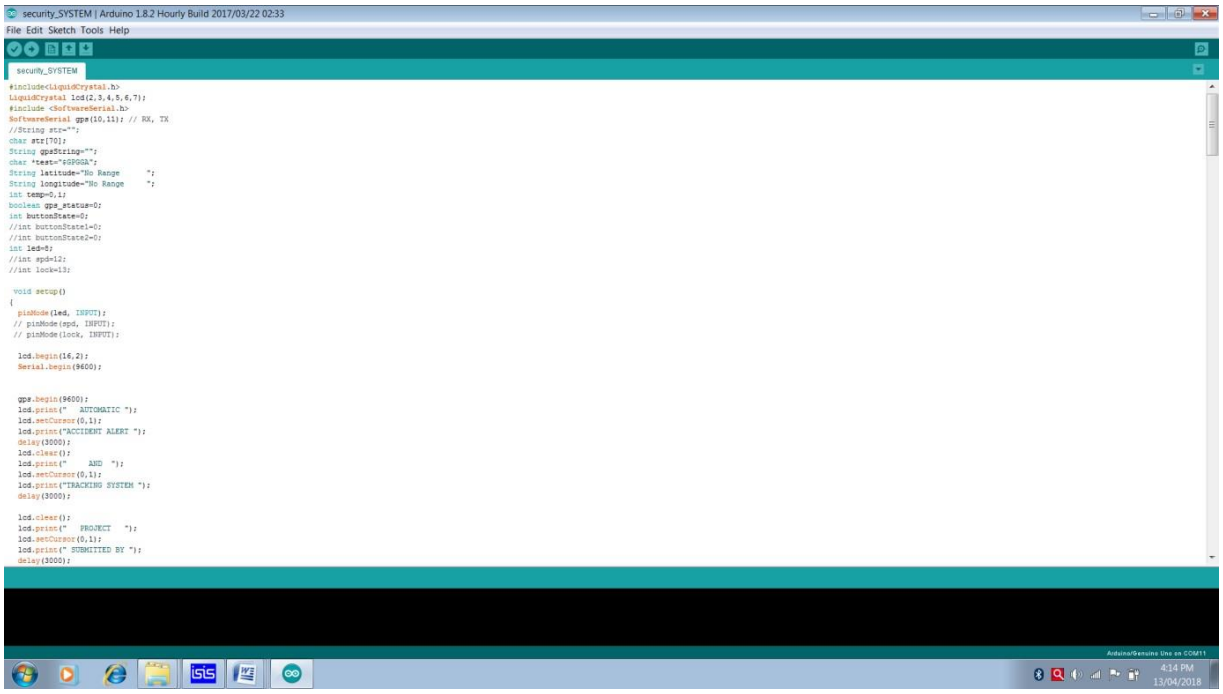


Fig 8.2 PCB Layout Design Software

SOFTWARE USED FOR PROGRAMMING

1: - ARDUINO ID



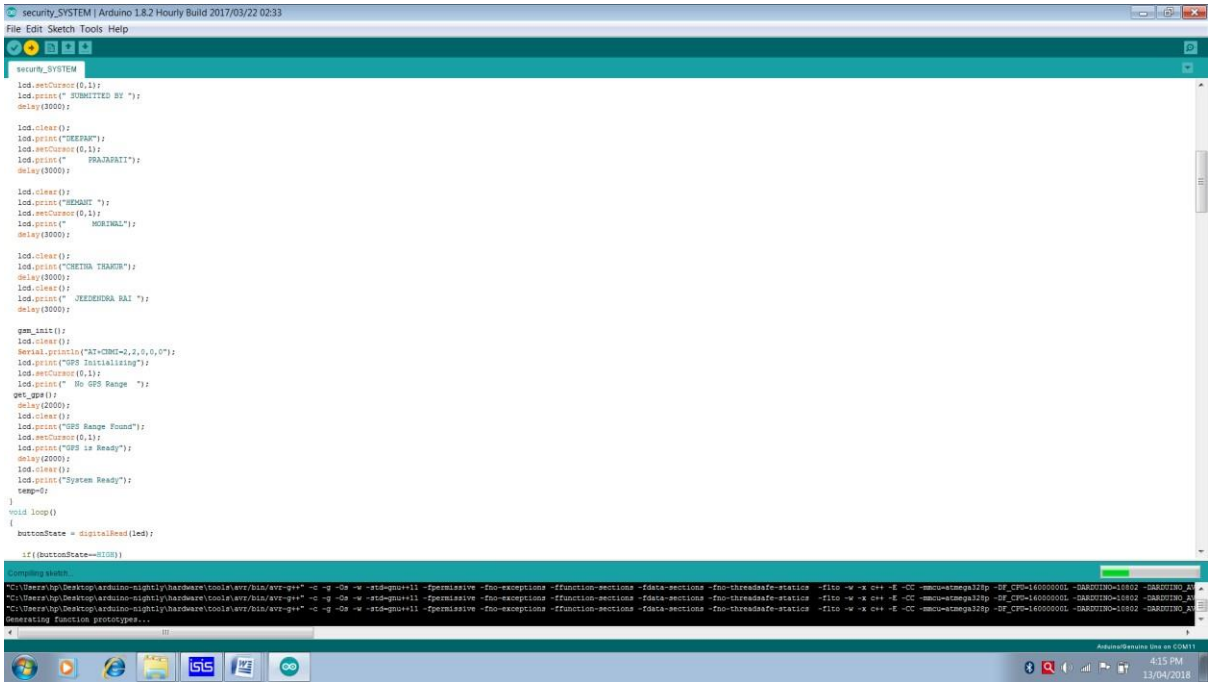


Fig 8.3 Software for Arduino Programming

Chapter – 9

TECHNOLOGY USED

Communication Technologies

With regards to the implementation of IoT devices, the used communication technologies could be considered as a vital and imperative point to attain successful operations. The communication technologies could further be regarded as being used in accordance with the environment where they will be applied. The main technologies that are used in IoT for irrigation could be classified into two categories. One could be regarded as the devices that function as nodes and lead to forward or transmit small data amount at short distances along with having low consumption of energy. Consequently, the other devices are the ones that have the ability to transmit huge amounts of data over long distances, having high-energy consumption. There are various wireless standards that could be used in the communication of IoT devices, and they could generally be classified between devices that communicate at long or short distances.

One of the most used and effective communication technologies has been identified to be Wi-Fi due to the possible accessibility for it. It has further been identified that the current low-cost devices for IoT mostly lead to support Wi-Fi, and while it has its limitations (area coverage and reach), it is regarded an effective overall method. Global System for Mobile communication (GSM) further has been identified to be a widely spread wireless technology which provides long-range communication and all it requires is a mobile plan of the service provider which operates and functions in that particular area. Two other noticeable technologies that have been established more recently are Long Range (LoRa) and Message Queuing Telemetry Transport (MQTT). LoRa provides very long ranges, and this has led to make this technology highly feasible and useful for secluded areas that do not have any service. On the other hand, although MQTT has also resulted in being a widely spread protocol as it have low overhead

and low power consumption, it is not being highly used for an irrigation system as yet.

Cloud Technologies

Two of the most imperative and mostly used storage systems could be regarded as cloud and traditional database. These storage systems are critical for various organisations working in different industries and sectors as they provide the opportunity to save and access useful information when needed. Through such storage systems, the concept of big data has taken place which defines huge amount of datasets being used for firms for various purposes [62]. With regards to the required services which are in demand in IoT, it is vital to use middleware. With the use of middleware, it becomes feasible to connect programs that have not been developed initially to be connected to each other. The classification of IoT middleware is further based on different features and interface protocol assistance [63].

Considering the usage of cloud in the agricultural sector and specifically in irrigation-based systems, data is gathered and processed by the use of sensors. In several studies, it has further been deduced that the data is processed in the cloud itself, and the users of it are able to view the information by connecting to the cloud. The usage of cloud in irrigation is mainly taken in terms of storing the monitored data and then retrieving it when needed [64]. Cloud technology provides both paid and free options to the users for storing, assessing, and displaying the data on varied devices and platforms. The fact that this technology is being used to store the information related to work significantly contributes to augmenting the overall performance efficiency. The stored data is accessed on various occasions and for various purposes out of which research and development could also be considered as one of the most critical uses. The facility of cloud technology has enabled many organisations in the agricultural sector to

store and view information that assists in improving work efficiency and effectiveness.

Considering the process of irrigation, cloud technology has also been used to generate alerts through developing algorithms. These alerts have been used to mitigate various risks and hazards that could have taken place otherwise. With the use of these alerts, it becomes more feasible to amend the work activities and take the necessary precautions through which any adversities could be mitigated [66]. Many programs have been developed related to cloud technologies that have been providing assistance in the work performance and while all of these programs have their own significance and use, they are implemented in accordance with their cost, applicability, services, and other factors. The irrigation system could be considered as a complex activity that has to be carried out in terms of its related risks, damages, and intricacies. Having said this, cloud technologies are used by individuals involved in the irrigational activities to not only reduce risks but also improve the outcomes of work in order to attain the set objectives.

Chapter – 10

APPLICATIONS

APPLICATIONS

Smart farming is a type of agriculture that works on technologies of IoT. It defines a system with a technology of state-of-the-art that allows the cultivation of the land in a very sustainable way.

Due to the usage of IoT technology in the field, the workload and management have become easier. For instance, with the use of sensors, one can easily detect the temperature, humidity, and quality of the soil. It also helps in automating the process of irrigation based on the soil condition.

This helps the farmer in monitoring the conditions of crops remotely and gives them a chance to manage the resources carefully. That is why smart agriculture is ideal and much more effective than ways of traditional agriculture.

The Internet of Things is much more beneficial for farmers than we think. Even though there is not much advancement in the field, the advancement made is still quite impressive and beneficial. Some key benefits of using IoT technologies in agriculture are described below.

1. Intelligence Data Collection

IoT devices enable sensors that help in collecting a bunch of useful data for farmers. It helps in collecting information regarding the quality of soil, predicting weather conditions, and helping in the progress of the plantation. This not only helps in analysing the condition of the farm but also in checking on the workers' performances.

2. Waste Reduction

IoT technology in agriculture also helps in managing cost-efficient production. For instance, smart devices help the farmer identify the irregularity in the crop

more accurately and precisely. Ultimately, it will be easy for them to take action beforehand and protect the yield from any damage. Moreover, it also helps in saving costs in terms of fertilization and irrigation, as the sensors in the field help in identifying the condition of the soil. Furthermore, these sensors also predict the best time for harvesting, which reduces the waste of crops.

3. Process Automation

Smart devices in agriculture also help in the automation of the various stages of production, which include fertilizers, irrigation, and pest control.Moreover, these automation devices give you more precise results than manual interventions. This leads to saving resources and high-quality products. This automatically ensures the quality of the harvest.

4. Animal Monitoring

Other than crops and yields, IoT in the farms also helps in analysing the health of animals on the farm, even from far away. It reduces the time of finding and catching a specific animal from the herd and checks its physical condition.Moreover, it also notifies the pregnancy details about the farm animal. And if an animal is sick, the application notifies the farmer immediately of the current situation.

5. Competitive Advantage

It also increases the rate, amount, and quality of harvesting, which gives competitive benefits to the business. Sensors installed on a harvesting machine or tractors immediately notify the owner if there is anything going wrong with its working.

Chapter – 11

RESULT

RESULT

The framework builds the yield profitability and lessens rancher's remaining operation at hand. There is proficient utilization of water. The time expended is less there by giving more throughputs. Controls the development of weeds, sparing the manure. Disintegration of soil could be halted absolutely by utilizing this sort of a framework. Prompts improvement of a financially savvy water system control framework. Recoveries electrical vitality. This framework underpins forceful water administration for the rural land. This design depends onthe abilities of present and cutting edge microcontrollers and their application necessities. Microcontroller utilized for the framework is promising that it can build framework life by lessening the power utilization coming about because of lower control utilization. General mechanization framework is utilized at water system. Initiation or deactivations of machines rely upon contact order prepared by processor. Better execution is seen under electromagnetic impedance moreover.

As portable handset can be worked till certain higher temperatures, it would work persistently. This mechanization framework will be utilized for impaired and individuals at long separation and ranches. Soil Moisture and Temperature sensors (SMT)- This can demonstratethe best time to begin water system, toward the start of the season and when to stop water system toward the finish of the season. Amid the season, know how much water is on the enclosure, avoid over watering and under watering, to make the ideal developing conditions and avert nitrogen draining.

Pump Status- See the status of your pumps (on/off) without physically visiting each pump shed. Joined with a stream sensor, you can rapidly analyze any pump related issues. Consolidate configurable cautions so you're informed when certain occasions happen.

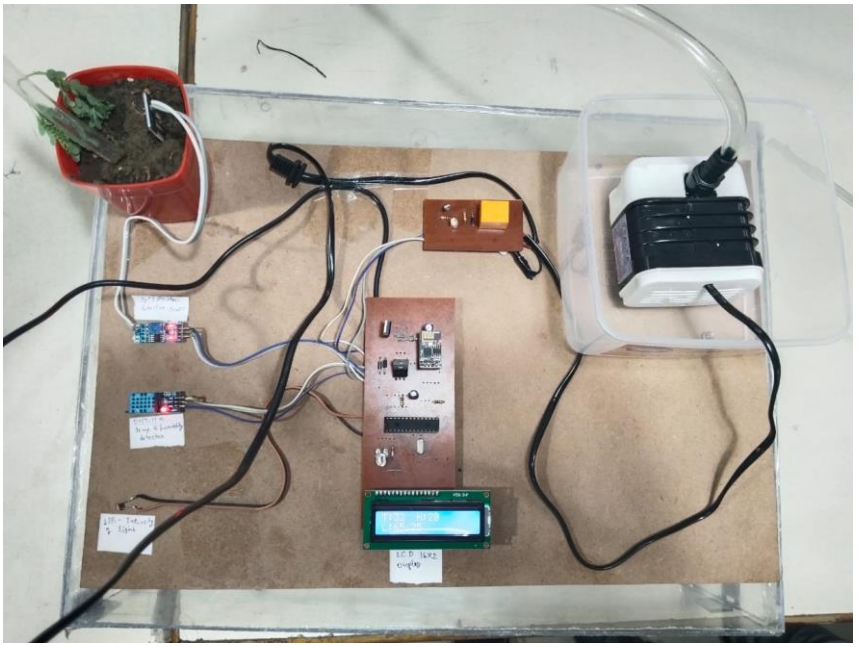
Fig 11.1 Output of IOT Based Smart Irrigation System

Chapter – 12

CONCLUSION

CONCLUSION

Horticulture are continuously being supplanted and upgraded by more complex and exact digital and electronic gadget. A high level of agribusiness income is lost to control misfortune, mistaken techniques for honing. The proposition is to play out agribusiness inkeen and more productive way. Moreover, this strategy advocates for the utilization of the Internet of Things. Web of Things has empowered the agribusiness trim observing simple andproficient to upgrade the profitability of the product and consequently benefits for the agriculturist. Sensors of various kinds are utilized to gather the data of yield conditions and natural changes and this data is transmitted through system to the rancher/gadgets that starts remedial activities. Ranchers
are associated and mindful of the states of the rural field at whenever and anyplace on the planet. This is to presume that, have accomplished the undertaking notice in theory in this project with the gear specify above.



Chapter – 13

FUTURE SCOPE

FUTURE SCOPE

Despite the fact that it is by all accounts all the more requesting and testing, there are numerous different potential outcomes like making complex associations of plants of comparative assortment or alleged Internet of Plants«. Additionally, utilizing in excess of onesensor is another thought for a trial adventure, yet there are likewise numerous other trial and test like thoughts, for example, utilizing solar power supply, clock for setting water system framework and so on. Nonetheless, freely of the path used to build it, there is presumably that this framework can be exceptionally useful in tackling numerous issues, from those that appear to be safe to those that are on the size of the most critical and most perilous ones for human populace. By methods for this framework, it is conceivable to control the measure of water discharged from the way toward watering the plant. Despite the fact that it very well may be exceptionally useful for humankind by and large, agriculturists, skilled workers, and botanists are the general population who could have the greatest advantage of utilizing this framework.

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