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Automatic Plant Watering System using Arduino

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ABSTRACT

In day by day activities identified with cultivating or garden watering are the most significant social practice and the most labor-intensive task. No mater whichever climate it is, either hot, dry, cloudy or wet, you need to have the option to control the measure of water that arrives at your plants. Present day watering frameworks could be successfully used to water plants when they need it. However, this manual procedure of watering requires two significant viewpoints to be thought of, when and how much water. So as to supplant manual exercises and make work simpler, automatic plant watering framework is made. It utilizes the innovation to identify the moisture level of the soil and automatically water the plant when there is no moisture recognized in the soil.

Key Words*: Irrigation, Moisture, Arduino, Sensor,*Automatic plant irrigation system, Arduino UNO, moisture sensor.

INTRODUCTION

This Irrigation is the utilization of controlled measures of water to plants at required spans. Water systems assist with developing scenes, and revegetate upset soils in dry regions and during times of not exactly normal precipitation.
Water system likewise has different utilizations in crop creation, including frost security, stifling weed development in grain fields and forestalling soil consolidation. Water system frameworks are likewise utilized for cooling animals, dust concealment, removal of sewage and in mining.

Types of Automated Irrigation Systems

There are a few techniques for water system. They differ in how the water is provided to the plants. The objective is to apply the water to the plants as consistently as could be expected under the circumstances, so each plant has the measure of water it needs neither an excessive amount nor little.

Micro irrigation system:

Water is disseminated under low pressure through a channeled network, in a pre-decided pattern, and provided to each plant with little pressure.

Drip irrigation system:

In this framework, water was given drop by drop to plant roots directly. This technique can be the most waterproficient strategy for water system, if managed properly, evaporation and runoff are minimized. The field water effectiveness of trickle water system is normally in the range of 80 to 90 percent when managed properly.

In current farming, dribble water system is frequently joined with plastic mulch, further limiting evaporation, and is the way of distribution of fertilizer. The procedure is known as fustigation. Deep percolation, where water moves beneath the root zone, can happen if a trickle framework is worked for a really long time or if the conveyance rate is excessively high. Dribble water system strategies run from exceptionally cutting edge and automated to low-tech as well as high-tech operations.

Lower water pressures are generally required than for most different kinds of frameworks, except for low vitality community turn frameworks and surface water system frameworks, and the framework can be intended for consistency all through a field or for exact water conveyance to singular plants in a scene containing a blend of plant animal groups.

Sprinkler irrigation system:

In sprinkler or overhead water system, water is funneled to at least one focal area inside the field and disseminated by overhead high-pressure sprinklers. A framework utilizing sprinklers or splashes mounted overhead on permanently fixed risers is frequently indicated as a strong set water system framework.

Higher weight sprinklers that pivot are called rotors and are driven by a ball drive, gear drive, or control instrument. Rotors can be intended to turn in a full or incomplete circle. Firearms are like rotors, except, actually they works at high weights of 275 to 900 kPa (40 to 130 psi) and streams of 3 to 76 L/s (50 to 1200 US gal/min). guns or firearms are utilized for water system not only for irrigation, but also for few engineering applications like dirt minimization and classification.

Sprinklers can be fixed on moving stages associated with the water source. Naturally moving wheeled frameworks known as moving sprinklers may water regions, for example, little area, sports fields, parks. As the tubing is twisted on the drum controlled by the water system water or a little gas motor, the sprinkler is pulled over the field. At the point when the sprinkler shows up back at the reel the framework stop. This sort of framework is referred to a great many people as a "water reel" voyaging water system sprinkler and they are utilized widely for dust concealment, water system, and land utilization of waste water.

Uses of Irrigation Systems

Saves you water and time:

Both sprinkler and dribble water system frameworks can be set to day by day or week by week watering, just as coordinated for explicit hours during day or night. The framework will likewise consequently close the water off when the water system process is finished. By having a robotized framework to disseminate your water flexibly, you don't need to be physically present for the water framework to be successful. The programmed shut off will downplay your water use, and lower your expenses since less water will be utilized.

Reduces weed development:

By introducing a water system framework explicitly intended for your landscape, just zones that really need water will get it. In this manner constraining your potential weed development precisely. Dribble water system frameworks are especially effective at this: the framework coordinates water explicitly to each plant's underlying foundations, as opposed to sprinkling over the complete land.

Improves plant development:

Plants will rise quicker and greener when watered with littler measures of water over a more extended period, which is actually what water system frameworks are intended to do. Introducing a water system framework will improve your plant development considerably.

Preserves soil supplements:

Watering by hand frequently prompts abundance water saturating the soil. Water overflow saturates the dirt and diverts valuable supplements from your plants. Utilizing a water system framework will save your dirt structure and keep your plants retaining supplements, not the overflow water.

Current Developments

Cautious investigation of all the significant elements like land geography, soil, water, crop and agro-climatic conditions are expected to decide the most reasonable automatic water system framework and segments to be utilized in a particular installation. Table 1 and 2 shows Crops reasonable for Automatic Irrigation System and Response of various harvests to Automated Irrigation System individually

Table. 1: Crops suitable for automatic Irrigation System

SL. NO	Crop Types	Example
1	Orchard Crops	Grapes, Orange, Mango, Lemon etc.
2	Vegetables	Tomato, Chilly, Capsicum, Cabbage, Onion, Pumpkin etc.
3	Cash Crops	Sugarcane, Cotton, Strawberry
4	Flowers	Rose, Carnation, Gerbera, Orchids, Jasmine etc.
5	Plantation	Tea, Rubber, Coffee, Coconut etc.
6	Spices	Turmeric, Cloves, Mint etc,
7	Oil Seed	Sunflower, Oil palm, Groundnut etc.
8	Forest Crops	Teakwood, Bamboo etc.

Table 2: Response of different crops to automatic Irrigation System

Crops	Water saving (%)	Increase in yield (%)
Banana	45	52
Cauliflower	68	70
Chilly	68	28
Cucumber	56	48
Grapes	48	23
Ground nut	40	152
Pomegranate	45	45
Sugarcane	50	99
Sweet lime	61	50
Tomato	42	60

Disadvantages of Irrigation System

1. Cost: There are costs in buying, introducing and maintaining automatic equipment.
2. Reliability: Can the irrigator trust a programmed framework to work accurately without fail? Here and there disappointments will happen. Frequently these disappointments are a result of human mistake in setting and keeping up the frameworks.
3. Increased channel maintenance: There is a need to expand support of channels and tools to guarantee the arrangement works accurately. Channels ought to be fenced to shield the programmed units from stock damage.

LITERATURE SURVEY

Jiachun et al., proposed a paper titled “A Handhelding Testing System for Irrigation System Management”[4]. This paper is based mainly on L8051F microcontroller and rtx51tny operating system. Here, they are using hand-held irrigation detection device to develop the needs of the saving water irrigation for the crops planted near karst slope area. This area has quick changes and tremendous differences of the regional climate. This device has several advantages such as simple operation, easy to carry up, less cost, wireless control and so on. By utilizing this device, the complications can be integrated between manual control and automatic control. Handheld device is the mobile device which is held using hands and in normal because of the portability, simple operation and less power usage widely used in testing, automation control industry such as TV remote controllers, Air Conditioners etc. Due to the development of the handheld device in irrigation system, it has brought convenient methods for managing personnel to participate or involve in the management of irrigation system. Mainly help in finding out the complement between the human and machine control.

With this specialized system, effective wireless network controls have been leading gradually into the irrigation system. However there are few factors such as regional differences , climate anomalies in karst slope fields that causes the irrigation system not achieving the accurate precision in irrigation , And this system is considered as one of the most leading human participation to analyze conditions of climate and the irrigation properties and prove the intellectual irrigation type in the proper sense.

wrote a paper on “Research of Automatic Monitoring System of Reservoir Based on Embedded System”[5]. The automatic monitoring system of reservoir plays an important role in modernizing of reservoir management. This paper clearly presents the construction of automatic monitoring system of reservoir. This system consists of typically 3 subsystems,

1. Acquisition subsystem
2. Transmission subsystem
3. Data management subsystem

Then, the plan of the data collection terminal is studied, which help in the registering the design of hydrological data collection terminal containing hardware design based on embedded system and software design. The main cause that affects data collection is examined and anti-jamming calculations or measures are undertaken. And then the system structure of data transmission is provided and the transmission is provided and the transmission mechanism of mixed-mode network, in which the elementary channel is wireless mobile communication and the backup channel is wire communication is typically attained. Then eventually the data management subsystem is briefly invited. Therefore the system is demonstrated to be more useful and wellorganized by the application on xueye reservoir. Anti-jamming effect has clearly received by wide-temperate chips used in industry which adopted CMOS low-power structure with very less power usage.

The automatic monitoring system tries to fulfill the data collection, transmission and automatic management. It tries to play major changes in time, efficiency, accuracy and low operation cost. Reservoir water level collection terminals help in installing a platform with altitude of 231.30m in heguanzhuang-huzhai junction in the west side of dam. A large – range of ultrasonic sensor with range of 20meters is installed at the height approximately 231.70m which is actually lesser than the dead storage water level, so therefore it helps in fulfilling the requirement of water level. The main role of role of data management subsystem is to store the data and related data, i.e., to input, delete, modify, store, retrieve, sort and helps in statics. Based on above results ,we can see that system can provide detailed and proper hydrological content in time and help in providing decision – making basic and reliable information for water schedule and technological flood control , which is proven to have social benefits and economic benefits also.

Jiang et al wrote a paper on “Water Saving Irrigation Control System based on STC89C52MCU”[6]. As the purpose is to save water the system uses communication between PC and microcontrollers using controlling valves and switches. To achieve the communication with MCU to control number of sum of system using PC’s serial port is used. As the purpose is to save water the system uses communication between PC and microcontrollers using controlling values and switches. As the machine are of same microcomputer system using STC89C52 chip is to overall structure mechanism. This paper describes, only one MCU and design a set of microcontroller communicates with PC machine. The MCCS [microcomputer control system] consists of microcomputer minimum system power.

The single chip microcomputer chooses STC89C52 as its core chip, has 8LC of programming memory, 512 bytes of bytes of data memory, 8 interrupt sources, 3 counters, a good price ratio, and for faster processing speed crystal oscillator’s frequency choosing around 19.7456MHz. To convert humidity value into digital data can be processed by SCM and system selects TLC1543 as its A/D conversion chip and can be used widely as multi-input channel. There is also usage of simple sound and light alarm, when soil moisture is very high or too low. MCU’s main program design value, receive the single called by pc machine, call the SCM, sends the moisture value tested by this SCM and then receive the irrigation time, then receive the irrigation time, then irrigation starts after moisture level reaches over the setting value alarm rings up and irrigation process finally stops. So thus, system tries to inculcate accurate quantitative and timing irrigation and involve in saving water. And also it is easy to use, cost low, easy to operate, very reliable and propagation takes place easily.

As we know agriculture covers more than two-third of the total freshwater on earth [8]. Due to this, there is a conflict arising between agriculture and other major economic sectors for allocation or in distribution of freshwater. So, to avoid conflicts new irrigation technology has come into existence i.e., RDI or (regulated deficit irrigation). These have a great impact on improving the water usage more efficiently. In this overall review, they have clearly given clarity how RDI can be used and implemented.

Case 1: growth stage – based deficit irrigation
Case 2: partial root- zone irrigation
Case 3: subsurface drip per irrigation

Among these 3 cases, we have partial root-zone irrigation which has gained more importance and have more impact because many field crops and some woody crops try to save water while irrigation up to 20% to 30%. There is a lot of improvement in water usage efficiently with RDI is mainly because of the following reasons. Enhanced guard cell signal transduction network which help in reducing transpiration water loss. Optimized stomatal control which helps in the photosynthesis to transpiration ratio. Decreases evaporative surface areas with partial root- zone irrigation that reduces soil evaporation. Using water efficiently will play a major role in the assessment of plant responses to RDI-which lead to water stress because the result of using RDI in producing yield is to estimate the quantity of irrigation that can be saved or the total yield that can be produced per unit of water supplied.

Deficit irrigation applied or used in partial root-zone deficit irrigation has helped in increasing the yields in many filed crops. Plants which have supply with deficit irrigation at the vegetative stage helped in uplifting the circulation of preanthesis carbon reserved in the vegetation tissues to the grains. Many water- conserving practices have been started to tackle the critical problem of water shortage all over the world. A mild water deficit used at the early growth of plants help in providing large profit to plant growth and also RDI practices can be implemented in real – world but many theoretical and technical problems has to be solved.

As we move towards development, human needs for materialistic resources increases [1]. One such resource is water. It is the most extensively used resource. There is a need to take a step towards saving water by implementing micro-irrigation control system. The objective of microirrigation control system is to supply water for a certain interval of time depending upon distance through which water has to travel through the pipe, type of soil, crop, etc. Implementation of this can help regions that have scarce water and needs immediate assistance with water conservation techniques.

A lot of rainfall happens during one particular season of a year as compared to other seasons [9]. Plants that survive only in highly moist soils might die due to drought. This problem can be solved by irrigation system. Irrigation management decides the amount of water that has to be pumped. Irrigation scheduling determines time and quantity of water.

We have various types of irrigation system, for example, sprinkler and drip irrigation. Drip irrigation concentrates on accurate delivery of water to plants' roots. Sprinkler irrigation system is placed between the plants and it sprinkles water to all the plants around it. To operate sprinkler system determining wetting pattern, application rate and sprinkler drop is necessary. Sprinkler system is of two types: spray type and rotor type.

When the country is walking towards advancement of technology there is a need to modernize agriculture too [11]. Due to increase in farm areas, the old manual practice would requires more laborers. But, implementation of automation that is cost effective, makes farming easy. Irrigation system can be monitored whenever external factors like temperature, humidity, light, etcetera varies. Through this methodology each and every environment factor can be controlled.

- Temperature: This can be controlled by using fan when temperature increases.
- Irrigation: This can be controlled depending on type of soil.
- Water flow: Soil moisture sensor helps in controlling flow of water.

This can be adopted in large land are and amount of water to be pumped can be manually calculated and software can be manipulated accordingly.

If we would like to have minimal water wastage in agricultural land, then it is necessary to focus on software of an irrigation system as well rather than just focusing on its hardware [15]. Effective management of water-saving irrigation system can be done by controlling provision of water to irrigation system.

In order to analyze how much must be provided to a particular agricultural field, one must study the amount of water, a particular type of soil or crop would consume in different seasons and develop a formula to it, apply the same practically. Since each type of soil and crop require different amount of water in different seasons.

This technique helps in providing just enough water to the land and thereby saving water. Also, modernizes agriculture which reduces number of strength, time consumption and work for a farmer.

Proposed Methodology

The circuit below shows a simple automatic plant watering system for automatically watering your gardens, plants, etc. Frequently, we cannot set the time for watering the plants due to which the soil of the plants becomes dry. So, for a proper care, we have to water the plants whenever the soil gets dry.

This circuit contains two probes, which will sense the moisture of the soil and switch on the relay at the specific value of dryness. You can connect any sprinkler system or pump with the relay to switch the circuit on automatically to water the plants. And addition to this is we have used ultrasonic sensor to detect the water level of a tank consist of water which we are using for watering the plant.

Measurement of soil moisture is done by the sensor which forwards the information and parameters regarding the soil moisture to the arduino, which controls the pump. If the level of soil moisture drops below a certain value(here 400 threshold), the arduino sends a high signal to the relay module which then runs the water pump and certain amount of water is delivered to the plant.

Again when soil moisture reaches a certain value (here 800 threshold), the arduino sends a low signal to the relay module which stops the water pump. The water level indication is achieved using ultrasonic sensor. Ultrasonic sensor is placed at the top of the tank and we have set a threshold limit for the same. So, if sensor measures value greater than threshold limit, then it will pass a signal accordingly.

Program is coded in such a way that if the signal is detected from ultrasonic sensor, a command like "Tank is empty" will be displayed on the LCD screen. And if a sensor measures value lower than high limit then it will send command like "Tank is full" which will be also displayed through LCD display. We can also connect buzzer to simply alert us if tank is empty.

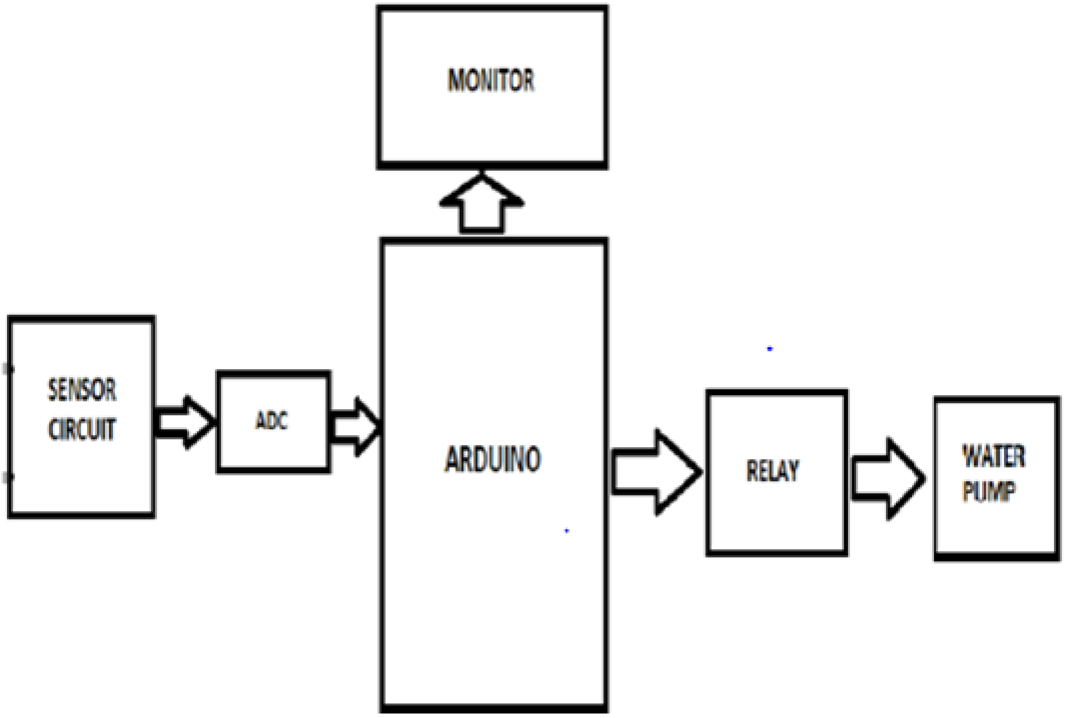

Fig. 1: Proposed Automatic Water Planting System

To complete the project, following schematic diagram is helpful in reaching the specified outcome, which is shown in Fig -2. After uploading the code to Arduino, Open the Arduino IDE serial monitor to see the values. Then, try your sensor in a wet and in a dry soil and see what happens. When the Analog value goes above a certain threshold, pump will turn on (indicates that the plant needs watering) and Tank level, Moist content, Water-pump status as well as Tank-pump status will be displayed on LCD according to the called function in the code. And when the value goes below a certain threshold, pump will turn off (indicates that the plant is ok) and similarly, all the stats will be displayed on LCD according to the called function.

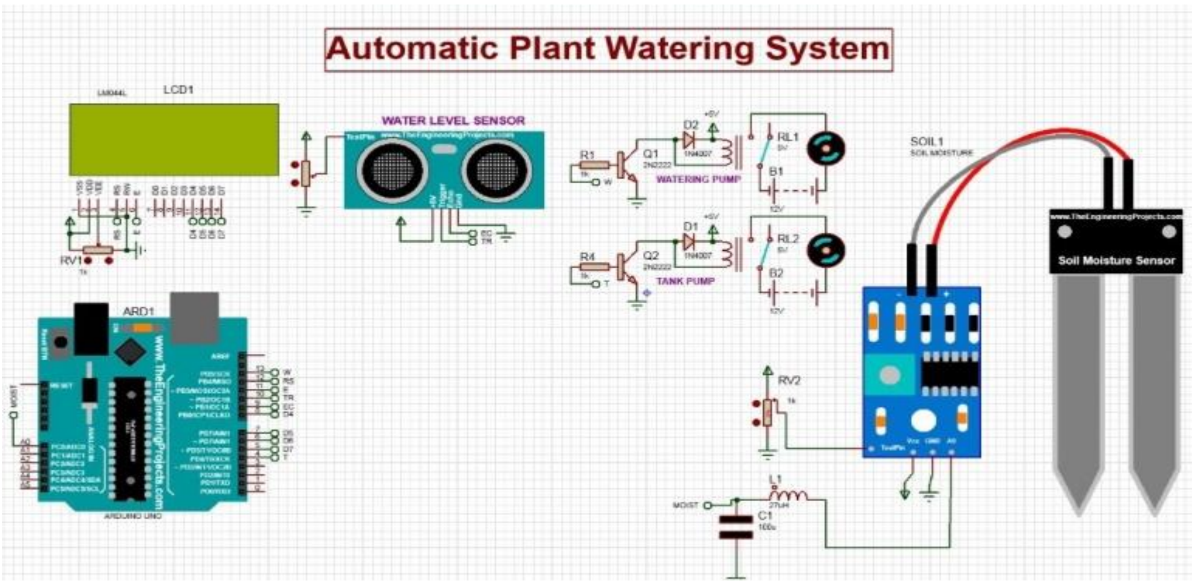

Fig. 2: Schematic Diagram of Proposed Methodology

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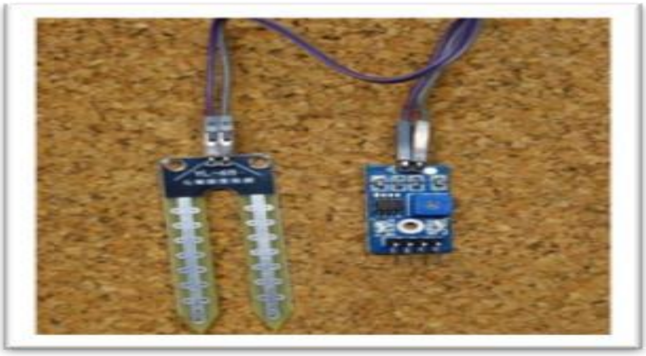

Fig. 3: Soil Moisture Sensor

The soil moisture sensor or the hygrometer is usually used to detect the humidity of the soil. So, it is perfect to build an automatic watering system or to monitor the soil moisture of your plants. The sensor is set up by two pieces: the electronic board (at the right), and the probe with two pads, that detects the water content (at the left). The sensor has a built-in potentiometer for sensitivity adjustment of the digital output (D0), a power LED and a digital output LED, as you can see in the figure-4.

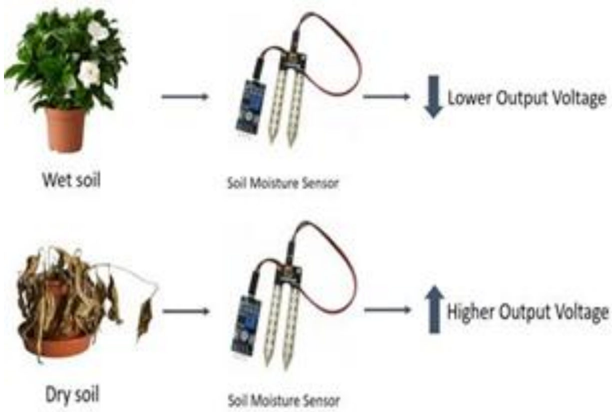

Fig. 4: Working of Moisture Sensor

The output can be a digital signal (D0) LOW or HIGH, depending on the water content. If the soil humidity exceeds a certain predefined threshold value, the modules outputs LOW, otherwise it outputs HIGH. The threshold value for the digital signal can be adjusted using the potentiometer. The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value.

When there is more water, the soil will conduct more electricity which means that there will be less Resistance. The moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower.

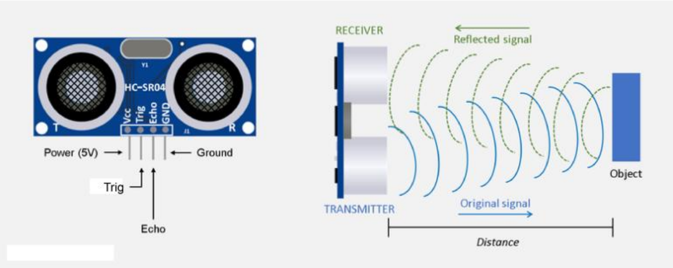

Fig. 5: Ultrasonic Sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation **is D = ½ T x C** (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second).

Fig. 6: 16x2 LCD Display

An LCD (Liquid Crystal Display) screen is an electronic display module and has a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. This LCD has two registers, namely, Command and Data.Command register stores various commands given to the display. Data register stores data to be displayed. The process of controlling the display involves putting the data that form the image of what you want to display into the data registers, then putting instructions in the instruction register. In your arduino project Liquid Crystal Library simplifies this for you so you don't need to know the low-level instructions. Contrast of the display can be adjusted by adjusting the potentiometer to be connected across VEE pin.

CONCLUSIONS

Automated irrigation system optimizes the usage of water by reducing wastage of water. This project can able to contribute towards socio-economic development of the nation. It has fast response and system is user friendly. The primary application of this project is for formers and gardeners who do not have sufficient time to water their crops or plants regularly. This project also covers an application for formers who are wasting water unknowingly during irrigation. The main objective of this smart irrigation system is to make it more innovative, user friendly, time saving and more efficient than the existing system.

Due to the direct transfer of water to the roots, water conservation takes place and also helps to maintain the moisture to soil ratio at the root zone constant to some extent. Thus, the system is efficient and compatible to the changing environment. Hence, this system is very useful as it reduces manual work of the formers and also helps in proper utilization of water and other resources. This project can be extended to greenhouses where manual supervision is less. Fully automated gardens and farm lands can be created using this principle in the right manner on large scale.

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