GSM BASED AUTOMATIC IRRIGATION SYSTEM USING SOLAR PANELS

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ABSTRACT

Pakistan’s economy is mostly reliant on agriculture and require advanced and improvised means of irrigation. The drawbacks of irrigation being manual can be fixed using automatic procedure. This summary handles the automated process of irrigation and theme by using soil moisture sensors. Moreover, to make the procedure more advance and fully automatic two major sensors i.e. humidity and temperature are also used. To make system Wireless, incorporation of GSM module have also been dove in. The Power requirement for components is fulfilled through solar energy in order to provide uninterrupted power supply as caused due to load shedding. The moisture sensor constantly measure the level of moisture in soil, when level becomes low, the system sends the signal to motor in order to turn it ON and when soil moisture level reaches to optimum threshold which is decided by user in programming, then automatically turning OFF the motor. Every time the motor ON and OFF automatically, the status of operation is submitted to user via SMS. By using such method water wastage is controlled while giving maximum opportunity to plants for smooth growth, accuracy is achieved due to reduction of labor and solar energy becomes source of uninterrupted power supply to system.

Keywords — Moisture sensor; humidity sensor; GSM module; wireless; Solar panels.

CERTIFICATE OF CORRECTNESS

It is here by confirmed that data in this project report "GSM Based Automatic Irrigation System using Solar Panel" completed by 1)Maj Muhammad Zeeshan Safdar 2) Maj Javed Alam 3) Capt Farhat Ullah Khan 4) Capt Mujtaba Haider under the supervision of Assoc Prof Col Dr Adil Masood Siddique in completion of our degree of Bachelors of Telecommunication Engineering is correct and approved.

Approved By

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DECLARATION

We, Maj Muhammad Zeeshan Safdar, Maj Javed Alam, Capt Mujtaba Haider and Capt Farhat Ullah Khan student Officers of Department of EE, Military College of Signals, Rawalpindi in the subject of **BS Telecom Engineering Session 2014-18**, hereby declare that the matter printed in the project titled as **"GSM Based Automatic Irrigation System Using Solar Power"** is our own work and has not been printed, published and submitted as research work, thesis or publication in any form in any university, research institutions etc. in Pakistan or aboard.

Signatures:

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Capt Farhat Ullah Khan

DEDICATION

We dedicate project work to our beloved Batch mate Capt Waqas Saeed (Late) who left us to meet his creator (May Allah be pleased with him).

ACKNOWLEDGEMENT

All admiration for the Great Allah who bless His mankind with wisdom, glory, knowledge, bravery and determination. Due to his countless blessing upon us due to which this project becomes possible. Without his Will we could not have completed the research work and project. We are extremely thankful to Associate Professor Col Dr. Adil Masood Siddiqui for his generous direction throughout this research work. He has given us a perfect research environment. We have completed this project in time due to his rightful direction regarding selection of hardware and system architecture. Whenever we caught up in stressed situation and needed his guidance, he spared time for us and put us in right course.

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CHAPTER 1

INTRODUCTION TO SOLAR AUTOMATIC IRRIGATION SYSTEM

1.1 About Chapter:

This chapter introduces the main idea of the proposed system of irrigation. The problems faced during previous methods of irrigation are explained and this project is presented as a solution of these problems. The basic method of this design is discussed and used components are also mentioned.

1.2 Background:

Many countries of world are highly dependent on agriculture and their progress of economy also hooked on with agriculture growth. Moreover, due to increase in population in many countries demand improvement in technology of food production.

Pakistan is one of those countries. The major source of country's income is agriculture. Every budget shows the enormous figures of income from agricultural field. In order to obtain optimum results in agriculture progress, the factors must be considered and undertaken which affect its progress. One of the most important building pillar of agriculture advancement is irrigation system. In short they both are directly related for effective agriculture growth.

1.2.1 Process of Irrigation:

Irrigation is a technique in which a controlled amount of water is supplied to plants at regular intervals. The most basic use of irrigation is to assist in growing of agricultural crops. The maintenance of landscapes, re vegetation of disturbed soils in dry areas, protecting plants against frost, suppressing growth of unwanted plants and preventing soil consolidation are also some of the targets of irrigation. Irrigation systems can also be used for dust suppression, disposal of sewage and in mining area. Irrigation has been a central feature of agriculture for over 5,000 years and has modified with the passage of time. The method should provide the water to soil in need and when soil becomes at optimum level it automatically stop the water flow. Moreover crops can be saved for provision of excessive water which normally damages the crops and also become wastage. Pakistan's economy is highly depends on agriculture. Hence, bearing in mind Pakistan, who is agriculture country and economy is directly related to it, new techniques and procedures must be adhered for provision of water to irrigation system. So keeping in view the bad effect of manual irrigation methods, led us to think for such

developed and modern method of irrigation which can be trusted. The aim is to make such proposed system which consumes less labor requirement, preserve energy and also reduce cost, in short making it fully automatic which facilitate all above features and cater for load shedding issues as well by being provided with solar energy[1].

1.3 INTRODUCTION OF AUTOMATIC IRRIGATION

The countries wherever agriculture incorporates a massive impact on economy demand a extremely effective approach of irrigation. A timely and consistent irrigation is want of the hour in such countries. Wherever lack of water isn't tolerated by soil throughout irrigation, the surplus of water provision is additionally not counseled for crops flourishment. Hence a possible irrigation for any land needs appropriate quantity of water with minimum quantity of delays. Today's world demands improved ways as compared to the previous ones to hold out methods quicker and that we area unit moving towards automation of each process. Within the planned system, we've got developed Associate in Nursing automatic irrigation system that detects the soil wet level and programmed in an exceedingly approach that if water level goes below necessary quantity, it automatically jolts the motor to provide water. During this approach, we have a tendency to get most results out of the fields and water wastage is additionally reduced to important level.

The projected system is automatic irrigation system. The automaticity implies that it turns itself on and off relying upon the soil wet demand. This automatic behaviour of irrigation is achieved exploitation totally different sensors that sense and tell the user if water is needed or not and the way abundant water are going to be enough for soil in order that water wastage is additionally avoided. The errors which can arise once manual irrigation is employed are corrected for the foremost half exploitation this methodology. the most important supply of electricity in Pakistan is thru hydraulic power however this supply has not paid the country with requisite quantity of power thus there's shortage of electricity that is not smart for method of irrigation as motors would like uninterrupted provide of electricity. As we have a tendency to square measure having electricity deficiency problems that the system is formed a lot of versatile through exploitation solar power. The system is freelance of any labour however the standing of undergoing method are going to be received by user through GSM. The trendy challenge for rising plant growth and reducing price justifies the event of an automatic irrigation system that may minimize the

waste of water and scale back labor. Country's economy being extremely supported agriculture demands innovation in method like irrigation. Feedback primarily based approaches alter a lot of economical handling than open loop systems, at expense of complexness and stability problems. Soil wet level is troublesome to live manually however the model uses sensors for the cause. A style is projected for field and residential surroundings. It's made from reliable elements and has comparatively low price. It's totally different sections are simulated and tested, and their effectiveness in reducing consumption of water and human intervention are in contestable. The planning is additionally a resource economical by itself overwhelming low power [3].

1.4 PROBLEM STATEMENT

How to make irrigation system more efficient to meet the demands of increasing population and economic growth?

Solar powered auto irrigation system is more reliable and faster when compared with conventional irrigation method. The method serves as an autonomous system for taking out the irrigation process. Whenever human labor is used to carry out an operation there is chance of error based on human errors. But if a system is developed such that it detects the problem itself and deals with it, according to the program designed in it then one can be more reliable on the system as the machinery doesn't need human labor anymore to fulfil its task hence the chance of error based on human error is ruled out completely. The crops require a very timely and consistent irrigation for its proper flourishment.

In the present study, we hypothesized that auto irrigation is required in our fields and must be replaced with simple irrigation system. As the crops need water depending upon the content of water that is already present in the soil so the crops are needed to be treated in a way that supply of water should be consistent which means that the crops must be provided enough water when it is required with no excess amount of water going in because either of such scenario could be harmful for the crops flourishment. It has been seen many times that crops have been squandered due to late or inconsistent water provision. An auto irrigation system liberates much of the human dependency for carrying out the process. It automatically turn On the water supply when level of moisture in soil becomes low at certain level. This supply is continuously judged and when it reaches a certain level (as designed in the system) it stops further water flow through pumps. The energy to drive the pumps is given through solar panels which makes the proposed system more efficient as pumps may need electricity time to time with no

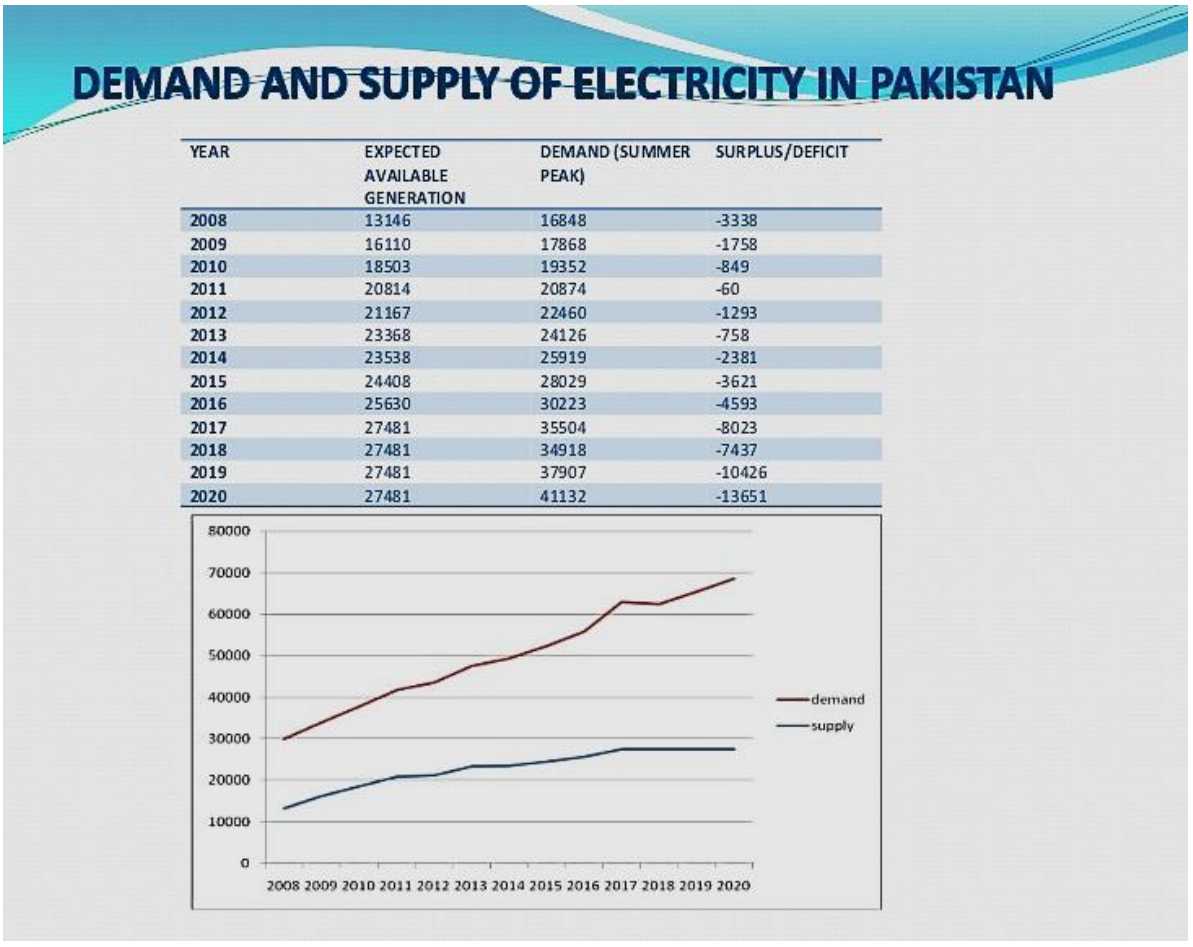
interruption due to load shedding. Also, typical irrigation uses fuels or heavy motors to drive pumps which may not be very much environment friendly as well as uses greater amount of electricity.

Therefore, looking at the stated reasons and to answer the above question we conclude that auto irrigation using solar energy is the current requirement in our crops fields. Because, not only this system makes the process of irrigation a reliable one but also economical as it uses energy given directly from sun so making no burden on country's electricity demand.

1.4.1 Electricity Deficiency Problem

At this present time, Pakistan is going through a major crisis of electricity deficiency. Enough power is not available in the industries of country. The industries which are highly depended on electricity are badly affected. The information in table 1.1 elaborates the present electricity situation of Pakistan. Considering the figures given in Table 1.1, we have developed an irrigation system based on solar power.

Table 1.1 Demand and supply of electricity in Pakistan



1.5 SCOPE OF PROJECT

Today's world demands better ways as compared to the recent ones to hold out procedures quicker. The proposed system allows one to keep the pace up with the technological world. For more efficient growth of our crops field we can depend on the system. Pakistan economy is highly based on our agriculture growth so we need maximum production in the form of fruits, vegetables etc. in order, to increase our economic growth. The automatic irrigation system helps to meet the required productivity of food. Given the fact that Pakistan is suffering from huge energy deficit issues one can never be sure that proper irrigation is being carried out. The electricity deficiency problems are being faced by everyone all over Pakistan. Due to the shortage, we are looking for alternative sources. Obviously, these alternative sources as solar energy in this project are also expensive but advantage of solar panels is that once they are inserted they are very efficient and aren't affected by electricity deficiency issues. So, all in all the purpose of this project is to maximize the crops for economic growth.

1.6 IMPORTANCE OF RESEARCH

The need of an efficient system in crops is need of the time. The crops demand water supply at the right time otherwise crops may not be able to flourish to their full potential. There are methods to determine water content in the soil of crops manually. One of which is soil sampling. Yes, water content is measured using such methods but what it demands is labor work and are highly labor intensive methods. They do not provide immediate feedback to turn on or off an operation as required.

The automatic irrigation system on sensing soil wet project is meant for the event of Associate in Nursing irrigation system that switches submersible pumps on or off by practicing sensors to perform this action on sensing the wet content of the soil. The most advantage of practicing this irrigation system is to cut back human interference and guarantee correct irrigation.

Solar powered automatic irrigation system when compared with typical systems shows many advantages of the project over other systems. Automatic behavior of the project suggests a great liberty from the labor work which saves the time and effort. Powered through solar energy gives the system an edge especially when discussing the project in Pakistan which is having load shedding issues.

Automatic irrigation systems not only supply water to soil at perfect timing but also saves the loss from excess water provision. The sensors used in irrigation are easily immersed in the soil. Sensors are programmed to allow water delivery to soil up to a specific safe limit above which crops may be harmed. Turning on and off itself without requiring any human assistance gives

proposed system a huge upper hand on other irrigation systems. Comparing the method of energy provision to drive pumps of this project to other conventional methods reveal many advantages of proposed system. The irrigation requires pumps for water flow in crops especially if the field is at somewhat above level to the water source (tube well, lake etc). Energy is supplied through heavy electric motors which uses great amount of electricity. Solar energy for water pumping process has many advantages on the typical electrical energy provision method. Firstly, it is environment friendly. On contrary, the pumps run by fuels pollute the environment and consume a lot of energy. Secondly, no power is required from outside AC source as the system generates its own electricity using solar photovoltaic systems Thus, it saves a lot of electrical energy which is great on part of country. The user friendly and the environment friendly nature of the project makes it stand out from the old irrigation methods [6].

1.7 BASIC METHODOLOGY OF PROPOSED SYSTEM

Basic methodology is discussed in this section while a detailed analysis of methodology of this project is provided in the 3rd chapter. The project uses sensors, Arduino board, relays, GSM and solar panels to carry out the process of automatic irrigation. The projected system provides automatic irrigation system that turns itself on and off relying upon the water demand. The water requirement is judged by submersible sensors in the soil. The project has three parts one part controls the solar electricity provision second part senses the moisture content of soil and sends information to Arduino which orders third part to bring the water or withdraw the water as required. The automaticity of irrigation depends upon the sensor immersed in soil. The sensor reads the content of water in the soil and compares it with the threshold level. The threshold values are decided by the user in the Arduino software code and the system will adhere to the values. The sensors send their information to Arduino which allows the water through starting the water pumps if the moisture content of soil is below our threshold value and stops water as soon as the soil crosses its threshold value. Basically, the sensor sends the information to the Arduino about the water content level which compares it with the programmed value and allows or stops water flow as required. A liquid crystal display is used to show the status of water pump. A charge controller circuit is used to charge the photovoltaic cells for supplying the solar energy to the whole circuit. The energy provided to the prototype is DC due to solar energy. The solar energy charges and discharges in solar panel plates [1].

CHAPTER 2

LITERATURE REVIEW

2.1 ABOUT CHAPTER

This chapter contains a literature review of solar automatic irrigation process. History of irrigation has been addressed and a whole timeline of irrigation is analyzed. Different methods of irrigation are being discussed along with their shortcomings. The problems that may hinder irrigation process are reviewed and their solutions are also suggested. Previous researches done on the given topic are also examined. The result is concluded in the end giving a whole perspective about the proposed project.

2.2 FACTS FROM HISTORY

History tells us very sad fact about famine. An immense number of people have died due to starvation. Millions and millions of people from all around the world suffered from this disaster. This unfortunate natural disaster had not left any part of world. Starting from Bengal, it had covered its way from China to Soviet Union and Europe as well. One of many factors which gave rise to scarcity of food in the past is lack of rains which consequently result in demolition of crops. This is a fact about food crops field, if they are not treated with enough amount of water they would lose their growing feature. In earlier times the only way of providing water to crops was rain. The fate of whole village depended on the crop fields as this was only source of food for them and if the given crop area lacked rain for any reason then this would destroy the whole crop. Thus, the area suffered from malnutrition in such ways.

After looking at these hard facts scientists and concerned people started thinking of an artificial way to provide water to crops through a substitute source as well. So that during rainless seasons they could depend on the artificial system.

The artificial way of supplying water to the plants in order, to enhance and boost their growth so that they reach their maximum potential and produce good vegetation is known as irrigation. After irrigation was adopted by mankind, the number of people dying from famine decreased to a significant level. The process of irrigating is further elaborated in next sections.

2.3 HISTORY OF IRRIGATION

Following is a timeline of irrigation starting from 6000 BC till now. The first irrigation system was developed and operated in 6000 BC in Egypt. The system used flood water to irrigate the crop land. The irrigation process under King Menes is considered as the first major irrigation method. He used canals and dams for water provision. It happened in 3100 BC. In 2000 BC, a cement pipe was created by Romans which helped water flow towards crops field.

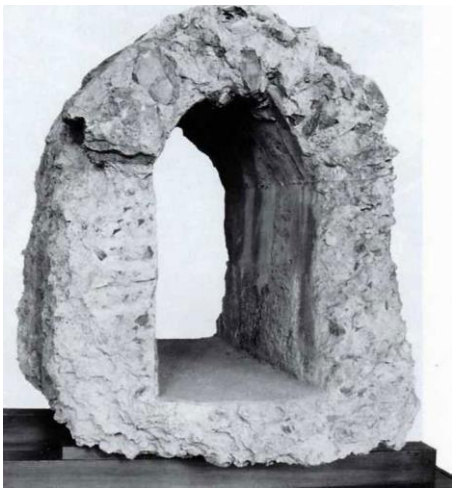


Fig. 2.1 Cement pipe

With further development and realization of technology, Egyptian engineered Noria. This Noria is wheel of buckets containing water and the wheel was moved through currents of water. The rotation of wheel along with buckets were used to provide water. So, we can say it was the first semi-automatic system of irrigation.

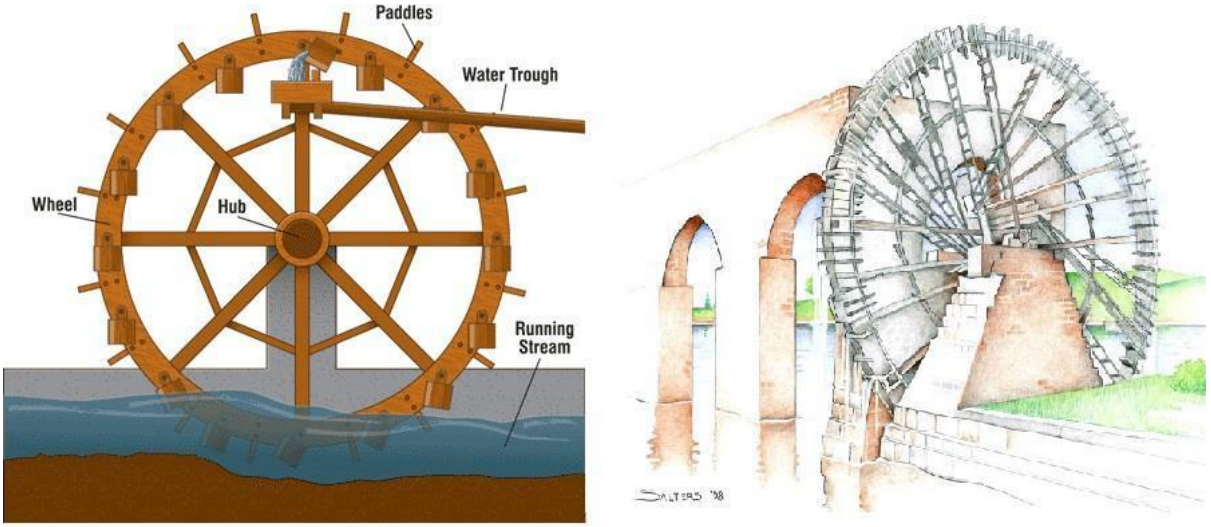


Fig. 2.2 Noria wheel

Qanat was another invention in 550 BC. This system irrigated plants using ground water. A well was created with natural slope angle and the water traveled through slope to the plants.

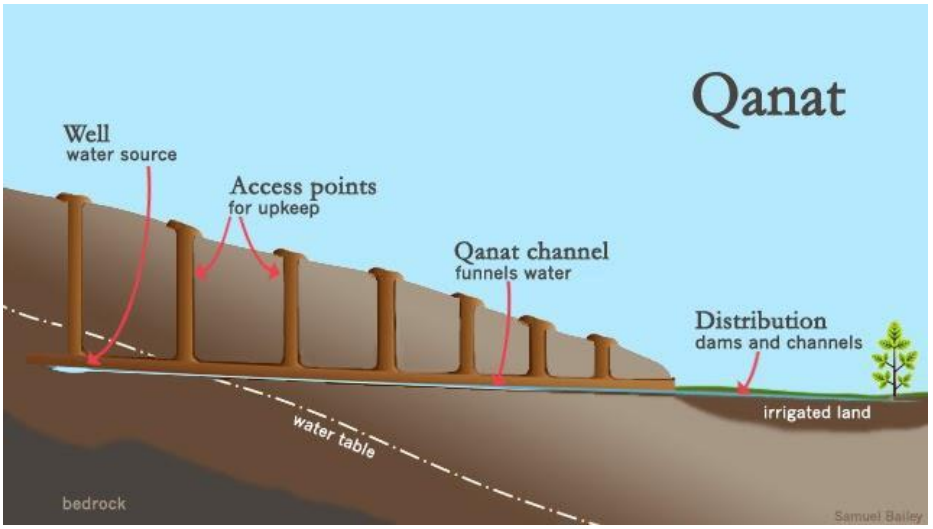


Fig 2.3 Qanat irrigation system

USA contributed a lot in understanding the way of irrigation and also discovered various methods to carry out the process. They were very active during late 1800's and early 1900's. Sprinkler irrigation was invented by John Gibson in 1872.

A lot of scientist are known to be pioneer of sprinkler irrigation but Mr. Lewen R. Nelsen is considered as the patent of sprinkler and coupling hoses irrigation. His method of coupling hoses is adopted even today.

Invention of John Dethridge in 1910 requires to be mentioned here. The structure he created consisted of a wheel upon which there were vanes which regulate the water flow. Rotation of wheel was used to measure the water for irrigation. His invention is considered to be one of the biggest contribution towards irrigation process. After a lot of wheels were created but the principle remained the same.

Fig. 2.4 Dethridge wheel

The world saw first irrigation pump in 1920. It used oil engines to drive the turbine. The water could now be send to far places using a lot less time. The method continued to improve during mid19's with inventions of portable irrigation, hydraulic valve, aluminum pipe, soil tension meter and other convenient sources came along with the passage of time. Every year came with further innovations and purpose of all innovations were to make the process as easy as possible. But things started to get more interesting when irrigation was made automated. The purpose of this invention is to eradicate any external errors that may arise due to carelessness of farmers or water provision inconsistency.

Fig. 2.5 First irrigation pump

2.4 PURPOSE OF IRRIGATION

A proper amount of water must be supplied to plants and crop fields in order to enhance their growth. Some of the main aims of irrigation are:

- It is done for the assistance of plant's growth
- Maintain the landscapes
- For revegetation
- Protection of plants against frost
- Prevents soil consolidation
- Enhancement of metabolic process of plants
- Reduction of soil temperature

- Dilution of salts in soil
- Easy germination of seeds
- Softening tillage pan.

2.5 PRESENT IRRIGATION METHODS

Irrigation is done today using different techniques. The selection of technique depends upon the geographical location of the area. If the irrigation is for a small patch of land, then instead of using heavy pumps one can depend on simpler methods i.e. sprinkler. The different methods have their own advantages and disadvantages. Various methods include:

2.5.1 Surface Irrigation:

Surface irrigation is done simply through flooding water to the field area.

It is further divided into three other sub-types:

1. Furrow Irrigation: Water is flooded in a small area in the form of furrows.

2. Basin Irrigation: Water is flooded in a large area and area is surrounded by water.

3. Border Irrigation: Supply of water in between defined borders or dikes.

This is the simplest form of irrigation but it is not considered to be very efficient as it is not directly controlled so there may be loss of water and crops may get spoiled due to excess water. The water is let to irrigate the land on its own.

Fig. 2.6 Surface irrigation

2.5.2 Sprinkler Irrigation:

Supplying water through showers from a hose is sprinkler irrigation. This method is best where minimum amount of water is required and loss of water is controlled using this technique.

Fig. 2.7 Sprinkler irrigation

Disadvantages of Sprinkler Irrigation

- High and continuous energy is required for the operation.
- The efficiency of application will be poor under high temperature distribution and high wind condition.
- Highly saline water 7mm hos/cm reasons leaf burning once temperature more than ninety five F.
- The system needs continuous attention of user and labour is required to set times of irrigating lands.

2.5.3 Drip Irrigation

In this methodology, roots of plants are provided with water slowly through drips. This is also a very water saving method of irrigation. It is mostly used where water is scarce. Basically, water is supplied to the roots of plants through small pipes or drips and in this way, most of the water will be able to approach the effective area and hence water is being preserved. But still this method requires labour and water can wasted if labour shows incompetency. The system is not autonomous and can face problems when not handled with care.

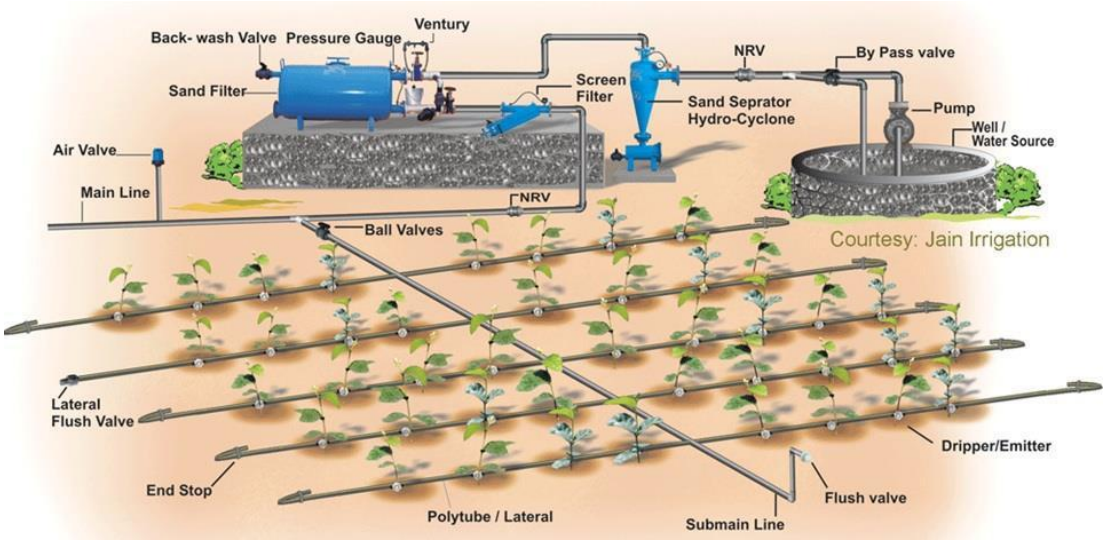


Fig. 2.8 Drip irrigation system

2.5.4 Sub-Surface Irrigation

Water is supplied to plants or crop fields by raising the level of water table under the ground. This method is feasible in areas where much water reserves underground is. It is operated in many parts of the world.

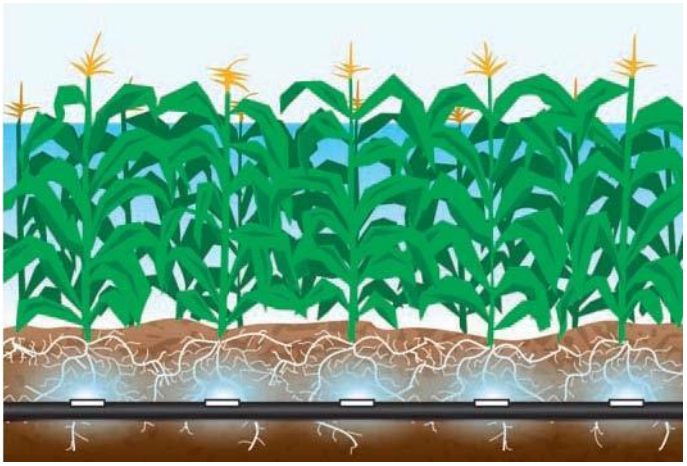


Fig. 2.9 Sub surface irrigation

Sub Surface Irrigation Drawbacks

It is quite expensive and labour intensive within the starting. The strategy needs associate degree uncommon combination of natural conditions. Therefore, its scope is restricted. Frequent removal of collected soil and substitute materials from channels is acute.

These irrigation methods have been adopted all over the world. The feasibility factor decides their selection over a certain area. Those countries whose economy is mostly dependent on agriculture mandate enormously effective means of irrigation. A judicious and steady irrigation is want of the hour in such countries. Wherever lack of water isn't tolerated by soil throughout irrigation, the surplus of water provision is additionally not counseled for crops flourishment. Therefore a possible irrigation for any land needs appropriate quantity of water with minimum quantity of intervals.

2.6 IMPORTANCE OF IRRIGATION IN PAKISTAN

Pakistan and agriculture are codependent on each other. We have seen that country's economy reaches its peak whenever its agricultural progress is at its best. Every government has taken serious steps to avoid any disaster relating to agricultural field. This importance of agriculture has urged the government officials to think of an innovative way of irrigating crop fields so that country takes full advantage of its precious agricultural fields. The more the production the better the agricultural progress is considered. Hence to improve production in our agricultural fields, the ways of food production technology must be improvised. As irrigation directly influence production, so an effective irrigation needs to be adopted in Pakistan.

2.7 FACTORS AFFECTING IRRIGATION

Water requirements during irrigation vary from place to place. It is influenced by some variables. Following are some factors which may affect irrigation in one way or the other.

- Soil Type
- Environmental temperature
- Soil temperature
- Humidity
- Location of field
- Dampness of soil
- Electricity provision

2.8 ELECTRICITY IN IRRIGATION

The importance of electricity cannot be denied in today's world. Almost all the industries that may influence the economy depend upon electricity. The limitation in supply of electricity results in less product formation in the industries. Same is the case with subject under study, irrigation demands electricity like any other major industry. With other problems, shortage of electricity is also a major factor that renders the progress of irrigation to reach its full potential. Thus, inconsistency in electricity provision would have serious consequences when final result is considered. On contrary to it, maximum food production is expected when electricity is provided with no interruptions. The water is supplied to fields through heavy pumps and substantial power is required to drive them. Thus, such a method should be arranged for irrigation in which water pumps are supplied with electricity all the time and this makes irrigation process an optimum one. Hence electricity directly influences the irrigation process. A good irrigation system would have a consistent and proactive source of electricity. The 24/7 provision of electricity is the main demand in irrigation process [12].

2.8.1 Electricity Issues in Pakistan

The major supply of electricity in West Pakistan is thru electricity power. Although estimations show that dams can provide enough electricity to the whole country but unfortunately due to some political restraints we are not able to get fully advantage of dams. Hence hydroelectric source was unable to provide the country with requisite quantity of wattage. Therefore, all the industrial activities in the country are bound to limit themselves where irrigation is no exception. How can plants reach their full potential if there are gaps of electricity due to load-shedding? The answer is they simply can't. Therefore, one may have to compromise in the production area, which in case of Pakistan is not tolerable. The country is already having issues regarding economy, so here it cannot afford any shortfall in its strongest revenue source.

2.8.2 Solar energy source

In order, to rectify the current situation in which deficiency of electricity has led to serious concerns, we can depend on other energy sources. Solar energy comes first to mind when alternative sources of electricity are discussed. In solar energy, electricity is generated when sunlight hits the panel, exciting electrons through photons of photovoltaic cells which makes flow of electrons. There are many reasons where one can prefer solar energy over other energy sources. Some of them are:

- The abundance of solar irradiance
- Easy usability
- No electricity bills
- Renewable energy source
- Environment friendly
- Low maintenance.

2.8.3 Solar Irrigation

As sunlight is everywhere so its apparatus can be arranged to any place where electricity is required. This makes it useful as compared to grid stations. The transmission of electricity could be troubling to areas far from the grid stations. Hence, solar irrigation would be a good choice in the fields which are not near a grid station. This liberates user from expensive electricity. Moreover, once the system for harnessing solar energy is arranged there will be no trouble afterwards. Due to its low maintenance attribute, less or no cost will be required. The client does not have to worry about some electricity bill. Therefore, it can be said with plausible reason that solar energy is good replacement for carrying out irrigation through alternative energy source.

Fig. 2.10 Irrigation through solar energy

2.9 AUTOMATICITY IN IRRIGATION

The methods for carrying out any process changes with the passage of time. Processes which were done 100 years ago, required a lot of human effort and hence people faced difficulty as compared to today. The approach for the same process would be a lot less difficult now. The purpose of all this modification is to help humanity and lessen their efforts. Machines were invented just to reduce human interference. If human interference is reduced, consequently there would less chance of errors. The machine would do the task as it is programmed to do so. Irrigation requires a lot of human effort when it is not assisted with modern science approach. The farmers subject the fields with water through manual methods. Their experience of the work would decide the timing and quantity of water that is to be supplied to fields. This may take a lot of risk because in case of wrong estimation, whole crop will give fruitless result and there will be no one to blame but a wrong guess which is very unfair to all the efforts done by countrymen. Even if they guessed it right, this process would be slow and would require a lot of tiresome work from farmers. Many studies have been done up till now to make the handling of system less cumbersome.

The studies have shown that one of the most feasible method to avoid the tedious efforts is automatic irrigation. In this method, irrigation is simply made automatic which means it switches itself on and off trusting upon the demand of soil. This automatic behavior of irrigation is attained by exploiting completely different sensors which manages to tell about requirement of the water when needed and also to preserve the water from wastages. The mistakes which can rise by using manual irrigation is employed are corrected for the foremost half exploitation this technique [10].

2.10 PREVIOUS RESEARCHES ON AUTOMATIC IRRIGATION

The process of irrigation has been used for many years to increase growth of crops. The method to carry out this process is continuously modifying with the technological advances. Up till now, the most reliable innovation in this scenario is the use of sensors and wireless units which serve as the guide for process requirement. The use of various sensors for irrigation process has reduced human interference. As suggested by Shahin A. Pathan and MR. S. G. Hate (2016) that, agriculture is the main stay of any country's monetary system. It needs to be automated hence to reduce manual labour. Various sensors were used by them to meet the automaticity of the irrigation system. Besides soil moisture sensors, temperature and light sensors were also

taken into the action. A threshold value must be there according to which the motors are to be switched on and off. So, they used MATLAB programming to set a reference value. Another important trait of their study includes the use of XBEE which links the soil data information to the authorized person. Hence, wireless networking also comes into play in this process. They used two wireless sensors units for the whole system. They deduced that the automatic irrigation can be modified as required by the users by changing the threshold values, and the information is transferred to the user using GPRS or Wifi [1].

2.10.1 Reducing Labour

Economy of some countries is highly based on agricultural development. So, many researches have been done in these countries regarding lowering the men labour for irrigation and therefore reducing chances of human errors. Same initiative was taken by Nagarajapandian M et al (2015), who stated that the manual methods for irrigation have not only been the source of crop degradation but also wastage of water. Hence, their study covered the automatic irrigation process to save loss of excess water. An irrigation system which operates using the soil dampness information through detection system was being proposed by them. They used micro controller AT mega 328 which encoded therefore on gather input via damping detection system. They concluded that if this project is used properly and efficiently it can save huge amount of water [2].

2.10.2 Controlling Water Wastage

Further studies reveal that along with water wastage problem, there are some other negative factors deterioration of soil flourishment. Chaitali R. Fule and Pranjali K. Awachat (2014) mentioned that due to inconsistent supply of water, there is nonstop elimination of water at traditional intervals from earth that is dropping the water level. As a result, the zones of un-irrigated land are frequently increasing. The irrigation process not only controls water from wastage but also supplies water to crops at the right time which one cannot manage to provide using conventional methods for irrigation. Further they mentioned that the conformist irrigation strategies like overhead sprinklers, flood kind feeding systems typically wet the lower leaves and stem of the plants. The whole soil surface is soaked and infrequently stays wet long once irrigation is completed. Such condition promotes infections by mold fungi. Thus, the need of automatic irrigation system is likeable. They used AVR ATMEGA-16L microcontroller to steer irrigation process. The controller is power efficient and operates on low power which adds

to its value considering power is a big issue of today. They concluded that this power efficient and time saving process can reduce the labour and it prevents crops from under irrigation or over irrigation [17].

2.10.3 Using Solar Power in Irrigation

Due to power deficiency issues the industries demand alternative methods for their regulation. The irrigation system needs not to be disturbed by any interruption therefore there must be a consistent source of electricity so as to drive the pumps regularly depending upon the demand of soil. Solar energy is one of the powerful renewable energy source. Hence the use of photo voltaic panels was considered feasible by Basim Alsayid et al (2013). A solar tracking system tracks the path of sunlight and arranges its plates such that it receives the maximum amount of sunlight and this process continues throughout the day. So to maximize the use of solar panel, they used solar tracker system. They suggested a very feasible system to carry out irrigation. It consisted of humidity sensors in soil and temperature sensors in air which are used to control DC water pump operation. LDR's are used to detect the sun position and this information is being processed by 16F877A PIC which moves the axes of PV panels according to the requirement. Simulation has been done on proteus and implemented afterwards. They found the system to be useful at the areas where power provision is difficult [7].

Spencer Abbot et al (2015) study also showed the use of solar energy for the irrigation process is feasible in many regions. Water level requirement is measured and signal is transmitted to the start circuit that adjusts its configuration thus on give enough DC power to drive the pumps and fulfil the appointed task. This technique isn't solely power economical however additionally proves to be value effective once thought of in long-standing time. The star irrigation method proves to be of nice value to the irrigation cites that square measure removed from grid stations.

2.10.4 Using Microcontrollers

The genesis of automatic irrigation process is microcontroller. There are various kinds of microcontrollers. Usually 80C51 microcontroller is used for embedded system because of its flexible properties. This intel microcontroller has 64K bytes memory via RAM module. Microcontroller includes four 8 bit ports and 32 input/output lines. This microcontroller is associated with sensors and is programmed so as to easily sense the threshold values and convey information about them to water controlling units. Same microcontroller was used by

Abhinav Rajpal et al (2011). They proposed a system in which all the information about water requirements is studied by sensors inserted in soil. These sensors then convey information to microcontroller circuit where it compares the received value from sensors with the threshold value as allotted by the programmer. The process stops if the value is above threshold and continues if it is still below. They concluded that such a system is feasible in countries where there are vast lands and accountability of all lands is difficult to manage manually. Thus such a system would give a relief as it is easy to use and also is environment friendly [15].

2.10.5 Use of Sensors

The incorporation of different sensors in automatic means of irrigation is prime important as they perform major role to make the system automatic. As their absence in the system doesn't make it fully automatic. There few sensors used in this process which sense different that may affect the process of irrigation. These sensors include:

- Soil moisture Sensors: it measures the level of moisture in soil. These square measure most significant because the data forwarded by them is most relative concerning water demand.
- Temperature Sensors: They sense temperature of soil and environment because any change in temperature may affect water demand of soil.
- Humidity Sensors: They observe the moisture level in atmosphere. The high wetness could increase moistness in soil.

Chaitali R. Fule and Pranjali K. Awachat (2014) did the research using these sensors and found that getting assistance from these sensors would enhance more sensing capabilities of the system and the final result will be improved. Thus, extra water can be saved while using these sensors. They concluded that this system would be most feasible in region where water wastage must be eradicated [17].

2.11 CONCLUSION

Upon studying and analyzing the content of previous researches on the given topic it can concluded that by utilization of automatic means of irrigation methodology will enable to save lots of the surplus water which may become wasted during labor-intensive ways. Also it helps in up method of irrigation and provision of water to the fields is completed in an exceedingly more practical manner improving this system. Moreover, electricity issue can even be resolved

by means of alternative energy. Thus, this methodology has Associate in nursing superiority over all alternative ways of irrigation owing to its steadiness and practicality.

CHAPTER 3

METHODOLGY AND COMPONENTS DETAIL

3.1 ABOUT CHAPTER

In this chapter, a detailed analysis of the actual project is presented. This chapter will enhance the understanding of readers regarding the methodology of GSM Based Automatic Irrigation System using solar power. The components of the project are thoroughly presented and important interfacing between the components are also explained.

3.2 COMPONENTS LIST

The major components used in this experiment are as follows:

- Arduino UNO
- Soil Moisture Sensors
- Temperature Sensors
- Humidity Sensors
- Solar Panel
- Battery
- SIM 900D GSM module
- Liquid Crystal Diode (LCD)
- DC Motors
- DC Fans
- Dual Motor Controller
- Relays
- Green Cover Shed

All the components are easily available in the market and are very convenient during their interfacing. Let's analyze the basic features of all the components that we have used in development of our project.

3.3 COMPONENTS DETAIL

3.3.1 Arduino Mega 2560

Background

An Arduino is a device that provides an open source platform for the electronics projects. The versatility and easy to use feature of an Arduino make it stand out of the rest microcontrollers. It is available in both hardware and software. In hardware, it is a board which reads various inputs and turns it into a desired output. While, the Arduino software has codes that are burnt into the Arduino device through a USB cable. The code is defined by user and the device can be manipulated to do required task [4].

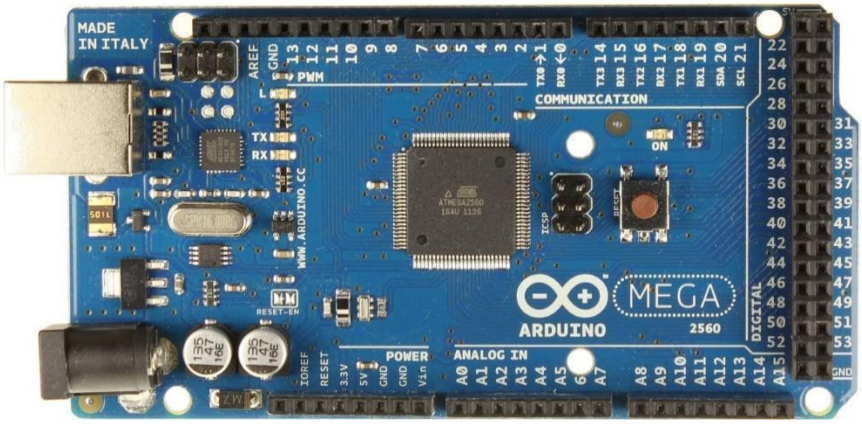


Fig. 3.1 Arduino Mega board

Types

Arduino is available in the market in various types depending upon the number of input and output ports, memory and complexity of the project. The most basic type is Arduino Uno. But in this project, we have used Arduino Mega as it offers more number of digital inputs and has wide range of memory. Other types of Arduino include, Lily pad, Red board, Leonard board, Arduino shields. The Fig. 3.1 shows a Mega Arduino 2560 which is also used in this project.

Features

Following chart shows the basic features contained in an Arduino Mega.

Table. 3.1 Features of Arduino Mega

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz

Description

The Arduino Mega has 54 I/O digital ports and 14 of these are PWM outputs. The digital I/O ports are connected both as inputs and outputs Pulse Width Modulation or PWM is basically a technique that is used to get analog outputs with digital means. In addition to digital pins, there are also 16 analog input pins.

The connection of Arduino Board is made with computer through serial communication via USB. A serial communication uses the connection of TX and RX pins of computer and Arduino. The RX of Arduino connects with TX of computer and vice versa. Serial communication is done on digital pins 0 (RX) and 1 (TX). All the Arduinos have UART ports for serial communication purposes. Arduino Mega has 4 UART pins. Serial 0 on digital pins 1(RX) and 2(TX), Serial 1 on 19(RX) and 18(TX), Serial 2 on 17(RX) and 16(TX) and Serial 3 is on 15(RX) and 14(TX). As far as memory of the board is concerned, it has 128 Kb of flash memory for code storage. Out of 128 Kb, bootloader uses 4 Kb of the memory, 8 KB of SRAM and 4 KB of EPROM.

Other pins of Arduino Mega include 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

3.3.2 SOIL MOISTURE SENSOR (YL69)

Introduction

As the name suggests, a soil moisture sensor is the one which is responsible for detecting the moisture content of soil. Given the project is about irrigation, so the importance of this sensor in this project is vital. The sensor measures the volumetric content of water in soil. YL-69 as shown in Fig. 3.2 is used as a soil moisture sensor in this system. The sensor consists of two parts as can be seen in Fig 3.2. One part is submersed in soil that has a probe with two pads, this part detects the water content. The other part is an electronic board which is connected to first part through wires. This part has a built-in potentiometer and moisture values of soil are compared in it with the threshold values.

YL-69 sensor is prime important in automatic means of irrigation as they provide relative and authentic information about requirement of the water. These sensors comprises of four ports which are GND, VCC and outputs for analog and digital values. The ports are present on the electronic board of sensor as shown in Fig. 3.3. These soil sensors are convenient to be implemented in fields to assist irrigation.

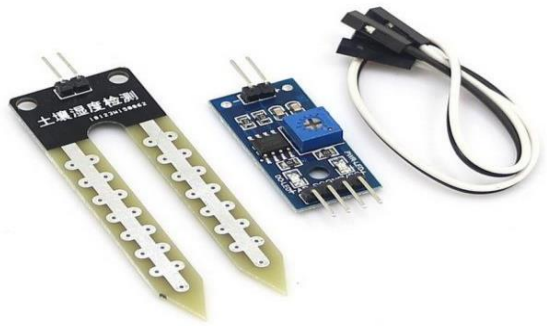


Fig. 3.2 Soil moisture sensor YL-69

Specifications

The operating voltage of sensor is between 3.3 and 5V. The sensors contain inputs for both digital and analog. This infer that water content in both analog and digital form

can be measured and controlled. The Fig. 3.3 shows the detailed diagram of electronic part of this sensor.

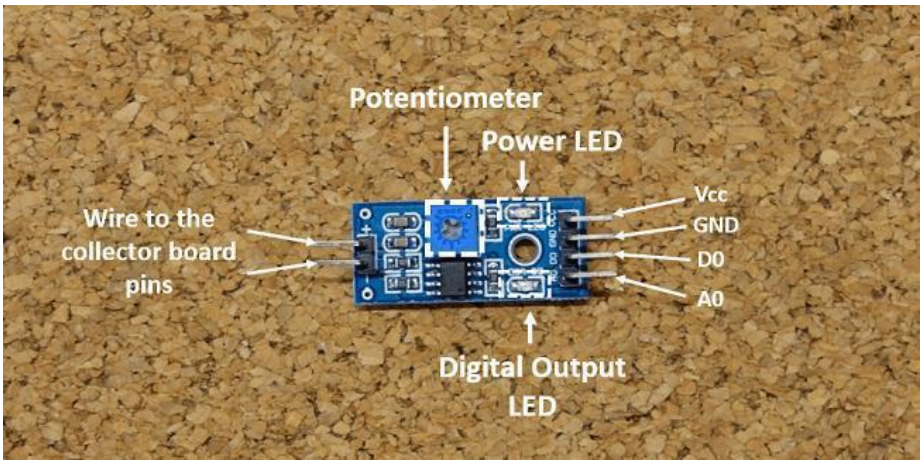


Fig. 3.3 Features of YL-69

Working

They operate on the simple principle of comparison. The real value of water content in soil is measured and compared with user defined value. If the user defined value happens to be below than the actual measured valued, the flow of water will be allowed in the fields. The soil will continue to get water as long as the upper threshold value of water content is not crossed by actual value. After that the irrigation would stop automatically. Hence, this sensor finds abundant applications on the genre of agriculture.

3.3.3 TEMPERARURE SENSOR (LM95)

Introduction

The temperature is another important factor in the process of irrigation. The rise or fall of temperature can cause changes in the water composition of soil. So, under different temperature the water requirement of soil will vary. Thus, to have smooth irrigation, it is also recommended that one should use temperature sensor which would keep the temperature of soil constant and the soil moisture sensor works to its full potential and gives better result. LM-35 is used as a temperature sensor in this system of irrigation.

Features

The features of the LM35 temperature sensor are given as follows:

- Measures the temperature in Celsius
- Linear sensor with 10mV/Celsius scale factor
- Accuracy upto 0.5 Celsius
- Wide range from -55 to 150 Celsius
- Inexpensive
- Operating voltage is from 4V to 30V
- Current drain is less than 60 micro Amperes
- Has a low impedance output

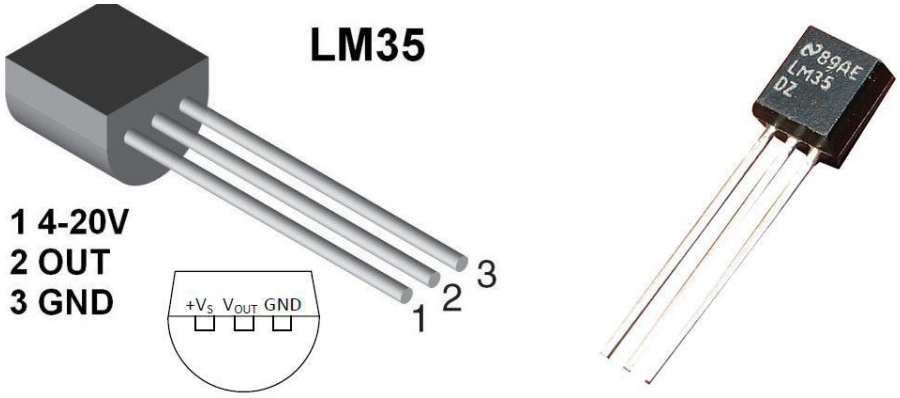


Fig. 3.4 LM-35 ports description

Working

LM-35 consists of 3 pins. First pin is Vcc and it is for input voltage. Third is GND pin and is connected to the ground of main circuit. The middle pin is analog output pin and information about sensors is obtained through this pin. The sensor is hung in air and it calculates the temperature of surrounding. With use of LCD, the value of temperature can be shown to the user. Arduino can also be connected with sensor through proper interfacing. The purpose of connecting Arduino is that we can command further processes after processing the value of sensors. When the temperature falls 10 degrees below the threshold value the Arduino sends the signal to reopen the roof top [5].

3.3.4 HUMIDITY SENSOR (DHT11)

Introduction

Humidity is another factor that can affect water content of soil and hinder performance of irrigation. The high humidity can increase the dampness in soil and under such condition we would not want to waste extra water in the soil which is not good for the growth of plant. Thus, this justifies the use of humidity sensor in automatic irrigation process. A humidity sensor will measure the value of humidity and improves the performance of soil moisture sensor in this project. DHT-11 is used as a humidity sensor in this project. The humidity present in the air is being measured by this sensor. The Fig. 3.5 presents DHT-11 humidity sensor. It is inexpensive and low power device.

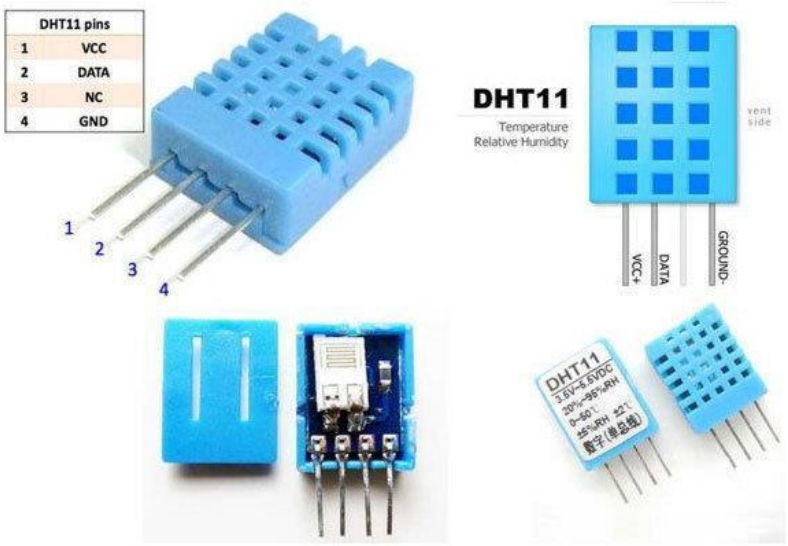


Fig. 3.5 Features of humidity sensor DHT-11

The attributes contained in this sensor makes it best choice for detecting and commanding further process in this project. For example, the low power consumption, small size and long range for signal transmission are some of its major advantages.

Specifications

Table 3.2 Specification of DHT-11

Item	Measurement Range	Humidity Accuracy	Temperature Accuracy	Resolution	Package
DHT11	20-90%RH 0-50 ℃	±5%RH	±2℃	1	4 Pin Single Row

Working

DHT-11 is provided with four pins. First pin is VCC for input. Second pin is data pin and is responsible for giving the digital output. Third pin is NC pin. Fourth and last pin is for GND purpose. The basic operation of this sensor is that it measures the humidity of surrounding. The values are in percentages. This value can be seen on LCD when sensor is wired with LCD. The sensor is used to control the further processes in the irrigation system when it is interfaced with Arduino. The Arduino will get the values from DHT-11and if according to code inserted into it the humidity happens to be too high, it will send a signal to fans, turning them on and flushing out the humidity. Likewise, the fans can be stopped automatically as the DHT-11 will continue to send values to Arduino and when normal humidity is reached the fans will be asked to stop.

3.3.5 SOLAR PANELS

Introduction

Solar is considered to be a recognized renewable source of energy. Sometimes it is preferred over other sources because of its reliability and economy in long run. The power produced from solar panels is always DC but can be converted to AC using an inverter. Basically, it harnesses the energy from sun light and convert it to DC power. The solar energy can be used in various fields including agriculture. The process of irrigation can be made to run under solar power because in Pakistan sun light is available for long time in a day and can be used as an energy source. In this project, the TPS series 5W 12V solar panels are used which are high efficient design with low light performance.

Fig. 3.6 Solar panels

Features

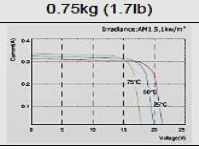
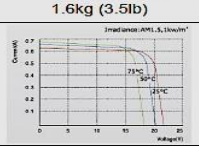
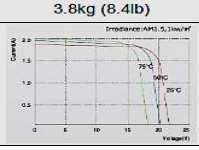
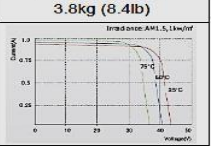
Some of the features of Solar Panels are as follows:

- Performance is good at very Low brightness from sun
- The lamination of solar cells with TPT/EVA bi-layer for extended life.
- Long life of solar cells up to 25years
- High efficiency
- High transparency
- Provided with sealing to withstand adverse environment
- Wire connection are enclosed in a junction box

The lamination used in silicon solar cells is TPT and EVA. The cell array is covered with aluminum frame with a high transparency low iron tempered glass which provide sufficient protection of cells from ruggedize, harsh environments; storm, wind, snowflake and ice.

Specifications: Solar panels harness the energy from the sun light and store it in the battery. This energy is used by all the components of the project. As it takes the energy from a natural source hence it is economical while project can also use the energy from WAPDA if required.

Table 3.3 Specifications of solar panel plates

	TPS-12-5	TPS-12-10	TPS-12-30	TPS-24-30
Maximum Power (+/-5%)	5W	10W	30W	30W
Voltage at Pmax (Vmp)	17V	17V	17.2V	34.4V
Current at Pmax (Imp)	0.29A	0.58A	1.74A	0.87A
Open Circuit Voltage (Voc)	21.6V	21.6V	21.6V	43.2V
Short Circuit Current (Isc)	0.34A	0.68A	1.93A	0.97A
Short Circuit I Temp Coeff	.065% / °C			
Open Circuit V Temp Coeff	-80mV / °C			
Output Power Temp Coeff	0.5%/°C			
Wind Survivability	201kph (125mph)			
Hailstone Survivability	1" @ 50mph			
Operating Temperature	-40 to +85°C			
Continuous Power Capability (6hrs average sunlight per day)	1.25W	2.5W	8W	8W
Size	222 x 270 x 17mm (8.7 x 10.6 x 0.67")	302 x 357 x 30mm (11.9 x 14 x 1.2")	541 x 510 x 30mm (21.3 x 20 x 1.2")	541 x 510 x 30mm (21.3 x 20 x 1.2")
Weight	0.75kg (1.7lb)	1.6kg (3.5lb)	3.8kg (8.4lb)	3.8kg (8.4lb)
IV Curves				

3.3.6 GSM SIM900D MODULE

Introduction

The communication between user and system is being managed by GSM/GPRS module. The architecture used for mobile interactions all around the world is based on GSM. To support higher data transmission rate GSM is extended to GPRS. GSM module contains a modem built together with power supply circuit and communication interfaces for computer. Communication interfaces include RS-232 and USB. GSM and GPRS modem are basically members of wireless MODEM family. They are fabricated for the communication of computer with network of GSM and GPRS. A SIM card must be required to establish and stimulate communication between networks. Just like mobile phones, they also have IMEI number for the identification purpose. A GSM/GPRS MODEM can receive and send SMS. They also have the feature to delete the SMS. Further they can read, add and entries can also be searched from the phonebook of SIM. They can also receive as well as make a call with an option of rejecting a call too [11].

The GSM module that we have used is SIM900D. It is a quad band GSM/GPRS module that works on frequencies GSM 850 MHz, EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz. SIM900D features GPRS multi-slot class 10/class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. SIM900D can meet all space requirements in user application. It has 48 SMT pads. Fig. 3.7 represents the basic structure of a GSM module that we have used in this project. SIM900D helps user to easily develop user's application through serial and debug ports. [16].

Fig 3.7 GSM Module

Table 3.4 Specifications of GSM Module

Sr. No	Features	Implementation
1	Power Supply	3.2V ~ 4.2V
2	Power Saving	Typical power consumption in sleep mode is 1.0mA
3	Frequency Bands	SIM 900D Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900
4	Transmitting Power	Class 4 (2W) at GSM and EGSM Class 1 (1W) at DCS and PCS
5	GPRS Connectivity	Default: GPRS multi slot class 10 Optional: GPRS multi slot class 8
6	Temperature Range	Normal operation: -30 C ~ 80 C Restricted operation: -40 C ~ -30 C and 80 C ~ 85 C Storage temperature: -45 C ~ 90 C
7	Data GPRS	GPRS data downlink transfer rate: 85.6 kbps GPRS data uplink transfer rate: 42.8 kbps Coding schemes: CS-1, CS-2, CS-3 and CS-4 Integrate the TCP/IP protocol Support Packet broadcast control channel (PBCCH)
8	CSD	Support CSD transmission
9	USSD	Support USSD transmission
10	SMS	MT, MO, CB, Text and PDU mode SMS storage: SIM card
11	FAX	Group 3 Class 1
12	SIM Interference	Support SIM card 1.8V, 3.3V
13	External Antenna	Antenna Pad
14	Audio Feature	Half Rate, Full Rate, Enhanced Full Rate, AMR, Echo cancelation and Noise suppression
15	Phonebook Management	Support phonebook types: SM, FD, LD, RC, ON, MC
16	SIM Application Toolkit	GSM 11.14 Release 99
17	Real Time Clock	Support RTC
18	Physical Characteristics	Size: 33*33*3 mm Weight: 6.2 g

3.3.7 RELAYS

Introduction and Working

Relays are used for automatic switching purpose. A circuit can be opened and closed using relays electromagnetically or electronically. The circuit is controlled by them by opening and closing contacts in another circuit. When contacts of relay are open than relay is not energize and act as open and normally closed with its contact closed. The applied current state will be changed in both case.

Generally, relays are used in the switching of smaller circuits and avoids power consuming elements. Nonetheless, relays are able to control high voltages and amperes through amplifying effect as application of small voltage on relay coil can be changed larger voltage that is switched by relay's contact.

Introduction to Songle Relays

A songle relay has three high voltage terminals. The terminals are shown in Fig 3.8a. There is NC, C and NO terminals which connect to the device that is to be controlled. The opposite side has three low voltage pins. These are Ground, Vcc, and Signal that is to be connected to the Arduino.

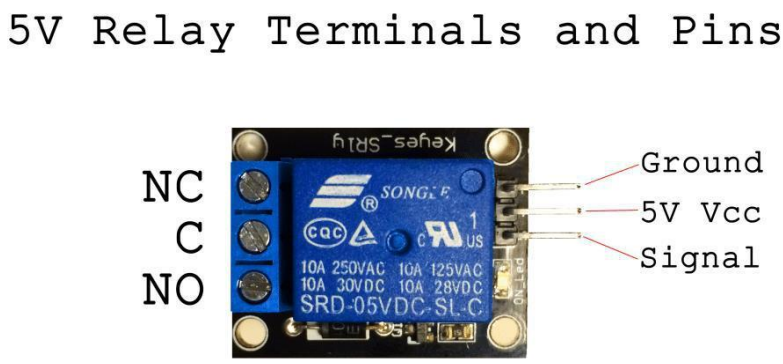


Fig. 3.8a. Ports of songle relay

A 120-240 switch is inside the relay that is connected by electromagnet. The electromagnet becomes charged as the relay is received with a high input signal at signal pin and as a result the contacts of switch open or close.

Normally Open Vs Normally Closed

Two types of electrical contacts exist in relay. First is NO and second is NC. And the use of them depends upon whether 5V is to be turned on or off. Common terminal is used for entering supply current in either configuration.

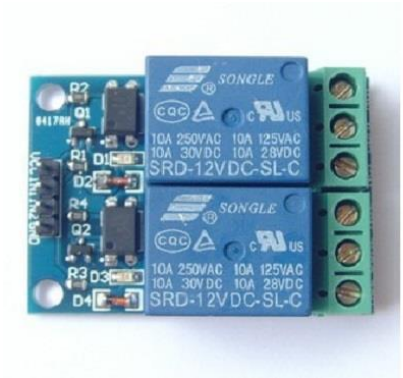


Fig. 3.8b. Songle relays
Fig. 3.8d. Normally close case of realys

3.3.8 LCD JHD629-204A

Introduction

LCD's are used to display any data on the screen of the device. In electrical engineering, it is used to show recorded values of any system so that user will easily get the information about the process going on.

There are many types of LCD's available. The different sizes of LCD's are available in the market, like 16*2 and 20*4 etc. The 204-a LCD's are a good choice in any engineering project.

Fig. 3.9 Jhd-204a LCD

JHD629-204a Pin Configuration

The LCD used in this project is JHD629-204a. It is of Jhd-204a family. Its dimensions are 20*4. The display color is yellowish green. It has a total of 16 pins. The ports description is demonstrated in Fig. 3.10.

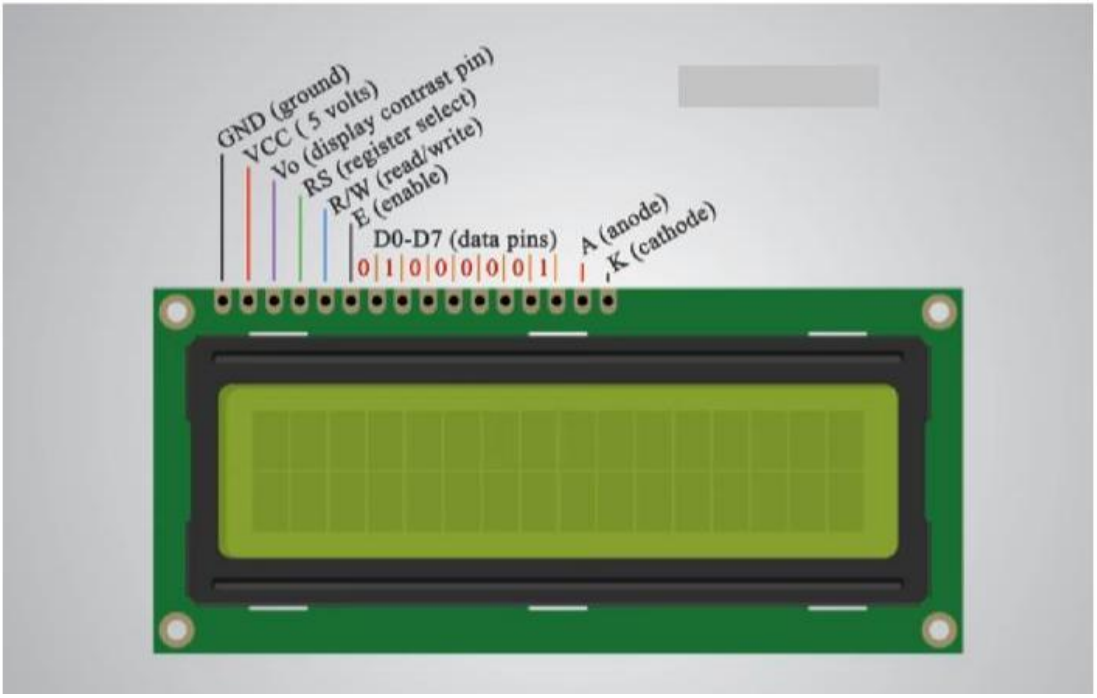


Fig. 3.10 Ports description of 204a LCD

3.3.9 DUAL MOTOR CONTROLLER

Introduction

The high power DC Dual-Motor Controller is adaptable and planned to flawlessly blend self-directed and human control of small and medium-sized robots. It can control two motors via two independent control interfaces. Operation voltage of this module is 4.8 - 46V. Its maximum power dissipation value is 25W and drive type of this module is dual high-power H-bridge driver.

Fig. 3.11 Dual motor controller

3.4 COMPONENTS INTERFACING

In this section, the connections between all components of this project are being discussed. This will help readers to understand the assembly of the project.

3.4.1 Introduction

Interfacing basically means communication or interaction. In engineering, interfacing can be defined as, designing computer hardware or software to communicate between devices and devices, devices and programs or devices and users. In any engineering project, the connections and interfacing are most important part of the design. The automatic nature of our project requires not only components to be connected in an order but its connection with users is also of vital importance. The different components are connected in such a pattern that it gives rise to our desired operations.

3.4.2 Interfacings in the project

The components of this project are connected to each other in a sequence so that we get our desired result at the output. The components connections are explained as follows and all the pins that need to be connected are being thoroughly studied in the previous section.

INTERFACING SENSORS WITH ARDUINO BOARD

The interfacing between all components are important and it is must to make sure that all pins required of components are connected with each other in the way they should be connected together. But the connection of Arduino with the sensors is most important because these two are vital components of this design. Hence firstly, automatic irrigation requires sensors and Arduino. So, the basic communication of this whole project is between sensors and Arduino board. Let's us discuss how they are interfaced with each other.

1. YL-69 Interfacing with Arduino Board

   The four pins of YL-69 as discussed in the components details section connects with their corresponding pins of Arduino board. The GND and Vcc pins of YL-69 connected with the GND and 5V pins of Arduino respectively. For taking the value of soil moisture sensor, digital pin or analog pin of Arduino can be used. Hence,

data pin of YL-69 connected with digital input pin of Arduino. This completes our interfacing between YL-69 and Arduino. Now it can be said that all the information from YL-69 is fed to the Arduino and code inserted in Arduino will decide further operations. This makes the system an organized and controlled process.

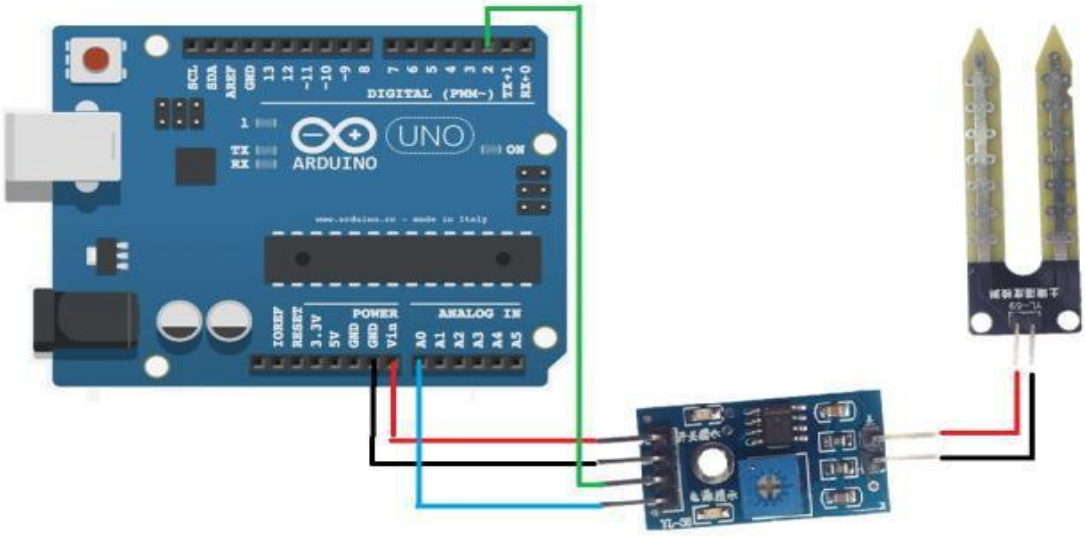


Fig. 3.12 Interfacing of YL-69 with Arduino

2. DHT-11 Interfacing with Arduino

DHT11 has 4 pins as discussed in the components details section. The GND pin of DHT11 connects with GND of Arduino. The Vcc pin of DHT11 connects with 5V pin of Arduino through a 10K resistor. Lastly, the data pin connects with digital pin of Arduino for digital input value of humidity.

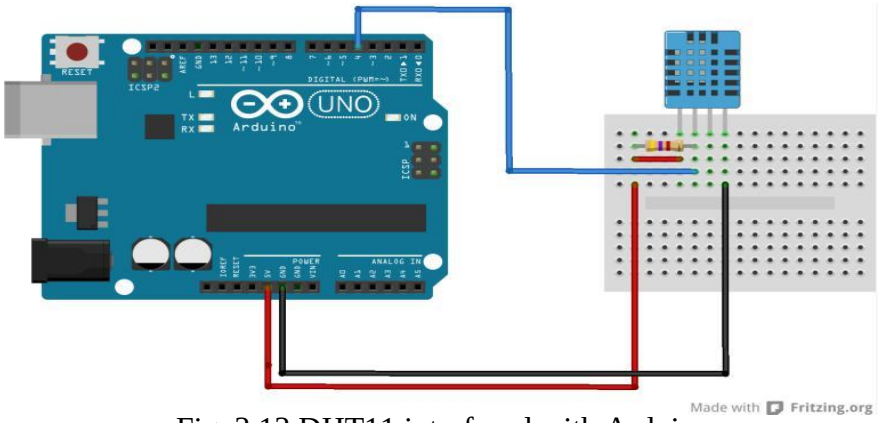


Fig. 3.13 DHT11 interfaced with Arduino

3. LM-35 Interfacing with Arduino

The GND and Vcc pin of LM-35 connects with GND and 5V pin of Arduino board respectively as shown. For temperature value, analog input pin () of Arduino is used. The analog pin connects with data pin of LM-35. This is the interfacing between LM-35 and Arduino.

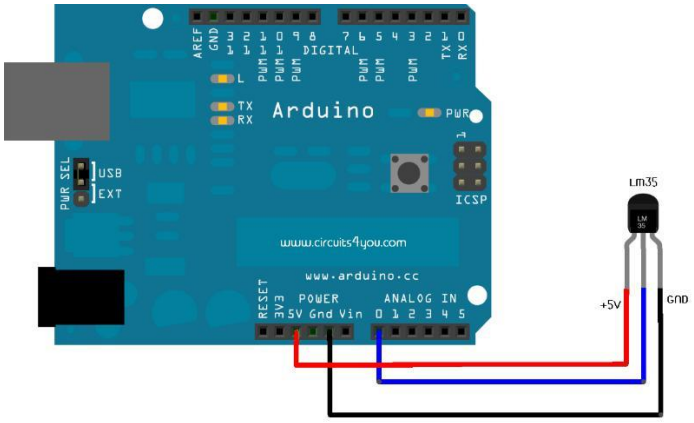


Fig. 3.14 LM-35 interfaced with Arduino

INTERFACING OF GSM WITH ARDUINO BOARD

The GND pins of both Arduino and GSM are connected to each other. The RX and TX pins of Arduino are connected to Tx and Rx of GSM such that Rx of Arduino links with Tx of GSM and Tx of Arduino joins with Rx of GSM.

The following figure shows the basic scheme.

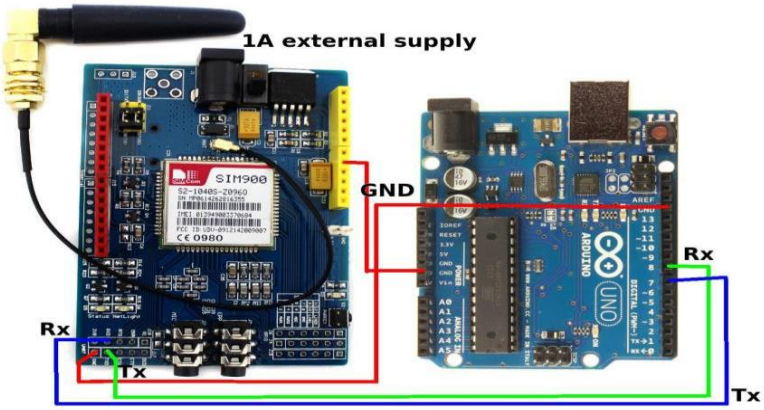
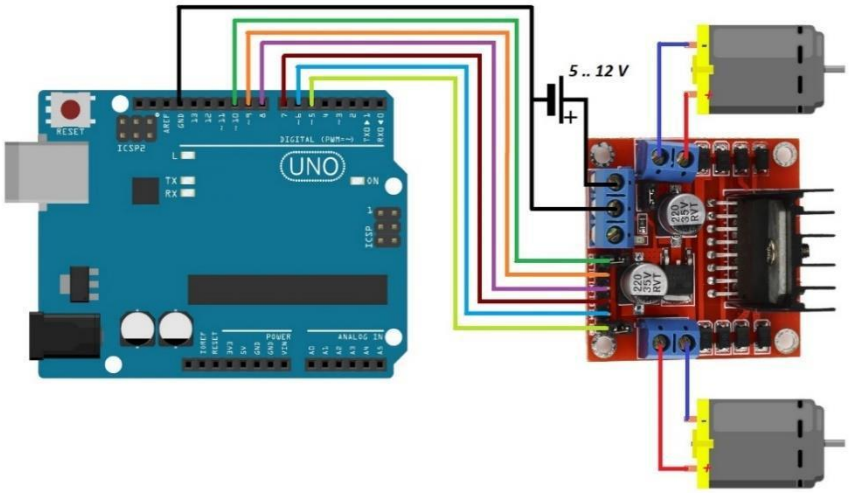


Fig. 3.15 GSM interfaced with Arduino

INTERFACING DUAL MOTOR CONTROLLER WITH ARDUINO BOARD

Arduino board also commands the operation of dual motor controller. The following figure shows the scheme of connection of dual motor controller with Arduino board.

Fig. 3.16 Dual Motor Controller interfaced with Arduino



INTERFACING LCD WITH ARDUINO BOARD

The LCD is responsible for displaying all the operations taking place in the project. Hence, it is also connected with Arduino. The sequence of the connections of LCD ports with Arduino is elaborated in the following figure.

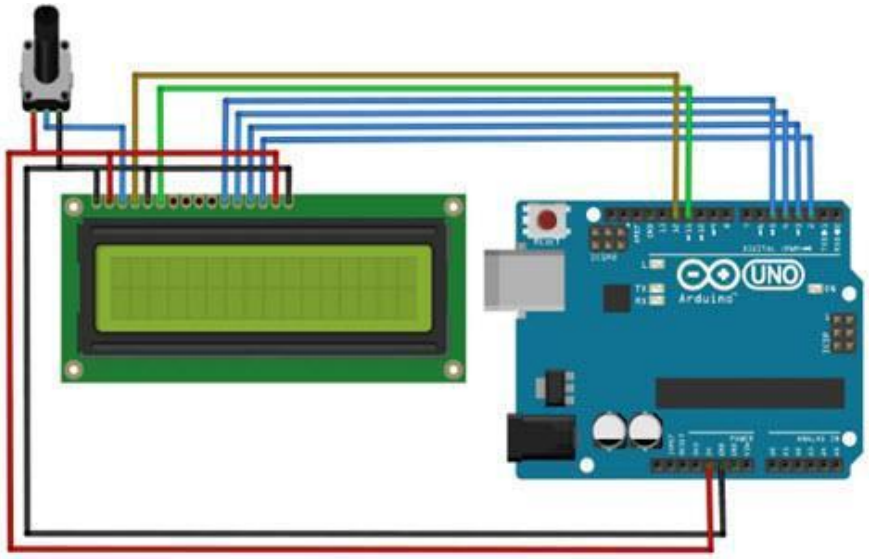


Fig. 3.17 LCD interfaced with Arduino

The important interfacing is between following pins:

Anode and Cathode of LCD with Vcc and GND of Arduino

Enable pin to digital pin 2 of Arduino

RS pin to digital pin 1 of Arduino

Digital Pins of LCD to digital pins of Arduino

3.5 BASIC WORKING

The automaticity of irrigation process is achieved using a variety of sensors. In this system, we have used three kind of sensors. These sensors are being chosen on basis of important parameters upon which process of irrigation depends. The first and most important one is moisture sensor which reads the contents of moisture in soil. We have used YL69 as a soil sensor. These sensors have been immersed in the region of soil where moisture level is to be determined. While immersed in soil, they are also connected back to Arduino board. The information about the water content in soil is read by YL69 and sent to Arduino. Likewise, all the sensors are connected to Arduino. This makes Arduino, the heart of this automatic system.

Humidity Sensor is also used in this system. The purpose of using this sensor is to keep environment as normal as possible. The presence of humidity in the atmosphere can affect the water level of soil. Thus, to have better working of soil moisture sensor it is necessary to use the humidity sensor. The humidity is calculated as percentages. When the humidity level goes above the set value, then the DC fans turn on to eradicate too much humidity and will automatically turn off as soon as the humidity level approaches its lower threshold.

Another sensor used in the design is temperature sensor. This sensor simply measures the temperature of the surrounding and shows the value on LCD. One of the main advantage of this sensor is that it always measures temperature in Celsius so that we don’t have to do further calculations. When the temperature of our concerned area is too high then dual motor connected with green shed will move in one direction so that

our system is covered with green shed (not allowing soil to be affected by heat of sun) and motor will move in other direction in the other case [8].
The working of soil moisture sensor will be optimum when we use humidity and temperature sensor to make the condition as normal as possible for the operation of soil moisture sensor. The DC motors, DC fans and green cover shed are all connected to relays. DC motors are associated with moisture sensor. DC fans are associated with humidity sensor and green shed is with temperature sensor [13].

The GSM module is interfaced with Arduino. The status of every operation taking place in the system is informed to user via SMS. For example, if moisture level of soil plant is below the threshold then the motors will start and at the same time GSM will send a SMS to user about motors starting acknowledgement. GSM is independent from the main system of project which means that if user doesn't get SMS about system's operations due to weak or no signal/network then motors will continue to follow the pattern as directed through code and user will start to get all SMS as soon as the network re-establishes [16].

The power provided to all components of this project is DC. The solar panel stores all the energy in battery connected with it. As soon as the power button is switched on, the DC power is made available to each component. LCD starts to show the current values of temperature, humidity and moisture of soil. The sensors are immersed in soil and hung in air. These sensors continuously measure their concerned parameters i.e humidity for DHT11. The sensors are connected to input ports of Arduino. While the Arduino is interfaced with LCD through proper connections. Hence, all the data form sensors are displayed on LCD and received by user on mobile phone. All the operations will be commanded by Arduino which follows the code inserted into it by user. We have used simple C language in Arduino software coding. The code contains set threshold values which governs starting and stopping of operations. The value read by sensors are brought into Arduino and compared with our set value. If moisture level is below our set value, then Arduino code will send a signal from its output port to relay that automatically switches motors and hence water flow starts from the water tank through pipes and into the dry part of soil. It will keep on following while the sensors

will continue to send moisture values back to Arduino which will keep on comparing it with set values. When our actual moisture value becomes greater than threshold value then the code again sends a signal to relays to switch off the motors and withdraw further flow of water as soil has been moisturized enough [9].

3.6 BLOCK DIAGRAM

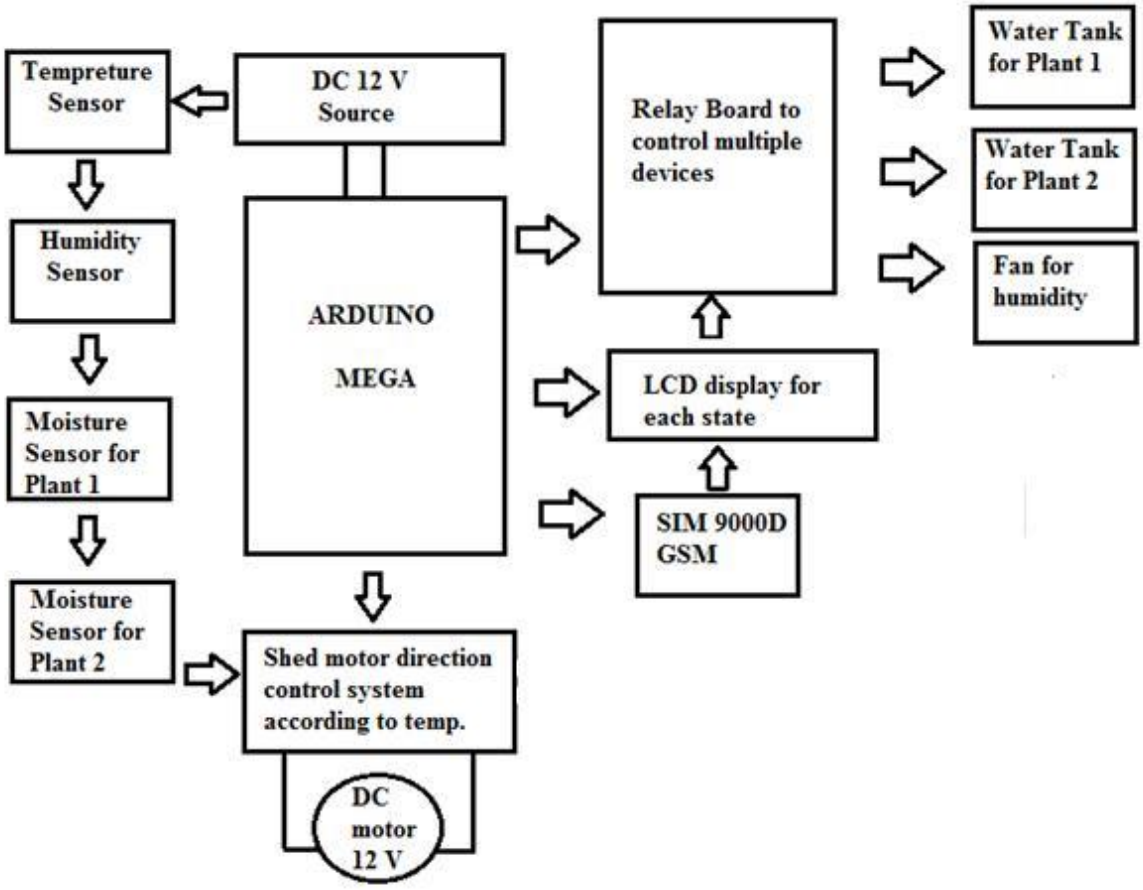


Fig. 3.18 Block diagram of project

The Fig. 3.14 gives the basic block diagram of designed system. The sensors are shown on one side of the figure connected to Arduino board. The components associated with them are connected to the other side of Arduino board. SIM900D can also be seen connected with Arduino board. DC 12V block in Fig 3.14 shows the power attained through solar panels. LCD is connected to Arduino and displays all information about the operations. Two water tanks are used in the project which are associated with soil moisture sensors. The water tank and DC fan are connected to the Arduino through relays because they follow auto switching pattern. The scheme presented in Fig 3.14 reflects the actual scheme used in this project of GSM Based Automatic Irrigation System.

3.7 FLOW CHART

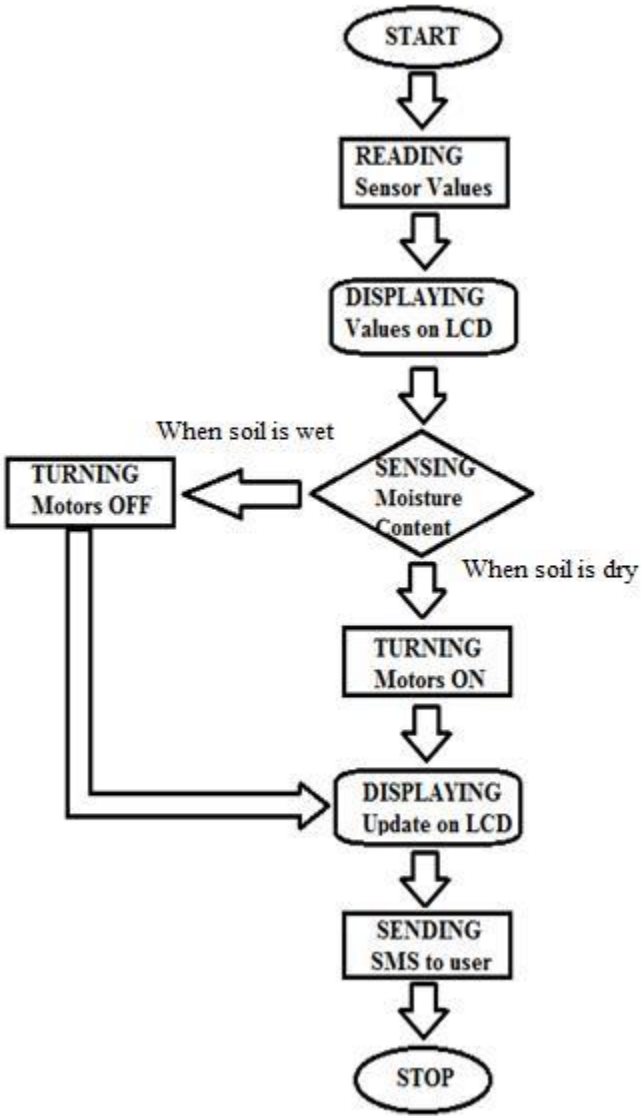


Fig. 3.19 Flow chart of this system

Fig 3.15 shows the sequence of basic processes that this project does. As can be seen from Fig 3.15 system first reads values from the sensors after we turn on the power. The values can be seen on the LCD by user and also sent to the mobile phone through SMS if the network is available in the area of phone. After that, it immediately starts on measuring the contents of soil moisture, temperature and humidity and delivers

values both on LCD’s and phone. If the soil requires water it starts the motors for the flow of water in the soil and stops just after the water content in soil crosses the threshold. The status will be shown on LCD and sent to user on phone.

CHAPTER 4

CONCLUSION AND FUTURE WORK

4.1 ABOUT CHAPTER

This chapter concludes our research and shows the advantages that can be accomplished using the design of irrigation discussed in this report. The further improvements are also addressed that may find more benefits in this project. This chapter also explains the points that must be followed to have a good irrigation system.

4.2 CONCLUSION

By use of automatic means of irrigation system will allow us to preserve the water and avoid its wastage as it was done in manual means of irrigation, moreover making the system more compatible and reliable for irrigation. Provision of water to crops by this way is more effective. By use of solar energy also reduces the problem of excessive load shedding issue. Thus, this method has become the top most edge over all previous methods of irrigation in regards to constancy and usability. This method gives rise to economy growth in Pakistan and also enhances the food production mechanism. By utilization of limited scale resources the system can be able to save sufficient water and energy. This automatic controlled method of irrigation makes production better. Hence, it can be called that this method of irrigation is economically favourable.

This significance of project is realized when different aspects are considered. For starters, presently Pakistan is facing enormous energy crisis. The irrigation process requires water to be fed into fields and for this purpose heavy pumps are needed to flow the water from resources to the main land. The continuous and timely irrigation must be done in order, to have better quality production. But the continuous irrigating of lands is quite a difficult task to accomplish when the supply of electricity is being interrupted from time to time. Secondly, water crisis is also making its mark in the country and under such adverse situation the wastage of water during irrigation would be last thing Pakistan would want right now. Thus, these are the major problems of

irrigation. For energy deficit issue, the use of solar power for irrigation has been suggested in this research and to control the water wastage, an automatic irrigation of lands is presented with comprehensive methodology. This project can be implemented easily everywhere and it uses solar energy and hence economical.

4.3 ADVANTAGES OF THIS SYSTEM

The main advantages of this project are:

- Very easy, simple to frame and construct.
- Provide security and very less manpower.
- This system has reduced excessive work load on the shoulder of farmer and gardener, as only the area between the plants are wet.
- This system has effectively lowered soil attrition and nutrient leaching.
- Water tanks required for this system has become much reduce in size as less than half of the water is required
- Sensors are used to monitor the soil moisture contents, so that moisture can be provided only when there is need.
- Temperature and humidity sensors are used, so that precautionary measures can be taken in harsh conditions.
- GSM is used to deliver the current conditions or data on the mobile phone anywhere in the world

4.4 FUTURE WORK

As this project is resource limited hence many further improvements can be made to increase the efficiency of the project and to increase the productivity of fields.

- By using more sensors in system it can become more adaptable and also increase the accuracy in measuring the water content in soil. For example, rain sensor can be used so that it stops water flow in case of rain.

- Currently this project works on DC power totally, however it can be operated on two way supply system when electricity is available motor operate at AC and in absence of AC it works on DC (Solar energy).
- Camera can be used to monitor the health of the crops or plants. Pictures should be taken after some regular intervals and using GSM delivers to the mobile and hence the health of plants can be monitored.
- Fertilizers can also be provided by using this system. For this purpose, sensors can be used to measure the level of important nutrients in the soil. If any component reduces in the soil, the sensor sends the signal to the Arduino and the deficiency can be removed by suppling the appropriate amount of fertilizer.
- PH of the soil can be measured by using the sensors and appropriate measures can be taken to cover this problem automatically.
- Pesticides can be sprayed automatically when needed.

This project can be improved and enhanced depending on the resources and it can be implemented on every scale from homes to commercial purposes. It can be automatically operated by using different technologies and further improvements can be made on irrigation technologies.

4.5 RECOMMENDATIONS

- **By Hiring True Contractor**

In order to preserve energy, make the system cost effective, installation of solar system judiciously it is important to hire the right contractor.

- **Correct decision to Start**

In order to achieve preserved water irrigation system we require special and well trained designer which definitely will come to supervise, monitor and gives advices on all matters for starting and installing such system in the fields, moreover will be able to help out in suggesting new and latest equipment to meet all requirements.

- **Keeping the system Upgraded and well Maintained**

When using Instable sprinkler systems which will definitely waste the water and will damage the garden it is suggested that keep the head of sprinkles with proper pressure by providing good pressure regulators. Moreover it is necessary to keep well maintenance of the garden/fields and equipment for durability.

- **Checking system every 1-2 years**

For smooth operation of system and keeping it well maintained different analysis and tests should be conducted by certified irrigation auditor, comparing results and making suggestion for changing in the design to keep it upgraded. By employing such changes time to time will also become cost effective and problem solving which occurs due to continuous use of system.

- **By Using Controller naming as "Smart Controller"**

These are named as weather based controller used for irrigation often called it smart controllers which control and lower the use of water by 15 percent. These make fully utilization to maximize the irrigation proficiency by dedicatedly measuring and monitoring the site conditions hence suggesting correct amount of water to the fields basing on the factors.

- **Effective Reutilization of Rain Water for Irrigation**

By storing sufficient amount of rainwater in tanks and in underground cistern, this can be used for automatic means of irrigation system making water preserved.

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APPENDIX

CODE C language

The code is developed on Arduino software and then fed into Arduino Mega 2560 board through USB cable.

CODE:

```
#include "DHT.h"
#include <LiquidCrystal.h>`


//Define Input Pins
#define mstPin = A0;
int sensorPin = A1;   // select the input pin for ldr
int sensorValue = 0;  // variable to store the value coming from the ldr sensor

#define DHTPIN 7
#define DHTTYPE DHT11   // DHT11 Humidity and temperature sensor type

// setting trigger values
#define temLowTrigger 25  //Setting the trigger value for the temperture, once the temperture lower than this trigger value, the heater band will start heating
#define humLowTrigger 45 //Setting the trigger value for the humidity, once the humidity lower than this value, start humidification
#define lgtLowTrigger 5  //Setting the trigger value for the temperture, once the temperture lower than this trigger value, the heater band will start heating
#define mstLowTrigger 300 //Setting the trigger value for the humidity, once the humidity lower than this value, start humidification
//////////////////////////////////////////////////////////
// initialize the library with the numbers of the interface pins
//           lcd(RS,  E, d4, d5, d6, d7)
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
DHT dht(DHTPIN, DHTTYPE);
const char DEGREE_SYMBOL = 167; //167 is the ASCII code for the degree symbol
char display_buffer[20] = "";
```

```
// Array symbol degree
byte level [8] = {B00001100,
 B00010010,
 B00010010,
 B00001100,
 B00000000,
 B00000000,
 B00000000,
 B00000000,
 };
 //

void setup() {

  Serial.begin(9600);
  Serial.println("Temperature and Humidity monitoring with DHT22");
  // set up the LCD's number of columns and rows:
  //lcd.begin(numCols, numRows);

 // Define Pins connected to output relays
  pinMode(8, OUTPUT);
  pinMode(9, OUTPUT);
  pinMode(10, OUTPUT);
  pinMode(13, OUTPUT);

  // Initialize the display and show initial messages
  lcd.begin (16, 2);
  lcd.clear ();
  lcd.setCursor(0, 0);
  lcd.print("  Green House  ");
  lcd.setCursor(0, 1);
  lcd.print("     System     ");
  delay(3000);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Maj. Zeeshan");
```

```
  lcd.setCursor(0, 1);
  lcd.print("Maj. Javed");
  delay(3000);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Capt. Farhat");
  lcd.setCursor(0, 1);
  lcd.print("Capt. Mujtaba");
  delay(3000);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("..Initializing..");
  lcd.setCursor(0, 1);
  lcd.print(".................");
  delay(3000);
}

void loop() {

  lcd.clear ();
  lcd.setCursor (0,0);
  lcd.print ("Temp: ");
  lcd.setCursor (12,0);//18
  // Shows the symbol of the degree
  lcd.print(" \xDF" "C");
  lcd.setCursor (0,1);
  lcd.print ("Hum: ");
  lcd.setCursor (13,1);
  lcd.print ("%");

  Serial.begin (9600);
  Serial.println ("Waiting for data ...");
  // Starts DHT sensor
  dht.begin ();

 // Moisture reading
  float h = dht.readHumidity();
```

```
 // Reading of temperature (Celsius)
 float t = dht.readTemperature();

// Check if the sensor is responding
 if (isnan(t) || isnan(h)) {
   Serial.println("Failed to read from DHT");
 } else {

    // Display the temperature in the serial monitor
    Serial.print ("Temp: ");
    Serial.print (t);
    // Display the temperature in the LCD
    lcd.setCursor (8,0);
    lcd.print (t);
    Serial.write(DEGREE_SYMBOL);
    Serial.print("C" );
    // Show the moisture in the serial monitor
    Serial.print (" Hum: ");
    Serial.print (h);
    Serial.println (" %");
     // Display the humidity in the LCD
    lcd.setCursor (8,1);
    lcd.print (h);

    if(h < humLowTrigger) //if the humidity lower than the trigger value
     digitalWrite(8, LOW); //start humidification
   else
     digitalWrite(8, HIGH);

    if(t > temLowTrigger)
     digitalWrite(9, LOW);//start COOLING
   else
     digitalWrite(9, HIGH);
    delay (3000);
    ////////////////////////////////////////////////////////
 }
 lcd.clear();
```

```
 ////////////////////////////////////////////////////
 ///////**************************************//////
 // Reading light and moisture sensor data!
 int M = analogRead(A0);
sensorValue = analogRead(A1);

 if(sensorValue < lgtLowTrigger) //setting a threshold value
 digitalWrite(10,LOW); //turn relay ON

 else digitalWrite(10,HIGH); //turn relay OFF

 delay(1000);


 sprintf(display_buffer, "Light : %d", sensorValue);
 lcd.setCursor(0,0);
 lcd.print(display_buffer);

 sprintf(display_buffer, "Moist : %d", M);
 lcd.setCursor(0,1);
 lcd.print(display_buffer);

    if(M > 300)
     digitalWrite(13, LOW);
   else
     digitalWrite(13, HIGH);

 // Wait 60 seconds until the next sensor read
 delay(2000);
}
```