

## Microcontroller Based Irrigation System: Beginning of Modern Agricultural Era

---

**Amresh kumar**

ECE-Dept, MVN University, Haryana, India  
[tiwariamresh581@gmail.com](mailto:tiwariamresh581@gmail.com)

### **Abstract-**

*India is a country of land and cultivation, agriculture is in its vein. But due to water scarcity and climate change in a developing country like India, it is almost impossible to see a well prospect in agriculture. Therefore the need of an irrigation system arises which not only take cares of the water problem but also maintains the water level and proper functionality for the crops. This paper consists of the design, implementation and future scope of the automatic microcontroller based irrigation system with moisture sensor. The main aim of this paper is to provide automatic irrigation to plants which helps in saving water, money and labor. This model of irrigation facilities will help millions of people. The model uses sensor technology with microcontroller to make a smart switching device. The model shows the basic switching mechanism of Water motor using sensors from any part of field by sensing the moisture present in the soil.*

Keywords— microcontroller; water pump; atmega16; moisture sensor; irrigation; humidity

### **I. INTRODUCTION**

The increasing demand of the food supplies requires a rapid improvement in food production technology. In many countries where agriculture plays an important part in shaping up the economy and the climatic conditions are isotropic, but still we are not able to make full use of agricultural resources. One of the main reasons is the lack of rains & scarcity of land reservoir water. Extraction of water at regular intervals from earth is reducing the water level as a result of which the zones of un-irrigated land are gradually increasing. Also, the unplanned use of water inadvertently results in

wastage of water. In an automated irrigation system, the most significant advantage is that water is supplied only when the moisture in soil goes below a pre-set threshold value. This saves us a lot of water. In recent times, the farmers have been using irrigation technique through the manual control in which the farmers irrigate the land at regular intervals by turning the water-pump on/off when required. This process sometimes consumes more water and sometimes the water supply to the land is delayed due to which the crops dry out. Water deficiency deteriorates plants growth before visible wilting occurs. In addition to this slowed growth rate, lighter weight fruit follows water deficiency. This problem can be perfectly rectified if we use automated irrigation system in which the irrigation will take place only when there will be intense requirement of water, as suggested by the moisture in the soil.

In the world of advance electronics, life of human beings the world of advance electronics, life of human beings should be simpler hence to make life simpler and should be simpler hence to make life simpler and convenient, we have made AUTOMATIC PLANT IRRIGATION SYSTEM. A model of controlling irrigation facilities to help millions of people. This model uses sensor technology with microcontroller to make a smart switching device. The model shows the basic switching mechanism of Water motor using sensors from any part of field by sensing the moisture present in the soil.

The project is designed to develop an automatic irrigation system which switches the pump motor ON/OFF on sensing the moisture content of the soil. In the field of agriculture, use of proper method of irrigation is important. The advantage of using this method is to reduce human intervention and still ensure proper irrigation.

The continuous increasing demand of the food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains & scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes waste. In the modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drip by drip due to which a large quantity of water is saved. At the present era, the farmers have been using irrigation technique in India through the manual control in which the farmers irrigate the land at the regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which the crops get dried. Water deficiency can be detrimental to plants before visible wilting occurs. Slowed growth rate, lighter weight fruit follows slight water deficiency. This problem can be perfectly rectified if we use automatic micro controller based drip irrigation system in which the irrigation will take place only when there will be intense requirement of water. Irrigation system uses valves to turn irrigation ON and OFF. These valves may be easily automated by using controllers and solenoids. Automating farm or nursery irrigation allows farmers to apply the right amount of water at the right time, regardless of the availability of labor to turn valves on and off. In addition, farmers using automation equipment are able to reduce runoff from over watering saturated soils, avoid irrigating at the wrong time of day, which will improve crop performance by ensuring adequate water and nutrients when needed. Automatic Drip Irrigation is a valuable tool for accurate soil moisture control in highly specialized greenhouse vegetable production and it is a simple, precise method for irrigation. It also helps in time saving, removal of human error in adjusting available soil moisture levels and to

maximize their net profits. The entire automation work can be divided in two sections, first is to study the basic components of irrigation system thoroughly and then to design and implement the control circuitry. So we will first see some of the basic platform of drip irrigation system.

The continuous increasing demand of the food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources. The main reason is the lack of rains & scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes waste. In the modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drip by drip due to which a large quantity of water is saved. At the present era, the farmers have been using irrigation technique in India through the manual control in which the farmers irrigate the land at the regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which the crops get dried. Water deficiency can be detrimental to plants before visible wilting occurs. Slowed growth rate, lighter weight fruit follows slight water deficiency. This problem can be perfectly rectified if we use automatic micro controller based drip irrigation system in which the irrigation will take place only when there will be intense requirement of water.

Irrigation system uses valves to turn irrigation ON and OFF. These valves may be easily automated by using controllers and solenoids. Automating farm or nursery irrigation allows farmers to apply the right amount of water at the right time, regardless of the availability of labor to turn valves on and off. In addition, farmers using automation equipment are able to reduce runoff from over watering saturated soils, avoid irrigating at the wrong time of day, which will

improve crop performance by ensuring adequate water and nutrients when needed. Automatic Drip Irrigation is a valuable tool for accurate soil moisture control in highly specialized greenhouse vegetable production and it is a simple, precise method for irrigation. It also helps in time saving, removal of human error in adjusting available soil moisture levels and to maximize their net profits.

The entire automation work can be divided in two sections, first is to study the basic components of irrigation system thoroughly and then to design and implement the control circuitry. So we will first see some of the basic platform of drip irrigation system.

### **1.1 Definition of Irrigation**

**Irrigation** is the artificial application of water to the soil usually for assisting in growing crops. In crop production it is mainly used in dry areas and in periods of rainfall shortfalls, but also to protect plants against frost.

### **1.2 Types of irrigation:**

- Surface irrigation
- Localized irrigation
- Drip Irrigation
- Sprinkler irrigation

Drip irrigation also known as trickle irrigation or micro irrigation is an irrigation method which minimizes the use of water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters

### **1.3 Concept of Modern Irrigation System:** –

The conventional irrigation methods like overhead sprinklers, flood type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surface is saturated and often stays wet long after irrigation is completed. Such condition promotes infections by leaf mold fungi. The flood type methods consume large amount of water and the area between crop rows remains dry and receives moisture only from incidental rainfall. On the contrary the drip or trickle irrigation is a type of modern irrigation technique that slowly applies small amounts of water to part of plant root

zone. Drip irrigation method is invented by Israelis in 1970s. Water is supplied frequently, often daily to maintain favorable soil moisture condition and prevent moisture stress in the plant with proper use of water resources.



Fig-1

A wetted profile developed in the plant's root zone is as shown in Figure (1). Its shape depends on soil characteristics. Drip irrigation saves water because only the plant's root zone receives moisture. Little water is lost to deep percolation if the proper amount is applied. Drip irrigation is popular because it can increase yields and decrease both water requirements and labor.

Drip irrigation requires about half of the water needed by sprinkler or surface irrigation. Lower operating pressures and flow rates result in reduced energy costs. A higher degree of water control is attainable. Plants can be supplied with more precise amounts of water. Disease and insect damage is reduced because plant foliage stays dry. Operating cost is usually reduced. Federations may continue during the irrigation process because rows between plants remain dry. Fertilizers can be applied through this type of system. This can result in a reduction of fertilizer and fertilizer costs. When compared with overhead sprinkler systems, drip irrigation leads to less soil and wind erosion. Drip irrigation can be applied under a wide range of field conditions. A typical Drip irrigation assembly is shown in figure below.

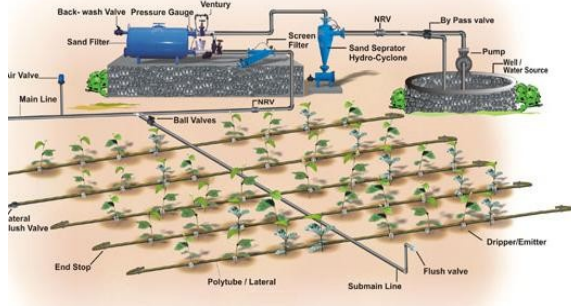


Fig-2

Irrigation is the artificial application of water to the soil usually for assisting in growing crops. In crop production it is mainly used in dry areas and in periods of rainfall shortfalls, but also to protect plants against frost.

Types of irrigation Surface irrigation Localized irrigation Drip Irrigation Sprinkler irrigation Drip irrigation also known as trickle irrigation or micro irrigation is an irrigation method which minimizes the use of water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters.

Concept of Modern Irrigation System The conventional irrigation methods like overhead sprinklers, flood type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surface is saturated and often stays wet long after irrigation is completed. Such condition promotes infections by leaf mould fungi. The flood type methods consume large amount of water and the area between crop rows remains dry and receives moisture only from incidental rainfall. On the contrary the drip or trickle irrigation is a type of modern irrigation technique that slowly applies small amounts of water to part of plant root zone. Drip irrigation method is invented by Israelis in 1970s. Water is supplied frequently, often daily to maintain favorable soil moisture condition and prevent moisture stress in the plant with proper use of water resources.

A wetted profile developed in the plant's root zone. Its shape depends on soil characteristics. Drip irrigation saves water because only the plant's root zone receives moisture. Little water

is lost to deep percolation if the proper amount is applied. Drip irrigation is popular because it can increase yields and decrease both water requirements and labour. Drip irrigation requires about half of the water needed by sprinkler or surface irrigation. Lower operating pressures and flow rates result in reduced energy costs. A higher degree of water control is attainable. Plants can be supplied with more precise amounts of water. Disease and insect damage is reduced because plant foliage stays dry. Operating cost is usually reduced. Federations may continue during the irrigation process because rows between plants remain dry. Fertilizers can be applied through this type of system. This can result in a reduction of fertilizer and fertilizer costs. When compared with overhead sprinkler systems, drip irrigation leads to less soil and wind erosion. Drip irrigation can be applied under a wide range of field conditions.

#### 1.4 AUTOMATED IRRIGATION SYSTEM

There are different types of irrigation system

- Surface irrigation
- Localized irrigation
- Drip Irrigation
- Sprinkler irrigation

The conformist irrigation methods like overhead sprinklers, flood type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surface is soaked and often stays wet long after irrigation is completed. Such condition promotes infections by leaf mold fungi. On the different the drip or trickle irrigation is a type of modern irrigation method that slowly applies less amount of water to part of plant root zone. Water is supplied regularly often daily to preserve constructive soil moisture situation and avoid moisture stress in the plant with proper use of water resources Drip irrigation save water since only the plant's root zone receives moisture. Little water is lost to deep percolation if the proper amount is applied. Drip irrigation is popular because it can increase yields and decrease both water requirements and manual labor Drip irrigation requires about partially of the water needed by

sprinkler or surface irrigation. Lower operating pressures and flow rates result in reduced energy costs. A higher degree of water control is possible. Plants can be supplied with more specific amounts of water. Disease and insect damage is reduced because plant undergrowth stays dry. Operating price is usually reduced. Federations may carry on during the irrigation. The automated irrigation system consists of soil moisture sensors, analog to digital converter, microcontroller, Relay driver, solenoid for control valves.

Design approach of hardware module of Irrigation system Use of AVR Atmega16-L microcontroller which is a low power. The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR. By executing superior instructions in a testing clock cycle, the ATmega16 achieves throughputs future 1 MIPS per MHz allowing the system designed to optimize power consumption against processing speed. The AVR central part combine a rich instruction put with 32 general purpose operational registers. All the 32 registers are directly linked to the Arithmetic Logic Unit (ALU), allowing two self-governing registers to be accessed in one single instruction executed in one clock cycle.

Device is artificial using Atmel's high concentration non volatile memory technology. The On chip ISP Flash permit the program memory to be reprogrammed in-system from side to side an SPI serial interface, by a conformist non volatile memory programmer, or by an On-chip Boot program running on the AVR core. By combining an 8-bit RISC CPU with In System Self-Programmable Flash on a huge chip, the Atmel ATmega16 is a authoritative microcontroller that provides a highly flexible and gainful solution to many embedded control applications. The ATmega16 AVR is supported with a full set of program and system progress tools counting C compilers, macro assemblers, program debugger/simulators, in-circuit emulators, and estimate kits.

## 2. Methodology

We have to consider some key elements while designing a mechanical model. Now we briefly discuss about these key elements.

### 2.1 KEY ELEMENTS

a) **Flow:** you can measure the output of your water supply with a one or five gallon bucket and a stopwatch. Time how long it takes to fill the bucket and use that number to calculate how much water is available per hour. Gallons per minute  $\times 60 =$  number of gallons per hour.

B) **Pressure:** most products operate best between 20 and 40 pounds of pressure. Normal household pressure is 40-50 pounds.

C) **Water supply & quality:** city and well water are easy to filter for drip irrigation systems. Pond, ditch and some well water have special filtering needs. The quality and source of water will dictate the type of filter necessary for your system. .

D) **Soil type and root structure:** the soil type will dictate how a regular drip of water on one spot will spread. Sandy soil requires closer emitter spacing as water percolates vertically at a fast rate and slower horizontally. With a clay soil water tends to spread horizontally, giving a wide distribution pattern. Emitters can be spaced further apart with clay type soil. A loamy type soil will produce a more even percolation dispersion of water. Deep-rooted plants can handle a wider spacing of emitters, while shallow rooted plants are most efficiently watered slowly (low gap emitters) with emitters spaced close together. On clay soil or on a hillside, short cycles repeated frequently work best. On sandy soil, applying water with higher gap emitters lets the water spread out horizontally better than a low gap emitter.

E) **Elevation:** variations in elevation can cause a change in water pressure within the system. Pressure changes by one pound for every 2.3 foot change in elevation. Pressure compensating emitters are designed to work in areas with large changes in elevation.

F) **Timing:** watering in a regular scheduled cycle is essential. On clay soil or hillsides, short cycles repeated frequently work best to prevent runoff, erosion and wasted water. In sandy soils, slow watering using low output emitters is recommended. Timers help prevent the too

dry/too-wet cycles that stress plants and retard their growth. They also allow for watering at optimum times such as early morning or late evening.

G) **Watering needs:** plants with different water needs may require their own watering circuits. For example, orchards that get watered weekly need a different circuit than a garden that gets watered daily. Plants that are drought tolerant will need to be watered differently than plants requiring a lot of water.

## 2.2 COMPONENTS DESCRIPTION

- ATmega16
- Moisture Sensor (Model: Sen92355p)
- LCD
- Operational Amplifier
- 555 Integrated Circuit
- Pump
  
- Power Supply
- Rectifier
- Resistance
- Printed Circuit Board (PCB)

## 3. EXPERIMENTAL DESIGN AND IMPLEMENTATION TECHNIQUE

In this work, the automatic water level monitor here presented consists of the following major units: sensors, comparator circuit, microcontroller, display unit, and the pump and the core work of detecting the level of water is done by the comparator. The diagram below describes the flow of operations in the system as well as their inter-operability (Fig-3).

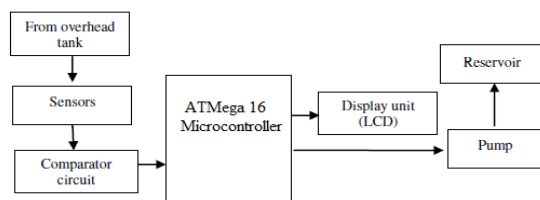


Fig-3

Taking advantage of the electrical conductivity property of water, we used the copper conductors as the water level sensor. When water touches the copper sensor positioned at a particular level in the tank, voltage is transferred to the copper which in turn is transferred to the

comparator circuit for further processing. The comparator was used to compare the inputs from the electrodes in the tank and with a pre-set resistance and output a HIGH or a LOW with respect to the result from the comparison. This HIGH or LOW was fed into the microcontroller which in turn uses this to control the water pump and display the appropriate status on an LCD screen. The programmable Atmega 16 microcontroller was programmed in Assembly Language and was used as the processor to control the functionalities of the entire system. A Liquid Crystal Display (LCD) served as the output unit which showed the status of the system on a screen. Relays were used in building a switching unit that simply triggers the pump on or off, depending on the signal received from the microcontroller. Four I/O ports were used and they have the connection to the microcontroller as illustrated below (Fig.4).

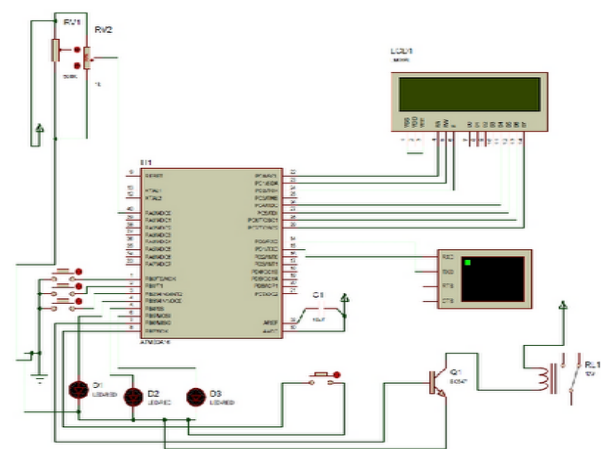


Fig-4

## 4. RESULTS AND DISCUSSIONS

The automatic irrigation system on sensing soil moisture project is intended for the development of an irrigation system that switches submersible pumps on or off by using relays to perform this action on sensing the moisture content of the soil. The main advantage of using this irrigation system is to reduce human interference and ensure proper irrigation. The Microcontroller acts as a major block of the entire project, and a power supply block is used for supplying power of 5V to the whole circuit

with the help of a transformer, a bridge rectifier circuit and a voltage regulator. The ATMEGA16 microcontroller is programmed in such a way that it receives the input signal from the sensing material which consists of a comparator to know the varying conditions of the moisture in the soil. The OP-AMP which is used as comparator acts as an interface between the sensing material and the microcontroller for transferring the moisture conditions of the soil, viz. wetness, dryness, etc.

Once the microcontroller gets the data from the sensing material – it compares the data as programmed in a way, which generates output signals and activates the relays for operating the submersible pump. The sensing arrangement is done with the help of two stiff metallic rods that are inserted into the agricultural field at some distance. The required connections from these metallic rods are interfaced to the control unit for controlling the operations of the pump according to the soil moisture content.

In this design, not all benchmark elements have been fully studied and tested. This was mostly due to time constraints. However the following observations were made:

The installation of the automated irrigation system is very simple. The layout of the system is the most cumbersome step. No technician is required. An installation manual should be provided to the user as well as a chart of the water needs of common houseplants and a list of compatible soil types. The pipe may be included or recommended by the manufacturer. More elaborate work may be required to connect the valve to the water mains.

Water savings have not been studied for the system as a whole. Nevertheless, the performance of the system and of the moisture probe has been demonstrated by previous experiments in real agriculture contexts.

Further testing should be done in real home or greenhouse environment to assess the reliability and durability of the system. All the components were selected to achieve some degree of power efficiency.

Regular maintenance of the irrigation system is not required, except to refill the water tank, to clean the tank, pipes and valves and to replace parts if broken.

When the soil is dry, the sensor output voltage is about 2.85 V which is the input to op-amp. The voltage is amplified in the op-amp and the output of 4.72 V is given to microcontroller. This voltage is enough to drive and turn on the relay. Also, the message “MOTOR ON” is sent to the mobile number of the farmer that is stored in the system. Similarly when the soil is wet, the sensor output voltage is about 29.5 mV which is the input to op-amp. The voltage is amplified in the op-amp and the output of 33.4 mV is given to microcontroller. This voltage is not enough to drive the relay and hence the relay is turned off. Also, the message “MOTOR OFF” is sent to the same mobile number. Table 1 shows the reading obtained from sensor, OP-AMP output and relay condition.

The performance of the system can be further improved in terms of the operating speed, memory capacity, and instruction cycle period of the microcontroller by using other controllers such as AVR and PICs. The number of channels can be increased to interface more number of sensors which is possible by using advanced versions of Microcontrollers. The system can be modified with the use of a data logger and a graphical LCD panel showing the measured sensor data over a period of time. This system can be connected to communication devices such as modems, cellular phones or satellite terminal to enable the remote collection of recorded data or alarming of certain parameters.

#### **4.1. Advantages of the design**

- Relatively simple to design and install.
- This is very useful to all climatic conditions any it is economic friendly.
- This makes increase in productivity and reduces water consumption.
- Here we are micro controllers so there is error free.
- This is safest and no manpower is required. Permit other yard and garden work to continue when irrigation is taking place, as only the immediate plant areas are wet.
- Reduce soil erosion and nutrient leaching.

- May be concealed to maintain the beauty of the landscape, and to reduce vandalism and liability when installed in public areas.
- Require smaller water sources, for example, less than half of the water needed for a sprinkler system.
- Highly sensitive,
- Low cost and reliable circuit.
- Works according to the soil condition.
- Complete elimination of manpower.
- Can handle heavy loads up to 7A.
- System can be switched into manual mode whenever required.

#### 4.2 Disadvantages

- This is only applicable for large size farms.
- Equipment is costlier.
- Require frequent maintenance for efficient operation.
- Have limited life after installation due to the deterioration of the plastic components in a hot, arid climate when exposed to ultraviolet light.
- This is applicable for only large farms.
- Have limited life after installation due to the deterioration of plastic component in a hot, arid climate when exposed to ultraviolet light.

#### 4.3 My Project

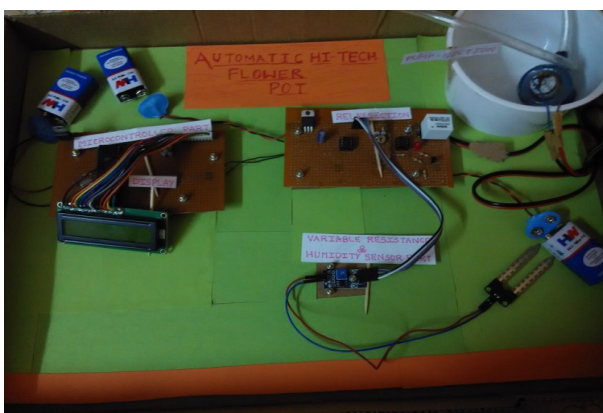


Fig-5

#### 5. CONCLUSION & FUTURE SCOPE

Efficient irrigation management is a major concern in many planting systems. In this project, we presented technology which allowed farmers to maximize their productivity while saving labor. This report shows in detail, the design of the hardware architecture, the software algorithm applied for the field irrigation system. The performance of the whole system proved its high reliability. Efficient scheduling of irrigation gives the highest return for the least amount of water. Potential applications of this system can be extended to environmental monitoring, precision agriculture, and facility automation by little modifications. The value of this technology can be best realized when integrated with agronomic knowledge, using the information gathered in the improvement of decision support systems. Also, improving operations by providing early warning of equipment failure and a predictive maintenance tool, improving energy management, providing automatic record-keeping for regulatory compliance, eliminating personnel training costs or reducing insurance costs. People can also link several such star irrigation networks through adding wireless routers to achieve large-scale remote irrigation application.

The Microcontroller and soil moisture sensor based irrigation system proves to be a real time response control system which monitors and wheel all the activities of irrigation system. The present system is a model to modernize the agriculture industries at a mass scale with optimum expenditure. In this paper, an automated irrigation model is proposed using different circuits as demonstrated in different figures. We designed and implemented this model considering low cost, reliability, alternate source of electric power and automatic control. As the proposed model is automatically controlled it will help the farmers to properly irrigate their fields. The model always ensures the sufficient level of water in the paddy field avoiding the under-irrigation and over-irrigation they can provide irrigation to larger areas of plants with less water spending and inferior pressure. Using this system, one can save manpower, water to get better manufacture and eventually income. Advanced soil moisture



level sensor will use in these we can measure different parameter that is pressure, temperature and humidity, of soil. Different amount of water requirements for different types of soil in this according to the type of crop, and water resistance capacity in different seasons, system provide definite amount of water to the plant hence, we can save large amount of water.

In present days especially farmers are facing major problems in watering their agriculture fields, it's because they have no proper idea about when the power is available so that they can pump water. Even after then they need to wait until the field is properly watered, which makes them to stop doing other activities. Here is an idea which helps not only farmers even for watering the gardens also, which senses the soil moisture and switches the pump automatically when the power is ON.

The performance of the system can be further improved in terms of the operating speed, memory capacity, and instruction cycle period of the microcontroller by using other controllers. The number of channels can be increased to interface more number of sensors which is possible by using advanced versions of Microcontrollers.

The system can be modified with the use of a data logger and a graphical LCD panel showing the measured sensor data over a period of time.

This system can be connected to communication devices such as modems, cellular phones or satellite terminal to enable the remote collection of recorded data or alarming of certain parameters.

The Microcontroller based drip irrigation system proves to be a real time feedback control system which monitors and controls all the activities of drip irrigation system efficiently. The present proposal is a model to modernize the agriculture industries at a mass scale with optimum expenditure. Using this system, one can save manpower, water to improve production and ultimately profit.

The working of project is basically dependent on the output of the humidity sensors. Whenever there is need of excess water in the desired field (RICE crops) then it will not be possible by using sensor technology. For this we will have to adopt the DTMF technology. By using this

we will be able to irrigate the desired field in desired amount.

Efficient irrigation management is a major concern in many planting systems. In this project, we presented technology which allowed farmers to maximize their productivity while saving labor. This report shows in detail, the design of the hardware architecture, the software algorithm applied for the field irrigation system. The performance of the whole system proved its high reliability. Efficient scheduling of irrigation gives the highest return for the least amount of water. Potential applications of this system can be extended to environmental monitoring, precision agriculture, and facility automation by little modifications. The value of this technology can be best realized when integrated with agronomic knowledge, using the information gathered in the improvement of decision support systems. Also, improving operations by providing early warning of equipment failure and a predictive maintenance tool, improving energy management, providing automatic record-keeping for regulatory compliance, eliminating personnel training costs or reducing insurance costs. People can also link several such star irrigation networks through adding wireless routers to achieve large-scale remote irrigation application.

Automatic water pump control system employs the use of different technologies in its design, development, and implementation. The system used microcontroller to automate the process of water pumping in an over-head tank storage system and has the ability to detect the level of water in a tank, switch on/off the pump accordingly and display the status on an LCD screen. This research has successfully provided an improvement on existing water level controllers by its use of calibrated circuit to indicate the water level and use of DC instead of AC power thereby eliminating risk of electrocution.

## **REFERENCES**

- [1.]Article in “pasumai vikatan” regarding soil moisture indicator and water

- management deficiencies in Indian agriculture sector.
- [2.] D. wobschall, "A Frequency Shift Dielectric Soil Moisture Sensor, IEEE Geoscience electronics.
- [3.] "Irrigation Engineering Principles", version 2 CE IIT, kharagpur. Web: <https://decibel.ni.com/content/docs/DOC-31081>
- [4.] <http://ece.gmu.edu/~jkaps/courses/ece511-f11/project/Team6-Report.pdf>
- [5.] <http://www.edgefxkits.com/automatic-irrigation-system-on-sensing-soil-moisture-content>
- [6.] <http://www.dnatechindia.com/Projects/Synopsis-and-Abstract/Automatic-Irrigation-System.html>
- [7.] <http://www.electronicshub.org/automatic-plant-irrigation-system/>
- [8.] <http://www.ijoart.org/docs/Micro-Controller-Based-Automatic-Plant-Irrigation-System.pdf>
- [9.] [www.engineersgarage.com](http://www.engineersgarage.com)
- [10.] <http://www.way2project.com>
- [11.] [www.atmegaavr.com](http://www.atmegaavr.com)
- [12.] M. A. Mazidi, J. G. Mazidi & R. D. Mckinlay, "The 8051 microcontroller and Embedded System", prentice hall.(c) 3, No. 2(2006)
- [13.] Clemens, A.J. 1990. Feedback Control for Surface Irrigation Management *in*: Visions of the Future. ASAE Publication 04-90. American Society of Agricultural Engineers, St. Joseph, Michigan, pp. 255-260.
- [14.] 2. Fang Meier, D.D., Garrote, D.J., Mansion, F. and S.H. Human. 1990. Automated Irrigation Systems Using Plant and Soil Sensors. *In*: Visions of the Future. ASAE Publication 04-90. American Society of Agricultural Engineers, St. Joseph, Michigan, pp. 533-537.
- [15.] Joaquin Gutierrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garraway, and Miguel Ángel Porta- Gándara "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module " IEEE 2013
- [16.] Jia Uddin, S.M. Taslim Reza, Qader Newaz, Jamal Uddin, Touhidul Islam, and Jong-Myon Kim, "Automated Irrigation System Using Solar Power" ©2012 IEEE
- [17.] Thomas J. Jackson, Fellow, IEEE, Michael H. Cosh, Rajat Bindlish, Senior Member, IEEE, Patric J. Starks, David D. Bosch, Mark Seyfried, David C. Goodrich, Mary Susan Moran, Senior Member, IEEE, and Jinyang Du, "Validation of Advanced Microwave Scanning Radiometer Soil Moisture Products", IEEE 2010
- [18.] Andrew J. Skinner and Martin F. Lambert, "An Automatic Soil Pore-Water Salinity Sensor Based on a Wetting-Front Detector" 2010 IEEE

- [19.] Samy Sadeky, Ayoub Al-Hamadiy, Bernd Michaelisy, Usama Sayedz, " An Acoustic Method for Soil Moisture Measurement ", IEEE 2004. Automatic Plant Irrigation System', International Journal of Advancements in Research & Technology, Vol. 2, Iss. 4, ISSN 2278-7763
- [20.] M. Dursun and S. Ozden. A wireless application of drip irrigation automation supported by soil moisture sensors. Scientific Research and Essays, Vol. 6(7):1573 -1582, 2011.
- [21.] Sensors and wireless sensor networks for irrigation management under deficit conditions, International Conference on Agricultural Engineering (AgEng2008), 2008.
- [22.] Intelligent Humidity Sensor for - Wireless Sensor Network Agricultural Application. International Journal of Wireless & Mobile Networks Vol. 3, No. 1, February 2011.
- [23.] AT89C52 Datasheet; Atmel Corporation. Modified May, 2000. [www.microchip.com](http://www.microchip.com).
- [24.] Hicks, F., Tyler, G.; & Edwards, T.W. (1971), 'Pump Application Engineering'. McGraw-Hill Book Company, New York.
- [25.] Khaled Reza, S.M., Shah Ahsanuzzaman Md. Tariq, S.M. Mohsin Reza (2010), 'Microcontroller Based Automated Water Level Sensing and Controlling: Design and Implementation Issue'. Proceedings of the World Congress on Engineering and Computer Science, pp 220- 224.
- [26.] Venkata Naga Rohit Gunturi (2013), 'Micro Controller Based
- [27.] Judy Hodgson, Trey Walters(2002), 'Optimizing Pumping Systems To Minimize First Or Life-Cycle Cost', Proceedings of the 19th international pump users symposium. Pp 1-8.
- [28.] Rojiha, C. (2013), 'Sensor Network Based Automatic Control System for Oil Pumping Unit Management', International Journal of Scientific and Research Publications, Vol. 3, Iss. 3. Pp 1-4.