SMART IRRIGATION SYSTEM

MINOR PROJECT REPORT

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BY

17211A0104 – ALLE VENNALA

17211A0119 – BONGU PRANATHI

17211A0120 – CHANDRIKA SRAVYA

17211A0138 – EDUPALLI LALITHYA

UNDER THE SUPERVISION OF

Dr. G. SRIDEVI

PROFESSOR & HEAD OF THE DEPARTMENT

DEPARTMENT OF CIVIL ENGINEEERING
B.V. RAJU INSTITUTE OF TECHNOLOGY
(UGC–AUTONOMOUS)
VISHNUPUR, NARSAPUR, MEDAK DISTRICT, TELANGANA STATE

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DECLARATION

We hereby declare that the work presented in this project work entitled **SMART IRRIGATION SYSTEM** is the outcome of our own bonafide work and is correct to the best of our knowledge and this work has been undertaken taking care of engineering ethics. It contains no material previously published or written by another person nor materials which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

Place: Narsapur
Date:

(A. VENNALA)
Roll No. 17211A0104

(**B. PRANATHI)**
Roll No. 17211A0119

(**C. SRAVYA)**
Roll No. 17211A0120

(**E. LALITHYA)**
Roll No. 17211A0138

B.V.RAJU INSTITUTE OF TECHNOLOGY
(UGC–AUTONOMOUS)
Vishnupur, Narsapur, Medak District.
Department of Civil Engineering

CERTIFICATE

This is to certify that the minor project work entitled **SMART IRRIGATION SYSTEM** carried out by **ALLE VENNALA (17211A0104)**, **BONGU PRANATHI (17211A0119)**, **CHANDRIKA SRAVYA (17211A0120)**, **EDUPALLI LALITHYA (17211A0138)**, a bonafide students of IV year in partial fulfillment for the award of Bachelor of Technology in Civil Engineering of the JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD, during the year 2021. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the departmental library. The minor project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

Place: Narsapur
Date:

Dr. G. Sridevi
Project Guide

Dr. G. Sridevi
Professor & HOD

Name and Signature of Examiner with date

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ABSTRACT

The project is about automatic irrigation system using the Arduino microcontroller with moisture sensor and water flow management. The Smart Irrigation System is an IoT based device which is capable of automating the irrigation process by analysing the moisture of soil and the climate condition (like raining). Also, the data of sensors will be displayed in graphical form on Thing speak cloud page. The key objective of the paper is to monitor the soil's moisture content during its dry and wet conditions with the aid of a moisture sensor circuit, calculate the corresponding relative humidity and irrigate it based on its nature using a PC based LabVIEW system, Arduino UNO, IOT, WIFI and an automatic water inlet setup which can also monitor and record soil's moisture content. A record of soil moisture is maintained in a Thing speak cloud server for backup. This backup is used for weather forecasting and directs the farmers regarding the type of crop to be cultivated in future. IOT gives the whole information to the operator about the irrigation. In this paper, we experiment for different soils suitable for different crops in various climatic parameters that govern plant growth and allow information to be collected at high frequency and with less labour requirements.

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(A. VENNALA)
Roll No. 17211A0104

(B. PRANATHI)
Roll No. 17211A0119

(C. SRAVYA)
Roll No. 17211A0120

(E. LALITHYA)
Roll No. 17211A0138

Place: Narsapur
Date:

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Water plays a vital role in the life of all living organism. Water used for domestic purposes as well as irrigation and industrial purposes. A water distribution network should be designed such a way that it meets the demand of increased population. An adequate water supply can give better living standards. The water quality should not get deteriorated in the distribution pipes. The deficiencies of water supply in urban regions are becoming a major challenge for authorities. Because most of the water supply scheme are intermittent system. When using an intermittent system, the water is distributed to residents for few hours in a day, hence most of the times the pipe lines are empty or partially full. A good water distribution network is the one which provide sufficient pressure at each point of distribution with less loss. A good water distribution network satisfies the consumer demand at required time. The design and analysis of water distribution network is a complex process in metropolitan areas where there is large number of pipes

In general, the layout of a water distribution network can be classified as dead-end system, ring system, grid system or radial system. A dead-end system has water mains along the roads without a particular pattern for towns that do not have road network patterns. A radial system delivers water into multiple zones. At the centre of each zone, the water is delivered radially toward the customers. A grid system follows the general layout of the grid road infrastructure with water mains and branches connected in rectangles. Drawbacks of this topology include difficulties of sizing the system. A ring system is a topology with each water main that go to each road, and there is a sub-main that is branched off the water main to provide a circulation of two directions. This system has many advantages over the grid system. The three methods of water distribution are gravitational system, pumping system and combined gravity and pumping system. In gravity system, the water from a high levelled source is distributed to the consumers at low levels by the mere action of gravity without pumping. This method is the most economical and reliable since no pumping involved. However this method needs lakes or reservoir as a source of supply. In the pumping system the treated water is directly pumped into the distribution mains without storing anywhere. It is also known as pumping without storage system. In a combined gravity and pumping system, the treated water is pumped at a

constant rate and stored into an elevated distribution reservoir. This system helps in operating the pumps at constant speed at their rated capacities, thus increasing their efficiency and reducing their wear and tear. This type of system is invariably and almost universally adopted

Aim is to develop a wireless three level controlled smart irrigation system to provide irrigation system which is automatic for the plants which help in saving water and money. The main objective is to apply the system for improvement of health of the soil and hence the plant via multiple sensors. Appropriate soil water level is a necessary pre-requisite for optimum plant growth. Also, water being an essential element for life sustenance, there is the necessity to avoid its undue usage. Irrigation is a dominant consumer of water. This calls for the need to regulate water supply for irrigation purposes. Fields should neither be over-irrigated nor under-irrigated. The objective of this thesis is to design a simple, easy to install methodology to monitor and indicate the level of soil moisture that is continuously controlled in order to achieve maximum plant growth and simultaneously optimize the available irrigation resources on monitoring software LabVIEW and the sensor data can be seen on Internet. In order to replace expensive controllers in current available systems, the Arduino Uno will be used in this project as it is an affordable microcontroller. The Arduino Uno can be programmed to analyze some signals from sensors such as moisture, temperature, and rain. A pump is used to pump the fertilizer and water into the irrigation system. The use of easily available components reduces the manufacturing and maintenance costs. This makes the proposed system to be an economical, appropriate and a low maintenance solution for applications, especially in rural areas and for small scale agriculturists.

This research work enhanced to help the small-scale cultivators and will be increase the yield of the crops then will increase government economy.

Over time, systems have been implemented towards realizing this objective of which automated processes are the most popular as they allow information to be collected at high frequency with less labour requirements. Bulk of the existing systems employ micro-processor-based systems. These systems offer several technological advantages but are unaffordable, bulky, difficult to maintain and less accepted by the technologically unskilled workers in the rural scenario. The Internet of Things (IoT) is transforming the agriculture industry and enabling farmers to contend with the enormous challenges they face. The industry must overcome increasing water shortages, limited availability of lands, difficult to manage costs, while meeting the increasing consumption needs of a global population that is expected to grow

up to 70% by 2050. India's major supply of financial gain is from agriculture sector and seventieth of farmers and general folks rely upon the agriculture. In Republic of India most of the irrigation systems square measure are operated manually. These antique techniques square measure replaced with semi-automated and automatic techniques. The on the market ancient techniques square measure like ditch irrigation, terraced irrigation, drip irrigation, system. The global irrigation situation is classified by redoubled demand for higher agricultural productivity, poor performance and decreased accessibility of water for agriculture. These issues are befittingly corrected if we have a tendency to use machine-controlled system for irrigation.

Automating farm or nursery irrigation permits farmers to use the correct quantity of water at the correct time, regardless of the provision of labour to show valves on and off. Additionally, farmer's mistreatment automation instrumentation is able to scale back runoff from over watering saturated soils, avoid irrigating at the incorrect time of day, which will improve crop performance by making certain adequate water and nutrients once required. Those valves are also simply automated by mistreatment controllers. Automating farm or nursery irrigation permits farmers to use the correct quantity of water at the correct time, no matter the provision of labour to show valves on and off. They lack in an exceedingly featured mobile application developed for users with acceptable user interface. It solely permits the user to observe and maintain the wetness level remotely in no matter of time. From the purpose of reading and performing at remote places the developed microcontroller primarily based irrigation system will work perpetually for indefinite fundamental measure, even in sure abnormal circumstances

1.2 OBJECTIVES

- To improve and stabilize the crop yields of smallholder olive farmers through the implementation of sustainable irrigation systems.
- To promote water management practices that optimizes the volume and timing of water distribution. To generate positive economic consequences for farmers and their families.
- Minimize year to year yield fluctuations, leading to higher and more stable farm income.

CHAPTER 2

LITERATURE SURVEY

Irrigation is most important for high yield of the farm. Today, by using WSN technology it is possible to monitor and control the environmental conditions as soil moisture, temperature, wind speed, wind pressure, salinity, turbidity, humidity etc for irrigation. Automated irrigation performed by using solenoid valve and pump. Solenoid valve is an electromechanical valve used with liquid controller to control an electronic current through solenoid which is a coil of wire that uses to control the state of the valve according to need of irrigation.

2.1 Sensor based Automated Irrigation System with IOT

In Sensor based Automated Irrigation System with IOT mentioned about using sensor based irrigation in which the irrigation will take place whenever there is a change in temperature and humidity of the surroundings. The flow of water is managed by solenoid valve. The opening and closing of valve is done when a signal is send through microcontroller. The water to the root of plant is done drop by drop using rain gun and when the moisture level again become normal then sensor senses it and send a signal to microcontroller and the value is then closed. The two mobile are connected using GSM. The GSM and microcontroller are connected using MAX232. When moisture of the soil become low moisture, sensor sense it and send signal to microcontroller, then the microcontroller gives the signal to mobile and it activate the buzzer. This buzzer indicates that valve needs to be opened by pressing the button in the called function signals are sent back to microcontroller. Microcontroller used can increase System Life and lower the power Consumption. There system is just limited to the automation of irrigation system and lacks in extra ordinary features.

2.2 Automated Irrigation System Using a Wireless Sensor Network and GPRS Module

Automated Irrigation System Using a Wireless Sensor Network and GPRS Module mentioned about using automatic irrigation system in which irrigation will take place by wireless sensor units (WSUs) and a wireless information unit (WIU), linked by radio transceivers that allowed the transfer of soil moisture and temperature data, implementing a WSN that uses ZigBee technology. It takes a measure of temperature and moisture using sensor and controlled by microcontroller. The WIU has also a GPRS module to transmit the data to a web server via the public mobile network. The information can be remotely monitored online through a graphical

application through Internet access devices. This irrigation system allows cultivation in places with water scarcity thereby improving sustainability and it is feasible system. But due to Zigbee protocol this system becomes more costly.

2.3 Wireless Sensor Network based Remote Irrigation Control System and Automation using DTMF Code

[3] In Wireless Sensor Network based Remote Irrigation Control System and Automation using DTMF code mentioned about using automated irrigation system for proper yield and handled remotely for farmer safety. Wireless sensor network and Embedded based technique of DTMF (Dual Tone Multiple Frequency) signalling to control water flow for sectored, sprinkler or drip section irrigation. Circuit switching instead of packet switching used by SMS controlled devices available currently in the market. The farmer can use his cell phone or landline phone for the purpose of starting and controlling the irrigation and the pesticide spraying, just by dialing and sending the DTMF commands over the GSM network. This system will be very economical in terms of the hardware cost, power consumption and call charges. Farmers have to control (on/off) the valves time to time (even at night) which increases the running cost because every time we have to make a call to on or off the valves and it is also very inconvenient. Farmers are unable to know the status of power supply at the field.

2.4 Wireless Sensor Network Based Automated Irrigation and Crop Field

Wireless Sensor Network Based Automated Irrigation and Crop Field Monitoring System mentioned about using wireless sensor network based automated irrigation system for optimize water use for agricultural purpose. The system consists of distributed wireless sensor network of soil moisture, and temperature sensors placed in the crop field. To handle the sensor information Zig bee protocol used and control the water quantity programming using an algorithm with threshold values of the sensors to a microcontroller for irrigation system. The system continuously displays the abnormal condition of the land (soil moisture, temperature level). Using a GSM modem with GPRS facility feature provides the information to fanners and interface with PIC 18F77 A microcontroller. The Irrigation system is automatic and manual mode. This system increases the crop fields, improve the crop quality, increase the energy and reduce the non-point source pollution. Due to PIC microcontroller the length of the program will be big because of using RISC (35 instructions).

2.5 Automated drip Irrigation system

Smart drip irrigation system for sustainable agriculture mentioned about using fully automated drip irrigation system which is controlled and monitored by using ARM9 processor.PH content and the nitrogen content of the soil are frequently monitored. For the purpose of monitoring and controlling, GSM module is implemented. The system is used to turn the valves ON or OFF automatically as per the water requirement of the plants. The system informs user about any abnormal conditions like less moisture content and temperature rise, even concentration of CO2 via SMS through the GSM module. The moisture sensor output will help to determine whether to irrigate the land or not depending upon the moisture content. Along with moisture sensor the temperature sensor output can also be taken into consideration while irrigating the land. If the moisture content of soil is very low and the temperature is very high then there is need of irrigation for plants, but the time for which irrigation will be provided is different for different temperature range. Small amount of water is lost through deep percolation if the proper amount is applied. ARM processor is that it is not binary compatible with x86. This means you not going to be running windows any time soon. There are several Unixoperating systems that can run on ARM however, such as Linux and BSD.

2.6 Designing of mobile controlled automatic Interactive Voice Response irrigation system

Agriculture is a dominant sector in India, which contributes to 13.7% GDP growth and provides employment to 65% of the population. These figures indicate that technological amendments should be made in order to improve productivity and sustainability. This paper proposes an Automated Irrigation system based on IVRS (Interactive Voice Response System) for remote controlling and monitoring of irrigation loads. It guarantees the farmer to perform his job efficiently with ease. The proposed system continuously monitors the soil moisture level and provides the necessary control signals for controlling the water flow to a particular farm sector. This is possible by controlling the switching operation of the solenoid valves, motors or pumps. Further, the designing, hardware development and implementation of the system is illustrated in detail. The paper also evaluates the latency involved in executing the complete process of control operation.

2.7 Precision irrigation based on wireless sensor network

The main purpose of this study is to present a complete irrigation solution for the farmer based on wireless sensor network. The challenge is to create an automated irrigation system which can reduce in the same time the water's waste and is cost effective. Different parameters are important to measure in order to calculate the efficient quantity of water needed by plants. In this study, the proposed solution is the use of low-cost sensor nodes having reduced power consumption able to realise necessary requirements. The system is composed of different types of nodes. Each node consists of a TelosB mote and adequate sensors or actuators. Soil nodes are used to detect the level of moisture and temperature in soil. Weather nodes monitor the climatic changes. Other nodes are connected to actuators which are able to control the opening of the irrigation valve if necessary.

2.8 Irrigation with grid architecture sensor network

Currently, various irrigation practices like localized irrigation, usage of sprinklers and sub-irrigation are being used while facilitating plant growth and conserve water. By making use of wireless sensor network (WSN) nodes in irrigation, a farmer can locate the specific areas, which need to be irrigated with limited amount of water and thereby avoid over irrigation and conserve water. This work considers a WSN based grid routing technique using which the whole of the observational field area is divided into grids. The soil water content measurements are carried out by making use of soil water content sensors over a time period. A model for the grid based WSN routing architecture has also been created using NS-3 simulation platform and a performance analysis has also been done.

2.9 Wireless solution for irrigation in agriculture

Indian economy is mainly based on agriculture. The most important parameter for the agriculture is timely and sufficient supply of water. Most of the farmers are dependent on electric water pumps for irrigation which demands electricity. The frequent, intermittent, low voltage supply of power to the agriculture sector has caused problems to the farmers who are spending their time monitoring the supply of power without which their work cannot start. The highly unreliable power supply with frequent power cuts have not only lowered the efficiency of farmers but also have led to the frustration of the farmer to give up agriculture and move to urban areas for better prospects in the globalized world. In my paper I am going to propose a system which shows, how mobile technology can benefit millions of farmers in rural India by

providing a solution for the irrigation problems caused by intermittent electrical power supply. The goal of this paper is to design an embedded device, which can control up to 8 devices by sending a specific SMS message from a cell-phone. This controller is extremely handy at places where we have to control the ON and OFF switching of the devices but no wired connection to that place is available.

2.10 A prototype of PC based remote control of irrigation

In recent years, more efficient and positive use of current water resources together with global warming becomes important. New technologies and ideas have been developed for many years to optimal use of water resources especially in agricultural field. Growers irrigate their own areas uniformly. However demand of water, fertilizer and agricultural chemicals are different for each trees or crops depending on plant ages and chemical content of soil. Determination of water demand for crops and trees is important to protect fresh water resources. In this study, a prototype of solar powered, low cost, remote-controlled real-time monitoring irrigation system was designed to control drip irrigation. Software (ValCon), developed by authors with C# language in Visual Studio.Net 2008 editor) was developed to control irrigation valve and monitor water content of soil. Control method of irrigation (automatic or manual) can be selected by users. Only water content of soil was monitored. Nevertheless, by using sensors which measure other features of water or air, it is also possible to extend the designed system. Remote controlled site-specific irrigation scheme prevents moisture stress of trees and salification besides providing the efficient use of fresh water resources. Also, this irrigation method removes labour that is needed for flooding irrigation.

2.11 Real-time optimization of irrigation scheduling in agriculture

A simulation optimization approach is developed for managing irrigation operations in agriculture. The approach combines a highly complex crop growth and yield simulation model with an optimization algorithm to calculate an irrigation sequence that maximizes crop yield. The approach overcomes the limitations of many existing irrigation scheduling optimization methods that rely on simpler but more inaccurate crop growth and yield models to ensure computational tractability. The performance of the approach is demonstrated through simulation.

2.12 Research on water-saving irrigation automatic control system based on internet of things

To improve irrigation water use efficiency, reduce cost of irrigation water, this paper discussed the design of wireless sensor network and Internet technology of farmland automatic irrigation control method. Emphasis on an analysis of the routing protocol of sensor network nodes to achieve the system hardware and software design, middleware, and applications such as mobile phone or wireless PDA of internet of things, will constitute a variety of sensors intelligent network, thus enhancing the overall automation system and monitoring levels. The final analysis of the network in the Internet based on the agricultural plants of farmland water-saving irrigation system integrated approach. User use mobile phones or wireless PDA can easily soil moisture content of online monitoring and control to realize the irrigation automation. Application results show that system through the embedded control technology complete intelligent irrigation, improve the agricultural irrigation water use efficiency and irrigation system automatization is generally low status, can well realize water saving.

2.13 Solar powered wireless multi-sensor device for an irrigation system

The paper presents the design and experiments of a multi-sensor device for use in agriculture crop irrigation. The soil and environment parameters are determined by specific sensors under the supervision of a microcontroller and sent through wireless communication to a central unit. The novelty is the assembly of all the sensors on a single structure, together with the wireless communication circuitry to permit the power management of the electronics in order to allow an autonomous supplying from a solar cell in parallel with a Li-Ion accumulator. The design of the power source was done to assure a 3.3V voltage. The research work was firstly focused on soil parameters: moisture and temperature. The main experiments were performed in order to calibrate the method used for sensing the soil moisture.

2.14 Monitoring of soil parameters for effective irrigation using Wireless Sensor Networks

WSN (Wireless Sensor Network) has attracted the attention of researchers due to its wide applicability to various fields such as disaster management, health and environment monitoring, agriculture, ecology, industrial automation and in military field applications like battlefield surveillance etc. In agricultural ecosystem -situ - continuous smart monitoring of soil parameters like humidity, pH, irrigation control systems etc. can be measured using WSN

with high end precision. In this manuscript, we propose to develop a WSN based Dynamic and Automated Irrigation System design and instrumentation. This process maintains soil type and software for real time sensing and control of agricultural irrigation system. The efficiency of irrigation systems can be enhanced by automated remote sensing and continuous analysis of soil parameters. Thus the data acquired is useful to the agricultural sector, namely pest management, irrigation management and soil management. Ultimately, this reduces the fresh water consumption and irrigation costs by maximizing the crop yield.

2.15 Wireless sensor and actuator system for smart irrigation on the cloud

The number of devices connected to the Internet is experiencing an explosive growth. The interconnection of smart objects embedded with sensors enables them to interact with the environment and among themselves, forming a Wireless Sensor Network (WSN). These network nodes perform acquisition, collection and analysis of data, such as temperature and soil moisture. Such data can be employed to automate the irrigation process in agriculture while decreasing water consumption, resulting in monetary and environmental benefits. The high storage and processing capabilities, the rapid elasticity and pay per-use characteristics makes Cloud Computing an attractive solution to the large amount of data generated by the WSN. This paper proposes and evaluates on a real deployment a cloud-based Wireless Sensor and Actuator Network (WSAN) communication system. This solution monitors and controls a set of sensors and actuators, respectively, to assess plants water needs.

2.16 Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network

Efficient water management is a major concern in many cropping systems in semiarid and arid areas. Distributed in-field sensor-based irrigation systems offer a potential solution to support site-specific irrigation management that allows producers to maximize their productivity while saving water. This paper describes details of the design and instrumentation of variable rate irrigation, a wireless sensor network, and software for real-time in-field sensing and control of a site-specific precision linear-move irrigation system. Field conditions were site-specifically monitored by six in-field sensor stations distributed across the field based on a soil property map, and periodically sampled and wirelessly transmitted to a base station. An irrigation machine was converted to be electronically controlled by a programming logic controller that updates georeferenced location of sprinklers from a differential Global Positioning System (GPS) and wirelessly communicates with a computer at the base station. Communication

signals from the sensor network and irrigation controller to the base station were successfully interfaced using low-cost Bluetooth wireless radio communication. Graphic user interface-based software developed in this paper offered stable remote access to field conditions and real-time control and monitoring of the variable-rate irrigation controller.

2.17 Research and development precision irrigation control system in agricultural

It is rapid to development agricultural modernization in China recently, but technology and equipment are short of advanced in water-saving agricultural. An intelligent water-saving system is presented for agricultural irrigation strategy, and neural network and the principle of fuzzy are proposed in this paper based on zigBee wireless sensor networks. It provides science basis for using water resources under the technologies of soil moisture sensors, air temperature sensors, precise irrigation equipment's, intelligent controller, and computer-controlled devices, so that agricultural irrigation get the best part out of water utilization. It is of significant strategic meanings in the implementation of agricultural water- saving research.

2.18 Web based service to monitor automatic irrigation system for the agriculture field using sensors

The paper describes the automatic irrigation system using the Arduino microcontroller with grove moisture sensor and water flow sensor. The communication will be established using the Zigbee protocol and the control will be sent based on the moisture level of the soil using Arduino microcontroller. The two xbee radios's used in the network will be treated as master and slave in combination with the Arduino microcontroller. Here when a particular moisture level is reached, depending on the value of the moisture level water flow will be allowed in the pipe and the flow range, water pressure will be updated along with the time in a database and also displayed in the web portal. The owner of the agricultural field can anytime check the moisture level and the motor status. The motor's functionality status will also be a sent to the farmer's mobile using GSM.

CHAPTER 3

EXISTING SYSTEM

3.1 OVERVIEW OF SMART IRRIGATION SYSTEMS

The agricultural land in India is mainly arid and semi-arid area. A statistical analysis by Hegde on Indian water resources suggests that 83% of the freshwater application is for irrigation purpose. Hence, an effective technology for the sustainable use of water is the need of the hour. The smart automated irrigation is one such solution for sustainable management of water resources.

The SIS (smart irrigation systems) is an emerging technology for controlling irrigation supply. The controller used in SIS will automatically control irrigation based on current weather, forecasted weather and soil condition to manage water usage. By identifying the characteristic of the soil, the water-soil relation can be obtained and hence, crop water demand can be computed. The soil characteristic constitutes both physical and chemical characteristics.

The frequency of irrigation is estimated based on the soil type namely clay, silt and sandy. Also, chemical, physical and biological parameters of the soil determine the water quality for irrigation. The chemical characteristics of irrigation water refer to the content of salts. In this research work, the loamy sand soil type and the salt properties of the irrigation water are considered while simulating SIS. Next subsection discusses, the irrigation schedule approaches, which presents the decision-making method used for irrigation.

3.2 IRRIGATION SCHEDULING APPROACHES

To determine the irrigation schedule there are two approaches namely qualitative and quantitative method. The accuracy of the irrigation depends on the irrigation scheduling approach used. Details of these methods are as follows:

Qualitative (by feel): The “feel” method is a low-tech, low-cost way to assess irrigation needs and are used by the garden and small farm irrigation managers. The “feel” approach requires a high level of intuition and experience, and also an extensive knowledge of the specific requirements of various crops being irrigated. Once understood, it can be a quick decision-making method.

Quantitative (water budget, soil moisture meter): There are two types of quantitative approaches namely water budget and soil moisture meters. Water budgeting is a quantitative approach that analyses temperature and crop water usage and then determines evapotranspiration (ETo) rates. In soil moisture measuring approach, soil moisture sensors are used to monitor soil moisture levels and then accordingly irrigate the fields. Such devices provide site-specific measurements that are more accurate in the calculation of ETo rates.

Irrigation delivery systems also play an important role in obtaining higher efficiency in irrigation systems. Next subsection discusses different existing irrigation delivery systems.

3.3 IRRIGATION DELIVERY SYSTEMS

Varieties of irrigation delivery systems are available, such as centre-pivot, flood, furrow, gravity, rotation, sprinkler, sub-irrigation, traveling gun, supplemental to micro-irrigation (surface, sub-surface, and micro-sprinklers).

In developing countries, commonly used practice for irrigation scheduling is qualitative with irrigation delivery techniques like a flood, furrow, gravity, sprinkler, and micro-irrigation. This qualitative approach is very inefficient in controlling the irrigation.

The SIS uses quantitative approach. Thus, the SIS is an efficient way of controlling irrigation water usage. It has two basic irrigation control technologies that have been implemented to manage water supply. One of the technologies is to use in-field sensors installed by the private landowner and another one is the local weather stations that are installed by government agencies for public use. In this research work, to begin with, various existing smart irrigation techniques using local weather station are reviewed.

Smart Irrigation Controllers

The design of automatic irrigation systems incorporates embedded system components like microcontroller with timers, sensors and electrical valves for water flow control. Few examples for automated irrigation are timer-based systems, volume-based systems and soil moisture sensor-based system.

In addition to embedded components, the SIS has smart controllers. These smart controllers automatically update the watering schedule depending on the changes in environmental conditions and dispatches right amount of water avoiding overflow or underflow. It is to be noted that, some of the recent smart irrigation controllers take the forecasted data for scheduling

irrigation. The accuracy of such system depends on the accuracy of the forecasted data. Next subsection discusses various types of SIS and their advantages and disadvantages.

3.4 TYPES OF SMART IRRIGATION CONTROLLERS AND TECHNOLOGIES

This section discusses various types of SISs. Recent research has shown that smart systems are most appropriate for increasing efficiency of irrigation practice. Existing irrigation system are timer-based irrigation, historical- weather and water usage data-based irrigation, soil moisture sensor-based irrigation, WSN based irrigation and weather station based irrigation.

It is observed from the literature that, different smart irrigation technologies with different settings lead to a different level of water savings. One such study was conducted by McCready , which uses (1) soil moisture sensor (SMS) controllers, (2) evapotranspiration (ETo)-based controllers, (3) rain sensor-based controllers (4) timer-based controllers. Different settings of these controllers resulted in different quality with different water-saving percentages.

Irrigation controllers can be broadly classified into two types as (1) open-loop based irrigation and (2) closed-loop based irrigation. In open-loop based systems the user makes a decision based on personal experience. Water saving merely depends on the level of experience of the decision maker. Examples for open-loop based irrigation systems are timer-based irrigation, volume-based irrigation, and historical ETo based irrigation.

In closed-loop systems the general control strategy is defined by proportional–integral–derivative (PID) controller. In this PID controllers, continuous feedback will be taken through sensors to decide on when to irrigate and how much to irrigate. Examples of such systems are SMS-based system, weather station-based system, real-time ETo based system and WSN. The SIS that use closed-loop method, following are the decision-making methods: (1) historical data with the sensor; (2) continuous feedback from SMS; (3) real-time data acquisition of environmental parameters such as soil moisture, temperature, radiation, wind speed, humidity, rain sensor and so on.

In real-time feedback systems, the irrigation decision depends on the actual dynamic demand of the plant itself particularly at plant root zone as stated by Hillyer. This method is more suitable for site-specific variable rate irrigation. Various sensors like tensiometers, relative humidity sensor, rain sensor, temperature sensors, etc. are used to decide on irrigation schedule.

The soil moisture sensor (SMS) based irrigation systems measures the volumetric water content in the soil. Next, depending on the moisture threshold value, the decision will be taken. SMS

come in variety which includes capacitance, neutron moisture, resistive, heat dissipation and time domain reflectometry, and tensiometers. SMS has to be calibrated before using it for particular soil types, thus, the calibration process is difficult and time-consuming.

WSN is suitable for variable rate and site-specific irrigation control particularly for agricultural lands with the spatial variability of soil. Similar to the weather station-based system, WSN system also uses real-time data from sensors like temperature, relative humidity, rain gauge, wind speed, wind direction, and solar radiation for irrigation calculation but they are specific to particular location.

CHAPTER 4

PROPOSED WORK

They proposed to utilize the solar energy from solar panels to automatically pump water from bore well directly into a ground level storage tank depending on the intensity of sunlight. While conventional methods include pumping of water from bore well into a well and from this well onto field using another pump, our system uses only a single stage energy consumption wherein the water is pumped into a ground level tank from which a simple valve mechanism controls the flow of water into the field. This saves substantial amount of energy and efficient use of renewable energy. A valve is controlled using intelligent algorithm in which it regulates the flow of water into the field depending upon the moisture requirement of the land. In this system we use a soil moisture sensor that detects the amount of moisture present in the soil and depending upon the requirement of level of moisture content required for the crop the water flow is regulated thus, conserving the water by avoiding over flooding of crops. Proposed irrigation system mainly consists of two modules- Solar pumping module and automatic irrigation module. In solar pumping module a solar panel of required specification is mounted near the pump set. Then using a control circuit, it is used to charge a battery. From the battery using a converter circuit it gives power to the water pump which is submerged inside the well. Then the water is pumped into an overhead tank for storing water temporarily before releasing the water into the field. In automatic irrigation module the water outlet valve of the tank is electronically controlled by a soil moisture sensing circuit. The sensor is placed in the field where the crop is being cultivated. The sensor converts the moisture content in the soil into equivalent voltage. This is given to a sensing circuit which has a reference voltage that can be adjusted by the farmer for setting different moisture levels for different crops. The amount of water needed for soil is proportional to the difference of these two voltages. A control signal was given to a stepper motor whose rotational angle is proportional to the difference in voltage. The stepper motor in turns controls the cross-sectional area of the valve to be opened controlling flow of water. Therefore, the amount of water flowing is proportional to the moisture difference.

4.1 BLOCK DIAGRAM

This section elaborates the assessing and controlling of the moisture content in the soil using Lab VIEW. The hardware and software implementation are discussed here below. The block diagram shows the flow of how the complete process is carried out.

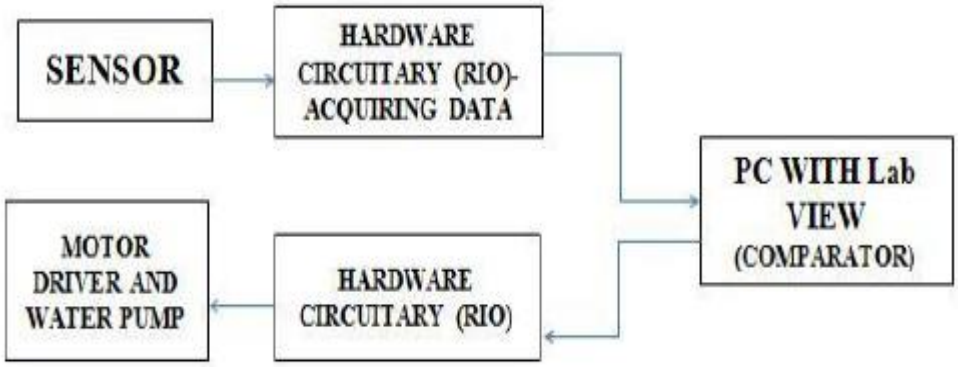

Fig.1 block diagram for monitoring and controlling moisture content in the soil

FLOW CHART

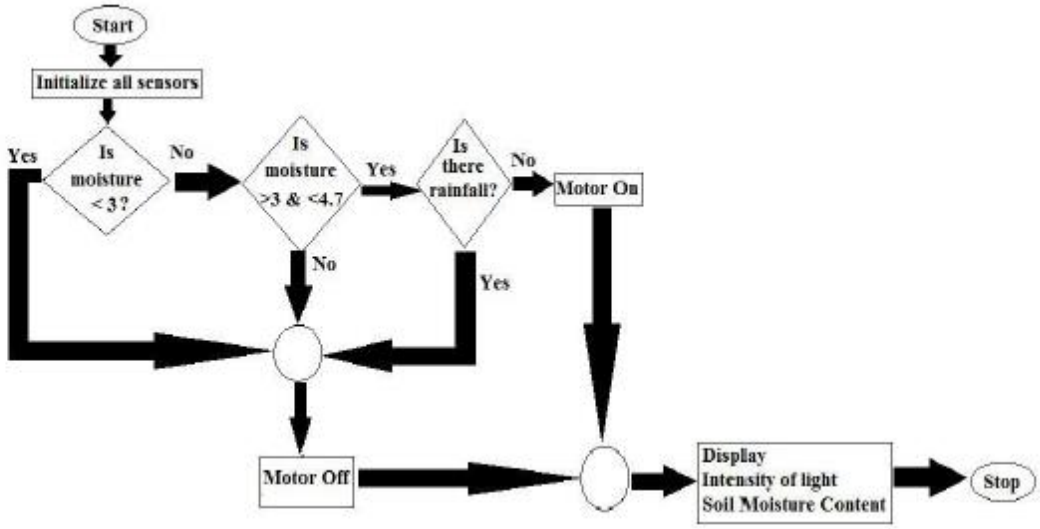

Fig.2 Flow chart for working procedure

CHAPTER 5

HARDWARE DESCRIPTION

The following components used to implement the smart irrigation system project

1. L293 Motor driver board

2. Arduino Uno

3. Water pump

4. 9V battery

5. Soil moisture sensor

6. Jumper wires

7. ESP8266-01 WIFI MODULE

5.1 L293D DRIVER MODULE

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC).

This L293D driver module is a medium power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular L293D motor driver IC. It can drive 4 DC motors in one direction, or drive 2 DC motors in both the directions.

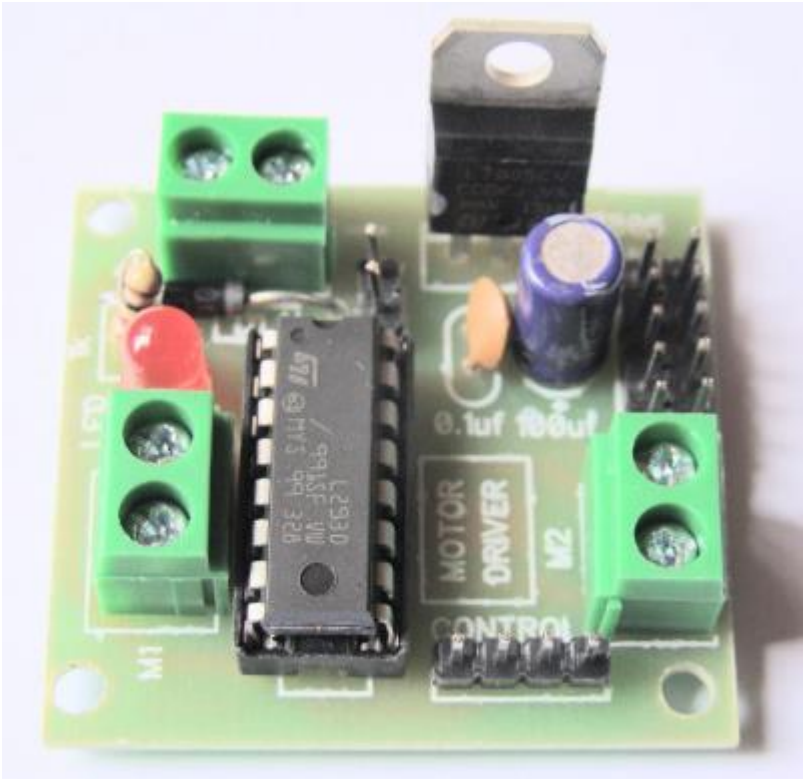

Fig.3 L293 driver board

Features of L293D Motor Driver Board

- L293D motor driver IC.
- Male burg stick connectors for supply, ground and input connection
- Screw terminal connectors for easy motor connection
- On Board LM7805 Voltage Regulator

5.2 ARDUINO UNO

It is a microcontroller board developed by Arduino.cc and based on Atmega328.Electronic devices are becoming compact, flexible and cheap that are capable of doing more function as compared to their predecessors that happened to cover more space, turned out costly with the ability to perform fewer functions. Experts always strive to introduce innovation in automation that requires minimum effort and gives maximum output. The microcontroller was introduced in the electronics industry with the purpose of making our tasks easy that come with even a remote connection with automation in any way. Microcontrollers are widely used in embedded systems and make devices work according to our needs and requirements. We have already discussed the controllers like 8051, Atmega16, Atmega328 and PIC16F877.Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6

analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins. You should also have a look at this UNO for beginners. There are many versions of Arduino boards introduced in the market like Arduino Uno, Arduino Due, Arduino Leonardo, Arduino Mega, however, most common versions are Arduino Uno and Arduino Mega. If you are planning to create a project relating to digital electronics, embedded system, robotics, or IoT, then using Arduino Uno would be the best, easy and most economical option.

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

First Arduino project was started in Interaction Design Institute Ivrea in 2003 by David Cuartielles and Massimo Banzi with the intention of providing a cheap and flexible way to students and professional for controlling a number of devices in the real world.

- The current version of Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output.
- It allows the designers to control and sense the external electronic devices in the real world.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular

needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

While the Uno communicates using the original STK500 protocol, it differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

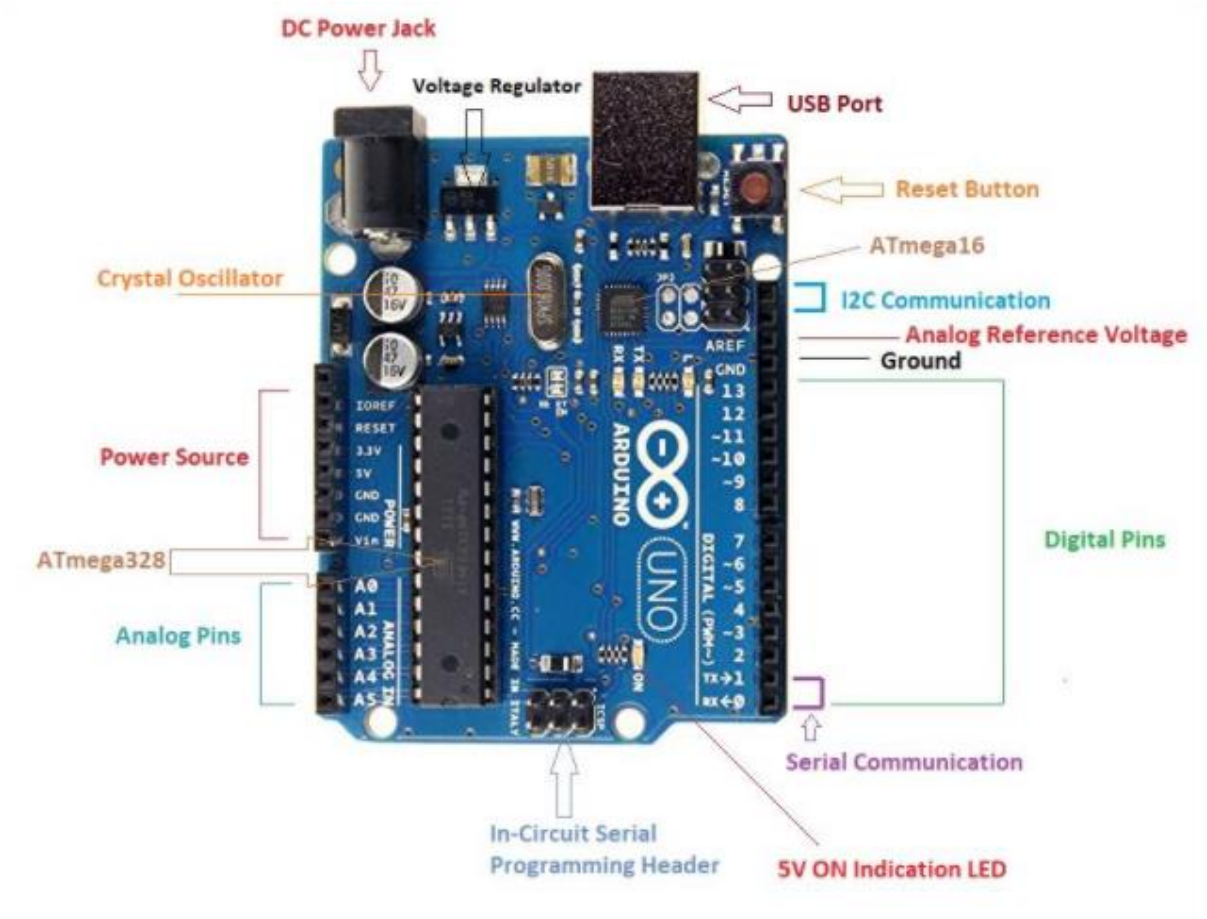

Fig.4 Arduino uno

This board comes with all the features required to run the controller and can be directly connected to the computer through USB cable that is used to transfer the code to the controller using IDE (Integrated Development Environment) software, mainly developed to program Arduino. IDE is equally compatible with Windows, MAC or Linux Systems, however, Windows is preferable to use. Programming languages like C and C++ are used in IDE.

Apart from USB, battery or AC to DC adopter can also be used to power the board.

Arduino Uno boards are quite similar to other boards in Arduino family in terms of use and functionality, however, Uno boards don't come with FTDI USB to Serial driver chip.

There are many versions of Uno boards available, however, Arduino Nano V3 and Arduino Uno are the most official versions that come with Atmega328 8-bit AVR Atmel microcontroller where RAM memory is 32KB.

When nature and functionality of the task go complex, Mirco SD card can be added in the boards to make them store more information.

Features of Arduino uno board

Arduino Uno comes with USB interface i.e. USB port is added on the board to develop serial communication with the computer.

Atmega328 microcontroller is placed on the board that comes with a number of features like timers, counters, interrupts, PWM, CPU, I/O pins and based on a 16MHz clock that helps in producing more frequency and number of instructions per cycle.

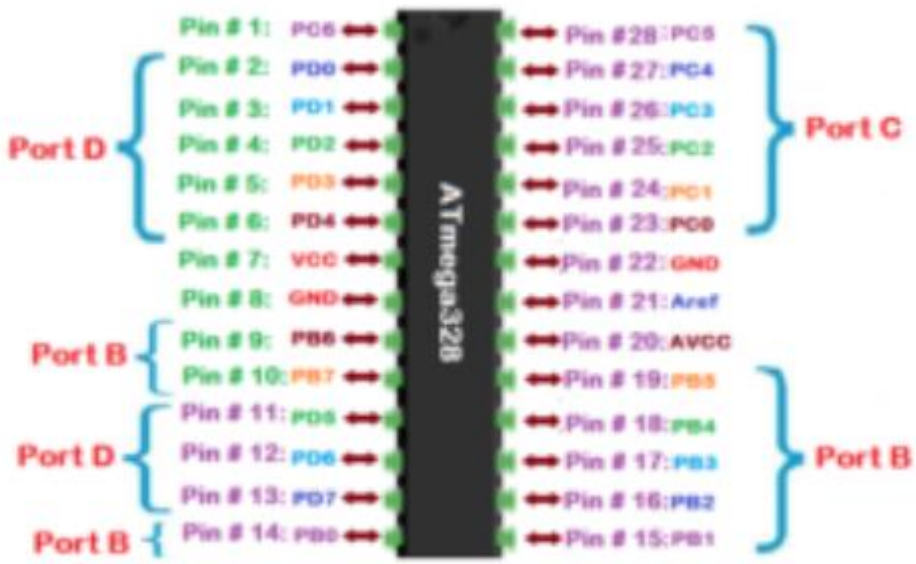

Fig. 5 Atmega328 micro controller

It is an open source platform where anyone can modify and optimize the board based on the number of instructions and task they want to achieve.

This board comes with a built-in regulation feature which keeps the voltage under control when the device is connected to the external device.

Reset pin is added in the board that reset the whole board and takes the running program in the initial stage. This pin is useful when board hangs up in the middle of the running program;

pushing this pin will clear everything up in the program and starts the program right from the beginning.

There are 14 I/O digital and 6 analog pins incorporated in the board that allows the external connection with any circuit with the board. These pins provide the flexibility and ease of use to the external devices that can be connected through these pins. There is no hard and fast interface required to connect the devices to the board. Simply plug the external device into the pins of the board that are laid out on the board in the form of the header.

The 6 analog pins are marked as A0 to A5 and come with a resolution of 10bits. These pins measure from 0 to 5V, however, they can be configured to the high range using analogReference() function and AREF pin.

13KB of flash memory is used to store the number of instructions in the form of code.

Only 5 V is required to turn the board on, which can be achieved directly using USB port or external adopter, however, it can support external power source up to 12 V which can be regulated and limit to 5 V or 3.3 V based on the requirement of the project.

Arduino uno pinout

Arduino Uno is based on AVR microcontroller called Atmega328. This controller comes with 2KB SRAM, 32KB of flash memory, 1KB of EEPROM. Arduino Board comes with 14 digital pins and 6 analog pins. ON-chip ADC is used to sample these pins. A 16 MHz frequency crystal oscillator is equipped on the board. Following figure shows the pinout of the Arduino Uno Board.

Communication and programming

Arduino Uno comes with an ability of interfacing with other other Arduino boards, microcontrollers and computer. The Atmega328 placed on the board provides serial communication using pins like Rx and Tx. The Atmega16U2 incorporated on the board provides a pathway for serial communication using USB com drivers. Serial monitor is provided on the IDE software which is used to send or receive text data from the board. If LEDs placed on the Rx and Tx pins will flash, they indicate the transmission of data. Arduino Uno is programmed using Arduino Software which is a cross-platform application called IDE written in C++ programming language. The AVR microcontroller Atmega328 laid out on the

base comes with builtin bootloader that sets you free from using a separate burner to upload the program on the board.

The Arduino program language is available for development by veteran engineers. The lingo can be accessed through C++ libraries or header files and people expecting to understand the specific purposes of different interests can shift from Arduino to the AVR C programming language on which it is based. Basically, one can incorporate AVR-C code clearly into one's Arduino programs if he/she wants to do so.

- Like other development boards of Arduino family, this also uses Arduino IDE software to make sketches (Arduino programs are called sketches)
- Sketches that are developed on Arduino IDE can be transferred directly by connecting our computer via USB port.
- IDE is compatible with Linux, MAC or Windows operating system
- Programming languages C and C++ are used
- Thousands of preloaded sketches are easily available which we can use in order to get Arduino to do something according to our requirements.

Applications

Arduino Uno comes with a wide range of applications. A larger number of people are using Arduino boards for developing sensors and instruments that are used in scientific research. Following are some main applications of the board.

- Embedded System
- Security and Defense System
- Digital Electronics and Robotics
- Parking Lot Counter
- Weighing Machines
- Traffic Light Count Down Timer
- Medical Instrument
- Emergency Light for Railways
- Home Automation
- Industrial Automation

There are a lot of other microcontrollers available in the market that are more powerful and cheap as compared to Arduino board. So, why you prefer Arduino Uno. Actually, Arduino comes with a big community that is developing and sharing the knowledge with a wide range of audience. Quick support is available pertaining to technical aspects of any electronic project. When you decide Arduino board over other controllers, you don't need to arrange extra peripherals and devices as most of the functions are readily available on the board that makes your project economical in nature and free from a lot of technical expertise. That's all for today. I hope you have got a lot of information regarding Arduino Uno board.

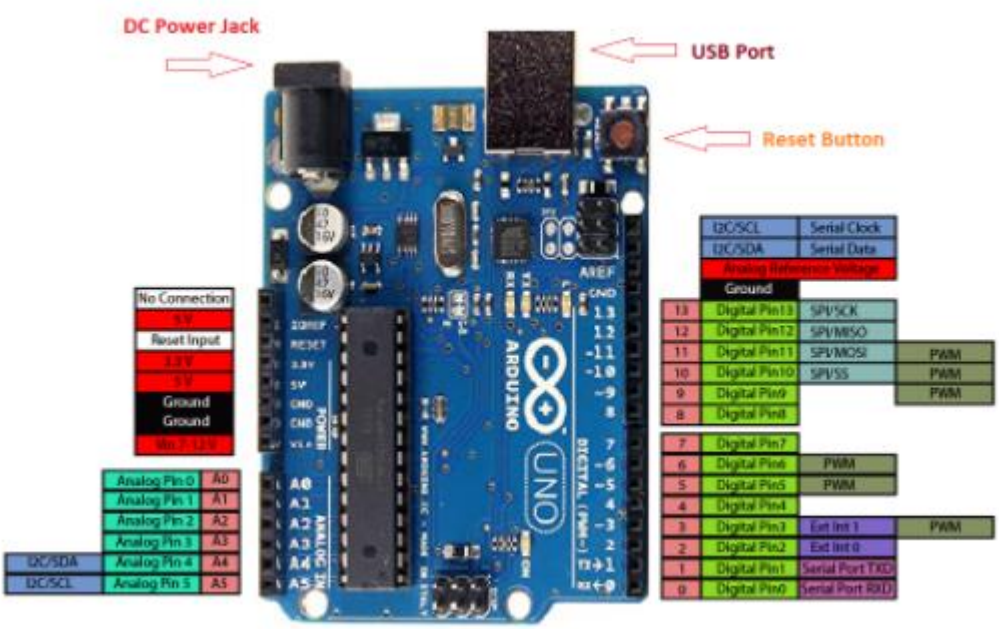

Fig.6 Arduino uno pinout

There are several I/O digital and analog pins placed on the board which operates at 5V. These pins come with standard operating ratings ranging between 20mA to 40mA. Internal pull-up resistors are used in the board that limits the current exceeding from the given operating conditions. However, too much increase in current makes these resisters useless and damages the device. LED. Arduino Uno comes with built-in LED which is connected through pin 13. Providing HIGH value to the pin will turn it ON and LOW will turn it OFF. Vin. It is the input voltage provided to the Arduino Board. It is different than 5 V supplied through a USB port. This pin is used to supply voltage. If a voltage is provided through power jack, it can be accessed through this pin.5V. This board comes with the ability to provide voltage regulation.

5V pin is used to provide output regulated voltage. The board is powered up using three ways i.e. USB, Vin pin of the board or DC power jack. USB supports voltage around 5V while Vin and Power Jack support a voltage range between 7V to 20V. It is recommended to operate the board on 5V. It is important to note that, if a voltage is supplied through 5V or 3.3V pins, they result in bypassing the voltage regulation that can damage the board if voltage surpasses from its limit. GND. These are ground pins. More than one ground pins are provided on the board which can be used as per requirement, Reset. This pin is incorporated on the board which resets the program running on the board. Instead of physical reset on the board, IDE comes with a feature of resetting the board through programming. IOREF. This pin is very useful for providing voltage reference to the board. A shield is used to read the voltage across this pin which then select the proper power source. PWM is provided by 3,5,6,9,10, 11pins. These pins are configured to provided 8-bit output PWM.SPI. It is known as Serial Peripheral Interface. Four pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) provide SPI communication with the help of SPI library. AREF, It is called Analog Reference. This pin is used for providing a reference voltage to the analog inputs. TWI, It is called Two-wire Interface. TWI communication is accessed through Wire Library. A4 and A5 pins are used for this purpose. Serial Communication. Serial communication is carried out through two pins called Pin 0 (Rx) and Pin 1 (Tx).Rx pin is used to receive data while Tx pin is used to transmit data. External Interrupts. Pin 2 and 3 are used for providing external interrupts. An interrupt is called by providing LOW or changing value.

5.3 MOTOR CONTROLLER

A motor controller is a device or group of devices that can coordinate in a predetermined manner the performance of an electric motor.[1] A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and electrical faults. Motor controllers may use electromechanical switching, or may use power electronics devices to regulate the speed and direction of a motor.

Motor controllers are used with both direct current and alternating current motors. A controller includes means to connect the motor to the electrical power supply, and may also include overload protection for the motor, and over-current protection for the motor and wiring. A motor controller may also supervise the motor's field circuit, or detect conditions such as low supply voltage, incorrect polarity or incorrect phase sequence, or high motor temperature.

Some motor controllers limit the inrush starting current, allowing the motor to accelerate itself and connected mechanical load more slowly than a direct connection. Motor controllers may be manual, requiring an operator to sequence a starting switch through steps to accelerate the load, or may be fully automatic, using internal timers or current sensors to accelerate the motor.

Some types of motor controllers also allow adjustment of the speed of the electric motor. For direct-current motors, the controller may adjust the voltage applied to the motor, or adjust the current flowing in the motor's field winding. Alternating current motors may have little or no speed response to adjusting terminal voltage, so controllers for alternating current instead adjust rotor circuit resistance (for wound rotor motors) or change the frequency of the AC applied to the motor for speed control using power electronic devices or electromechanical frequency changers.

The physical design and packaging of motor controllers is about as varied as that of electric motors themselves. A wall-mounted toggle switch with suitable ratings may be all that is needed for a household ventilation fan. Power tools and household appliances may have a trigger switch that only turns the motor on and off. Industrial motors may be more complex controllers connected to automation systems; a factory may have a large number of motor controllers grouped in a motor control centre. Controllers for electric travelling cranes or electric vehicles may be mounted on the mobile equipment. The largest motor controllers are used with the pumping motors of pumped storage hydroelectric plants, and may carry ratings of tens of thousands of horsepower.

5.4 WATER PUMP

In smart farming, the water outlet valve of the tank is controlled by soil moisture sensing circuit. The moisture sensor placed in field which converts moisture content of soil into equivalent voltage. The obtained voltage is given to microcontroller which has reference voltage that can be adjusted by farmers as per different moisture levels according to the different types of crops.

5.5 9V BATTERY

This is General purpose 9V Original HW marked Non-Rechargeable Battery for all your project and application needs.

Its Universal 9V battery size and connecting points; it is useful in many DIY projects as well as household applications and they can easily be replaced and installed; the same as you would an AA battery or an AAA battery.

Fig.7 9V battery

Safety Precautions:

- Avoid short-Circuit the battery terminals.
- Do n0t put it beside the high-temperature condition.
- Don’t throw it into the fire or water after use

Specification:

- Product: 9V battery
- Battery type: Zinc Carbon battery
- Dimension: 26.5mm x 48.5mm x 17.5mm
- Nominal voltage: 9V

Features:

- Constant 9V Output till lasts
- Metal Jacket Body
- Good Built Quality and hence Leakproof
- Easy to install and Replace
- Corrosion-free Connector Point for long-term use
- 0% Mercury and Cadmium. Environment-friendly
- OEM Compatible.

5.6 SOIL MOISTURE SENSOR

Soil moisture sensor consist of two conducting plates which function as a probe and acting as a variable resistor together.

When the sensor is inserted into the water, the resistance will decrease and get better conductivity between plates.

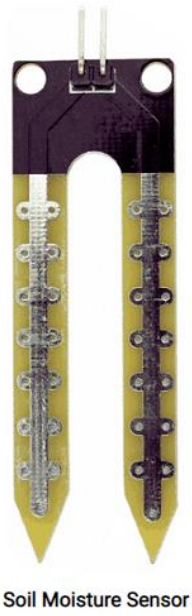

Fig.8 Soil moisture sensor

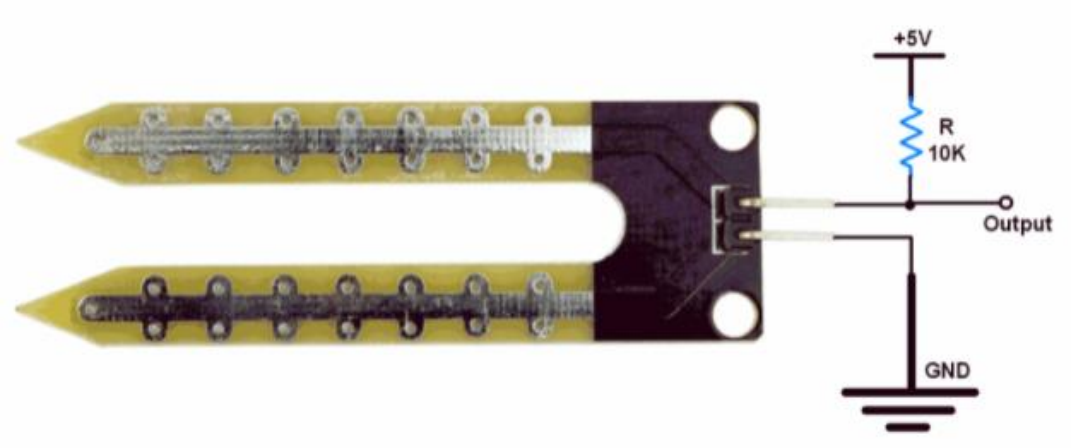

Fig.9 Working principle of soil moisture sensor

The above figure shows the working principle of the soil moisture sensor.

WORKING PRINCIPLE:

- Soil moisture sensor has two conducting plates. First plate is connected to the +5Volt supply through series resistance of 10K ohm and second plate is connected directly to the ground.
- It simply acts as a voltage divider bias network, and output is taken directly from the first terminal of the sensor pin, which is shown in figure above.
- The output will change in the range of 0 – 5 Volt, in proportion with change in content of water in the soil.
- Ideally, when there is zero moisture in soil, the sensor acts as open circuit i.e. infinite resistance. For this condition, we get 5V at the output.

5.7 JUMPER WIRES

A jump wire (also known as jumper, jumper wire, jumper cable, DuPont wire or cable) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test.

Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

There are different types of jumper wires. Some have the same type of electrical connector at both ends, while others have different connectors. Some common connectors are:

- **Solid tips** – are used to connect on/with a breadboard or female header connector. The arrangement of the elements and ease of insertion on a breadboard allows increasing the mounting density of both components and jump wires without fear of short-circuits. The jump wires vary in size and colour to distinguish the different working signals.
- **Crocodile clips** – are used, among other applications, to temporarily bridge sensors, buttons and other elements of prototypes with components or equipment that have arbitrary connectors, wires, screw terminals, etc.
- **Banana connectors** – are commonly used on test equipment for DC and low-frequency AC signals.

- Registered jack (RJnn) – are commonly used in telephone (RJ11) and computer networking (RJ45).
- **RCA connectors** – are often used for audio, low-resolution composite video signals, or other low-frequency applications requiring a shielded cable.
- **RF connectors** – are used to carry radio frequency signals between circuits, test equipment, and antennas.
- **RF jumper cables** - Jumper cables is a smaller and more bendable corrugated cable which is used to connect antennas and other components to network cabling. Jumpers are also used in base stations to connect antennas to radio units. Usually the most bendable jumper cable diameter is 1/2".

5.8 ESP8266-01 WIFI MODULE

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system. It is mostly used for development of IoT (Internet of Things) embedded applications.

Fig.10 ESP8266-01 WiFi Module

ESP8266 comes with capabilities of

- 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2),
- general-purpose input/output (16 GPIO),
- Inter-Integrated Circuit (I^2C) serial communication protocol,
- analog-to-digital conversion (10-bit ADC)
- Serial Peripheral Interface (SPI) serial communication protocol,
- I^2S (Inter-IC Sound) interfaces with DMA(Direct Memory Access) (sharing pins with GPIO),

- UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2), and
- pulse-width modulation (PWM).

It employs a 32-bit RISC CPU based on the Tensilica Xtensa L106 running at 80 MHz (or overclocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI.

- ESP8266 module is low cost standalone wireless transceiver that can be used for end-point IoT developments.
- To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate.

There are many third-party manufacturers that produce different modules based on this chip. So, the module comes with different pin availability options like,

- ESP-01 comes with 8 pins (2 GPIO pins) – PCB trace antenna. (shown in above figure)
- ESP-02 comes with 8 pins, (3 GPIO pins) – U-FL antenna connector.
- ESP-03 comes with 14 pins, (7 GPIO pins) – Ceramic antenna.
- ESP-04 comes with 14 pins, (7 GPIO pins) – No ant.

etc.

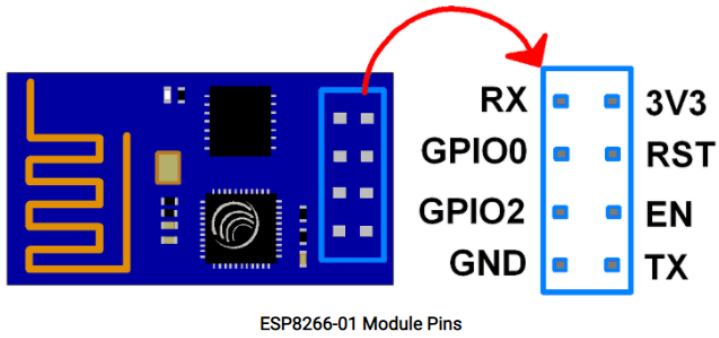

Fig.11 ESP8266-01 Module Pins

3V3: - 3.3 V Power Pin.

GND: - Ground Pin.

RST: - Active Low Reset Pin.

EN: - Active High Enable Pin.

TX: - Serial Transmit Pin of UART.

RX: - Serial Receive Pin of UART.

GPIO0 & GPIO2: - General Purpose I/O Pins. These pins decide what mode (boot or normal) the module starts up in. It also decides whether the TX/RX pins are used for Programming the module or for serial I/O purpose

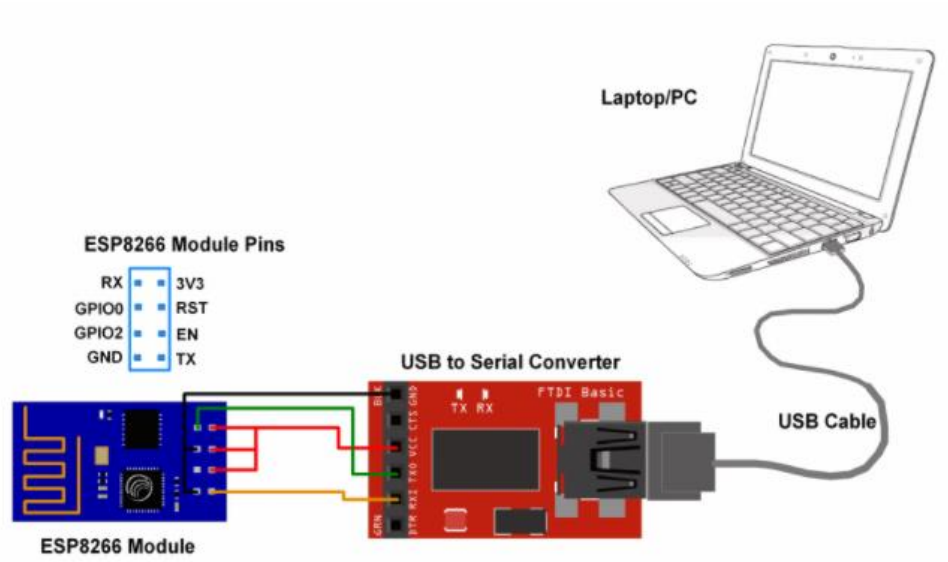

Fig.12 ESP8266 Module Serial Connection with PC

5.9 CLOUD SERVER

Cloud computing is a general term used to describe a new class of network based computing that take place over the internet. This technology can be adopted in all areas of society. Cloud computing can also be implemented in agricultural area. It is very important for a farmer to take care of his field and nurture his crops well. Though it is their occupation, farming involves a lot of toil, struggle and hard work. Cloud is used to store all the plant related data like soil moisture level, growth progress, animal movements etc. There are practical applications for the use of cloud computing that create a whole ecosystem, from sensors and monitoring tools that collect soil data to agricultural field images and observations from human actors on the ground accurately feeding data repositories along with their GPS coordinates. As an example, sensors are now able to detect the amount of moisture it contains. The future growth of agriculture depends on how the new technologies such as cloud computing are adopted with a focus on farmer needs.

The use of appropriate technologies should help a farmer in terms of accessibility and affordability.

In this project we are using Thingspeak cloud server to store the data and to maintain.

How cloud computing helps agriculture Industry

There are practical applications for the use of cloud computing that create a whole ecosystem, from sensors and monitoring tools that collect soil data to agricultural field images and observations from human actors on the ground accurately feeding data repositories along with their GPS coordinates. As an example, sensors are now able to detect the location of a bale of hay in a field, as well as the amount of moisture it contains. Farmers can also use the cloud to access information from predictive analysis institutes, whereby they can have an accurate prediction on products that are in demand by different markets and adjust production accordingly. They are also able to have insight on weather conditions and other parameters affecting production.

Cloud IoT

Cloud computing technologies provide new opportunities in IoT-based applications and services. Cloud computing technology provides three different kinds of services to the user:

- Infrastructure as a Service (IaaS),
- Platform as a Service (PaaS)
- Software as a Service (SaaS)

These are run either by private, public or virtual private Cloud or a combination of Cloud types. Cloud computing provides security, monitoring and maintenance of data.

The main use of the Cloud technology is an efficient use of resources and cost reduction. It has high flexibility, accessibility and device independence. We call the combination of Cloud computing and IoT technologies together as a new model: ‘Cloud IoT’. This Cloud IoT is expected to disrupt both current and future Internet.

CHAPTER 6

PROJECT CODE

6.1 Project code

```
#include <SoftwareSerial.h> //include the software serial library

int sensor; //variable to store sensor values

int data; //variable to stored mapped sensor values

int pump_status; //variable to store pump status values

SoftwareSerial esp8266(3, 4); //set the software serial pins RX pin = 3, TX pin = 4

//definition of variables

#define DEBUG true //show messages between ESP8266 and Arduino in serial port, when set to true

#define SSID "shubham" //replace x with your wifi network name

#define PASS "shubhamtrivedi" //replace x with your wifi network password

void sendAT(String command, const int timeout, boolean debug)

{

 String response = "";

 esp8266.print(command);

 long int time = millis();

 while ( (time + timeout) > millis())

 {

  while (esp8266.available())

  {

   char c = esp8266.read();

   response += c;
```

```
    }
  }
  if (debug)
  {
    Serial.print(response);
  }
  return response;
}
void setup()
{
  Serial.begin(9600);// begin the serial communication with baud of 9600
  esp8266.begin(9600);// begin the software serial communication with baud rate 9600
  sendAT("AT+RST\r\n", 2000, DEBUG); // call sendAT function to send reset AT command
  sendAT("AT\r\n", 1000, DEBUG);
  sendAT("AT+CWMODE=1\r\n", 1000, DEBUG); //call sendAT function to set ESP8266 to station mode
sendAT("AT+CWJAP=\""SSID"\",\""PASS"\"\r\n", 2000, DEBUG); //AT command to connect wit the wifi network
while(!esp8266.find("OK")) { //wait for connection
  }
  sendAT("AT+CIFSR\r\n", 1000, DEBUG); //AT command to print IP address on serial monitor
  sendAT("AT+CIPMUX=0\r\n", 1000, DEBUG); //AT command to set ESP8266 to multiple connections
}
```

```
void loop(){
  // put your main code here, to run repeatedly:
  sensor=analogRead(A0); //read raw sensor data and store it in variable sensor
  data=map(sensor,0,1023,100,0); //map the raw sensor data and store the result in data variable
  String sensor_value=String(data); //convert interger to string data type
  Serial.print("Soil Moisture: "); //print soil moisture on serial monitor
  Serial.println(data); //print soil moisture value on serial monitor
 if(data<50){ //check if sensor value is less then 40
    digitalWrite(8,HIGH); //switch on the water pump
    digitalWrite(9,LOW);
    pump_status=100; //update pump status variable value to 100
  }
  else{
    digitalWrite(8,LOW); //switch off the water pump
    digitalWrite(9,LOW);
    pump_status=0; //update pump status variable value to 0
  }
   String pump = String(pump_status); //convert integer to string data type
   updateTS(sensor_value,pump); //call the function to update ThingSpeak channel
  delay(1000);
}
void updateTS(String T,String P){
  Serial.println("");
  sendAT("AT+CIPSTART=\"TCP\",\"api.thingspeak.com\",80\r\n", 1000, DEBUG);
```

```
  delay(2000);

  String cmdlen;

  String cmd="GET /update?key=S7ERDVN51GY72397&field1="+T+"&field2="+P+"\r\n";
// update the temperature and humidity values on thingspeak url,replace xxxxxxx with your write api key

   cmdlen = cmd.length();

  sendAT("AT+CIPSEND="+cmdlen+"\r\n", 2000, DEBUG);

   esp8266.print(cmd);

   Serial.println("");

   sendAT("AT+CIPCLOSE\r\n", 2000, DEBUG);

   Serial.println("");

   delay(1500);

   }
```

CHAPTER 7

RESULTS

Project ‘Smart Irrigation System’ is used for the optimization use of water in agricultural field without the intervention of farmer by using soil moisture sensor that senses the moisture content of the soil using Microcontroller that turn ON/OFF the pump automatically according to the need of water for irrigation and hence helpful in saving water.

Thus the “Smart Irrigation system based on soil moisture using Arduino” has been designed and tested successfully. It has been developed by integrated features of all the hardware components used. The system has been tested to function automatically. The moisture sensors measure the moisture level (water content) of the different plants. If the moisture level goes below the desired and limited level, the moisture sensor sends the signal to the Arduino board which 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. Thus, the functionality of the entire system has been tested thoroughly and it is said to function successfully. The results of our experiment in the form of a general representation of our automatic irrigation system tested on the basis of the microcontroller and the Arduino sensor technology.

When the program was loaded onto the Arduino, the soil moisture sensor began to show the value of soil dryness.

- If the drying value is higher than the given value 400, the pump will turn on and start to irrigate in the system.
- When the value is equal to or lower than the given value, the pump will switch off and irrigation in the field will be completed.

CHAPTER 8

CONCLUSION

8.1 CONCLUSION

In this approach, automatic irrigation system using the Arduino microcontroller with moisture sensor and water flow management implemented and we can interface LCD screen in order to display the current status of the soil moisture content levels, percentage of water utilized to water the plant, duration of time for which the water pump is ON, etc. We can also show the graphical representation of the moisture content levels in the soil. To improve the efficiency and effectiveness of the system, the following recommendations can be put into consideration. Option of controlling the water pump can be given to the farmer. The farmer may choose to stop the growth of crops or the crops may get damaged due to adverse weather conditions. In such cases farmer may need to stop the system remotely. The idea of using IOT for irrigation can be extended further to other activities in farming such as cattle management, fire detection and climate control. This would minimize human intervention in farming activities.

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