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Providing Water to the Plants Automatically Using Microcontroller

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Abstract: In current situation, the field of agriculture farmers is facing major problems in watering their crops. It's because they are not aware of about the availability of the power. Even if it is available, they need to pump water and wait until the field is properly watered, which compels them to stop doing other activities which are also important for them, and thus they loss their precious time and efforts. But, there is a solution "An Automatic Plant watering System "not only helps farmers but also others for watering their gardens as well. The aim of the project is to use control engineering principles and concepts to provide a microcontroller based automatic plant watering system. The system will help in saving money and water and at the same time increasing crops production. The automatic plant watering system is controlled using ATmega328 micro controller based on arduino platform. The soil moisture/humidity levels are checked using soil moisture sensor. Whenever there is a change moisture/humidity in the soil the sensor senses change and gives signal to the micro-controller to activate or deactivate watering system.

Keywords: *Automatic watering; Soil moisture; Arduino uno; Sensor; Water pump.*

1. Background

The continuous increase in food demand requires a rapid improvement in food production technologies. Food insecurity is a major challenge in developing countries. Agriculture in Ethiopia is mainly rain fed. Global warming has led to climate changing thus rendering the rain fed agricultural systems unreliable. This has resulted on more land being put under irrigation to meet the food demand for the growing population. In agriculture, one of the most important jobs is to watering the farming land. Most of the farmers use the manual control over the land that is to monitor the pumping or watering the land by visiting the site. This will surely need more and more labor and as a result the efficiency of work may be degraded. An automatic system can be developed to monitor all the controlling operation. Automatic control system reduces the human labor and increase the efficiency of the corresponding work. In this project, an automatic control system is introduced for watering the land by measuring the humidity or in other word the temperature. The system measures the humidity of the soil and depending upon the condition it will provide the needed water in the land. The agriculture technique has been developed day to day all over the world and so the agriculture engineering has been enhanced gradually to serve the world with more integrated and efficient system. It will sense the humidity in a continuous fashion. There is a sensor included in this system which senses the humidity and sends the record to the Microcontroller. The pumps are connected with the system relay circuit. There are two conditions are set in between which the pump will be ON or OFF. When the water supply is needed, Microcontroller sends digital pulse to the system to enable the relay circuit and the water will be supplied till the time the pump will be ON.

2. Statement of the Problem

The majority of the farmers need to travel to the field every time to switch on/off the motor, hence wasting time. To overcome this problem, we designed an automatic plant watering system using arduino microcontroller. With the proposed work, the farmer can save his time by turning on/off the motor automatically.

2.1. Project Objective

The objective of this project is providing water to the plants automaticaly using microcontroller. The objectives of our system can be divided into two categories which are as follows.

General Objective: To develop effective and convenient automatic plant watering system to increase the productivity of crops.

Specific Objectives: The secondary objectives of this study are as follows:

- To develop system that automatically regulates the moisture of the soil.
- To minimize human labor used in irrigation.
- Improve crop quality,
- To provide convenience in accessing the system from anywhere at any time.
- Most importantly conserve water thus saving money.
- The system checks the temperature, humidity.
- To save time of the owner for the large fields.

Project Scope: The scope entails the design as well as implementation of micro controlled plant watering system, depending on the soil moisture content. Humidly/moisture sensor will be the input of the system and an electric water pump will be the output of the microcontroller.

3. Methodology

System Development: For successful completion of this project some steps will be followed to carry out different tasks.

Different literature will be revised relating to this project and data will be collected about automatic plant watering system. Some software's were selected to develop the software programming. All the required materials are not available Arduino software so some sensors like YL-69 SMS were replaced by equivalent materials.

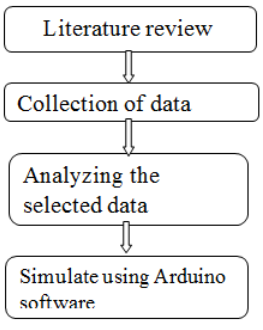

Figure 1.
Methodology of the project.

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System development Tools: The system consists of hardware and software. System development tools are: - motor pump, LCD, LED, relay, Arduino uno, moisture sensor, transistor, power supply, battery and resistor.

Hardware requirement list: The hardware part involves Arduino Uno R3 microcontroller, motor pump, sensors, Relay and power supply.

Software requirement list: The software part is the Arduino Board is programmed using the Arduino IDE software used to interface hardware and proteus 8 professional. The Arduino Based Automatic model atomization the agricultural sector for the development of agriculture will be focused in the following steps:

- Complete layout of the whole setup will be drawn inform of a block diagram.
- Sensor will first sense the condition and give its output to the Arduino microcontroller & displayed on the LCD.
- The soil condition is checked by moisture sensor, depending upon the soil condition & water level, water pump motor is turned on or off.

3.1. Significance of the Project

The increasing world population has led to exponential increase in food demand. This event has necessitated the need for more land to be cultivated. Due to change of weather patterns brought about by global warming, irrigation remains as the only reliable method of crops production.

The systems helps in saving water and thus more land can be brought under irrigation. Crops grown under controlled conditions tend to be healthier and thus give more yields.

3.2. Project Organization

This project report is organized into five chapters:

- Chapter one gives the introduction to the project, the project objectives and the scope.
- Chapter Two is the literature review which describes the system and the components used in the design.
- Chapter Three gives a complete technical aspect of the design.
- Chapter Four analyses and discusses the project.
- Chapter Five gives the conclusion of the whole project, if the objective and scope of the project were achieved. This chapter also includes appendices and the references used.

3.3. Limitation of the Project

Some of the major limitation may be

1. Single moisture sensor only covers the small area of fields.
2. Atmospheric moisture contents also brought some fluctuation in the measure value of soil moisture content.
3. Some chemical reaction erode the sensitivity and physical structure of sensor.

4. Literature Review

4.1. Sensors

A sensor is a device that detects and measures a physical quantity from the environment and converts it into an electronic signal. The physical quantity could be moisture, temperature, motion, light or any other physical phenomenon. Examples of sensors include: oxygen sensors, temperature sensors, infra-red sensors, humidly sensors, soil moisture sensors and motion detection sensors. The output of the sensors is usually charge, current or voltage [1].

4.2. Soil Moisture Sensors

A soil moisture sensor is a device that measures the volumetric water content (VWC) of soil. Mathematically VWC, θ, is given as follows;

$$\Theta = Vw/VT$$

Equation 2-1: mathematical representation of VWC.

Where: Vw is the water volume and VT is the total volume (soil volume + water volume).

Soil moisture sensors are classified according to how they measure the soil moisture content.

4.2. Types of Soil Moisture Sensors

4.2.1. Electrical Resistance Blocks Sensors

These sensors are made up of two electrodes made from a porous substance like sand ceramic mixture or gypsum. The two electrodes are imbedded in the soil during installation [1]. Moisture is allowed to move freely in and out of the sensors electrodes as the soil becomes moist or dries up. The resistance of the electrodes to the flow current is correlated with moisture content. To measure this resistance the electrodes are biased (energized) with a dc voltage and the current flowing through them measured. Applying Ohm's law;

$R = V/I$

Where: R is resistance (Unknown) (Ω)

V is biasing voltage (3.3V to 5.0V)

I is the current flowing through the electrodes (Amps)

When the moisture content in the soil is high more current will be allowed to flow thus indicating low resistance. On the other hand for dry soils the sensor will indicate higher resistance portrayed by the low current reading. This type of sensor is cheap and readily available. Electrical resistance blocks Sensors can also be readily assembled from home using two metal plates or steel nails. Electrical resistance blocks Sensors are mostly used in small projects and gardens due to the following disadvantages;

- They are badly affected by soil PH and salinity thus requiring regular maintenance
- They have low sensitivity.
- The electrodes; especially which provides a constant source of ions; do not dry at the same rate as the soil surrounding it.

Electrical conductivity probe sensors: Electrical conductivity probes employ the same principle as the Electrical resistance blocks Sensors. The one major difference between the two types of sensors is that Electrical conductivity probes sensors have their electrodes/probes in direct contact with the soil [1].

A large volume of water will mean more ions and thus better electric conduction. Electrical conductivity probes sensors takes advantage of this phenomenon [1].

The amount of current passing between the probes is directly proportional to the soil moisture content. Moist soil allow more current to flow between the probes while drier soils only allow a little current to flow between the probes. Better conductivity indicates a lower electrical resistance. Most of the soil moisture sensors currently in the market especially for small projects are Electrical conductivity probes sensors. They have the following advantages.

- They are cheap
- They are readily available

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- Easy to calibrate and install

Dielectric sensors: Dielectric sensors measure the soil water content in the soil by measuring the dielectric permittivity of the soil. A dielectric material is substance that does not conductor electricity, but supports electrostatic fields efficiently. The volume of water in the soil influences the dielectric permittivity of soil [1]. The dielectric of water which is 80.4 is greater than other soil constituents. Therefore change in the amount of water in the soil will directly lead to change in the soil dielectric permittivity.

Dielectric sensors are classified into two types namely: Capacitance sensors and Time Domain Reflectometry (TDR) sensors. These sensors do not measure electrical conductivity while measuring soil moisture [2].

Capacitance sensors: Capacitance sensors use frequency domain reflectometry (FDR).Frequency domain reflectometry is the measure of signal reflections through a medium across frequency. Capacitance sensors contain two electrodes which are separated by a dielectric material.

Time Domain Reflectometry (TDR) sensors: Time Domain Reflectometry uses the principle of waveguides. The actual content of water in the soil is measured under this technology and not the water potential [2]. The TDR device sends signals to the rods inserted in the soil. The time required for an electromagnetic signal to travel along the wave guide is measured. The rate at which the send signal returns is used to measure the water content in the soil. The return rate is dependent on the dielectric properties of the soil. The signal takes longer time in moisture soils and shorter time in dry soil. This pulse signal is then converted into soil moisture measurement [1]. TDR sensors give accurate readings faster and require very little maintenance. The major disadvantage of TDR sensors is that they require different calibrations depending on different soil types.

Heat dissipation sensors: Heat dissipation sensors measure the soil moisture content by measuring the amount of heat dissipated from a medium which is of ceramic kind in most cases. The water contained in the medium spaces is directly proportional to the heat dissipated from the medium [3]. The less the water contained in the medium the less the heat dissipated and more heat is dissipated if the water contained in the medium is high. More heat dissipated leads to lower reading on the sensor and less heat dissipated leads to higher reading on the sensor.

Tensiometer Sensors: Tensiometers sensors measure the soil moisture content in the soil by measuring the moisture tension/suction in the soil. Tensiometers sensors is made up of two major parts; a plastic tube which has a ceramic porous medium at its tip and a vacuum gauge on the opposite end [2].

During installation the ceramic tip is buried in the soil at the calibrated depth which should be as near as possible to the plants root area. The vacuum gauge measures the effort the plants roots have to put to extract water from the soil [1]. This is the measure of the soil measure tension which is measured in centibars. If the soil moisture content is low the roots work harder to extract water from the soil. The reading on the sensor is high. When water is more available in the soil the roots works less and thus lower reading is indicated on the sensor [3].

YL-69 Moisture Sensor: This is an Electrical resistance Sensor. This soil moisture sensor reads the moisture content around it. A current is passed across the electrodes through the soil and the resistance to the current in the soil determines the soil moisture.

Digital potentiometer: A potentiometer is basically a variable resistor. Like analog potentiometers, digital potentiometers are used to scale or adjust resistance of a circuit. Digital potentiometers are also known as a digital pot or digipot. Digipots are used mostly in scaling analog signals to be used in a microcontroller.

Digipot output resistance is variable based on digital inputs and thus also known as resistive digital-to-analog converters (RDACs). Some RDACs come with nonvolatile memory thus provide wiper setting retention after a power ON to OFF cycle. Digipots are available as integrated circuits (ICs).

On the soil moisture sensor the digital potentiometer acts as a low resolution digital to analog convertor (DAC) thus adjusting it varies the sensitivity of the sensor.

LM393 comparator: A compactor is an electronic device that compares two voltages or currents and gives a digital signal as the output. It indicates which of the two compared quantities is large. A comparator has a least two input pins and one output pin. Operational amplifier operating in open loop configuration and without negative feedback can be used as a simple comparator.

4.3. Sensor Selection

When deciding on which sensor to use the following factors should be put into consideration: [1, 3].

Price: This is the most important parameter when selecting any component. The price of the sensor will ultimately affect the price of the whole system as this is one of the major system modules. Sensor with the most competitive price should be chosen.

Power: In any electrical system power efficiency is critical. Moisture sensor will low power consumption should be selected. Sensors which can be battery powered can be used in areas without electricity connection.

Technology: Technology used to design sensor dictate the sensitivity, cost and durability of the sensors. Most low cost sensors have poor sensitivity, rust and corrode over time. Resistive or conductive sensors which are affected by soli salinity thus have a short life.

Shape: Long and slender sensors can be used in many applications than bulky ones.

Durability: Soil moisture sensor which are not affected by soil salinity, corrode or rust should be selected. Soil moisture sensor probes that measure conductivity should be avoided, since they will wear out over time.

Accuracy and Linearity: A quality soil moisture sensor probe should give an output which is proportional to water content over the full output range. In addition, the soil moisture sensor probe should have a good output range to reduce sensitivity to noise.

Voltage Range: Choose a sensor that has a big supply voltage range. Powering a sensor with the wrong voltage will damage the sensor or give inaccurate results.

4.4. Sensor Installation

Sensors orientation and installation depends on the sensor type, size and shape (flat, node, and rod). Installation should be guided by the manufacturer's installation manual. But in general the sensor should be installed as close to the root area as possible [1]. On new fields; the SMS should be installed prior to planting crops. The sensor should be installed at approximately 3 inches deep. For existing fields trenches are dug at uniform intervals and SMS installed Flat sensor probes are commonly found in two types and typically use TDT technology. These are the Exposed wave guides and the Encased wave guides. Both of these sensor types are installed horizontally [2]. Node probes type soil moisture sensors are usually installed vertically around the root area. Granular Matrix technology is typically used in this SMS type. For rod type probes SMSs; the probes are installed inclined at 450 to the ground to allow the probes to the read moisture content from the root zone. TDR technology is typically used in this class of sensors. SMSs should be installed away from structures, tree canopy, construction roads and plant debris.

4.5. Sensor Calibration

As is the case of sensors installation, sensor calibration should also be done in line with the manufacturer's specifications. Different sensors have different calibration procedures. Development stage of the plants root also determines the SMSs calibration [2]. The soil type and crops water requirements greatly influence the sensors calibration.

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4.6. Maintenance

The technology used to design the sensors determines the regularity of maintenance. Electric resistance and conductance sensors tend to corrode with time and thus require regular maintenance and replacement. TDT and TDR sensors are the most stable and durable thus requiring minimum maintenance.

4.7. Microcontroller

A microcontroller consists of peripherals such as RAM, EEPROM, Timers etc., required to perform some predefined task [4]. There are different microcontroller types including: 8051, PIC (Programmable Interface Controller) and AVR. Microcontrollers are used in digital applications as control units [5]. Some microcontrollers come with their in-build circuits like Analog to digital convertors or digital to analog convertors.

Microcontrollers are mostly programmed using assembly language but in recent years high level languages like C, C++ PASCAL and java have been used [6]. High level programming of microcontrollers brings the advantage of not having a different program for each microcontroller manufacturer. High level programming is also neat, easy to document and maintain and user friendly.

4.8. Types of Microcontrollers

8051 Microcontroller: These are among the earlier microcontrollers to be fabricated. Due to superiority in technology in the newer versions, very few companies still fabricate 8051. Earlier 8051 have 12 clocks per instruction whereas the newer versions have 6 clocks per instruction. 8051 microcontroller does not have memory bus and ADC. First 8051 microcontroller to be fabricated with Harvard architecture was done in 1980 by Intel [4].

Programmable Interface Controller (PIC): Programmable Interface Controllers are commonly referred to as PIC. PICs are slightly older than 8051 microcontrollers. PICs are preferred to 8051 because of their small low pin count devices. PICs perform better and are affordable than 8051 [5]. The Microchip technology fabricated the single chip microcontroller PIC with Harvard architecture. The only major downside of PIC is its programming part is very tedious. PICs are hence not recommended for beginners.

AVR:

In 1996, Atmel fabricated this single chip microcontroller with a modified Harvard Architecture. This chip is loaded with C- compiler and a free IDE. Like PIC, AVR microcontrollers are difficult for the beginners to work with. AVR microcontroller has on-chip boot-loader thus AVR can be programmed easily without any external programmer [5]. AVR controllers has number of I/O ports, timers/counters, interrupts, A/D converters, USART, I2C interfaces, PWM channels, on-chip analog comparators [3].

Arduino

Arduino is an open-source electronics design platform. The Arduino board is specially designed for programming and prototyping with Atmel microcontrollers [6]. An arduino interacts with physical world via sensors. Using arduino; electric equipments can be designed to respond to change in physical elements like temperature, humidity, heat or even light [6]. This is the automation process. For example, reading a humidity sensor and turning on and off of an automatic irrigation system. There several types of arduino boards.

The open-source Arduino environment allows one to write code and load it onto the Arduino board's memory. The development environment is written in Java and based on Processing, AVR-GCC, and other open source software [6]. Similarly, AVR-C code can be added directly into the Arduino programs if one so wishes [6].

4.9. Types of Arduino Boards

Legacy Versions: Arduino legacy versions include Arduino NG, Diecimila, and the Duemilanove. These arduinos use ATMEGA168 chips. They require manual selection of either USB or battery power [6]. For Arduino NG one is required to hold the rest button on the board for a few seconds before uploading a program on to it.

Arduino Uno

This is the most common arduino type. This arduino type uses ATmega328 AVR microcontroller.
ATmega328 is more preferred due to the following features:

- Have three 8-bit bi-directional I/O ports with internal pull-up resistors.
- 1K Bytes EEPROM
- 32K Bytes of flash memory.
- 2K Bytes of RAM

Arduino Mega 2560: This is regarded as an advancement of arduino uno. It has more memory than arduino uno. It has a total of 54 input pins of which 16 are analog inputs. It has a larger PCB board than arduino. Overall it is more powerful than arduino uno. This arduino board is based on ATmega2560 [6].

Arduino LilyPad: This arduino board is designed for wearable applications. It is usually sewn on fabric. This board requires the use of a special FTDI-USB TTL serial programming cable. Arduino LilyPad is used to design "smart" wearable [6].

Arduino Mega ADK: This arduino board is specifically designed to interact with android devices.

Automatic switching circuits: In electronics automation many times the designer is confronted by a situation where he/she has to switch very high voltage equipment on, using a low voltage circuit. For example using a 5v dc voltage, it is possible to switch on/off a 230v ac machine [7]. Digital or discrete signals enables as opposed to analog signals are used. There are a number of components used in electronic switching today.

The Triac Switching circuit: The Triac is a two thyristors connected back to back, used for high or medium power control for both a.c and d.c applications. Either of electrodes A2 and A1 can act as anode and either is cathode. The device can be triggered by either positive or negative voltage on the gate with respect to A2. This device is effectively two thyristors (SCR s) back to back in construction with an external n-region which is the gate.

Relay switching circuit: This is an electromagnetic switch which is activated when a current is applied to it. A relay uses small currents to switch huge currents. Most relays use principle of electromagnetism to operate but still other operating principles like solid state are also used [7]. A contactor is a type of relay which can handle a high power required to control an electric motor or other loads directly. Solid state relays have no moving parts and they use semiconductor devices to perform switching.

A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit. Relays are like remote control switches and are used in many applications because of their relative simplicity, long life, and proven high reliability. Relays are used in a wide variety of applications throughout industry, such as in telephone exchanges, digital computers and automation systems.

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Highly sophisticated relays are utilized to protect electric power systems against trouble and power blackouts as well as to regulate and control the generation and distribution of power. Although relays are generally associated with electrical circuitry, there are many other types such as pneumatic and hydraulic. Input may be electrical and output directly mechanical, or vice versa.

4.10. Resistors

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistor is a component that resists the flow of direct or alternating electric circuit. Resistors can limit or divide the current, reduce the voltage, protect an electric circuit, or provide large amounts of heat or light.

4.11. Transistors

A transistor is a semiconductor device used to amplify and switch electronic signals and electrical power. It is composed of semiconductor material with at least three terminals for connection to an external circuit.

5. System Design and Description

5.1. Components of Automatic Plant Watering System

Overall operation of the project: The automatic plant watering system has three major parts; humidity sensing part, control section and the output section. The input to the circuit is applied from the regulated power supply. The a.c. input i.e. 230v from the mains supply is step down by the transformer to 5v and is fed to a rectifier.

Working principle of block Diagram: The power supply provides power to the Arduino, to the LCD and motor pump. There are two functional components in this project. They are the moisture sensors and the motor/water pump. Thus the Arduino Board is programmed using the Arduino IDE software. The motor can be driven by a 10-12 volt power sources. The moisture sensor measures the level of moisture in the soil and sends the signal to the Arduino if watering is required. The motor/water pump supplies water to the plants until the desired moisture level is reached.

5.2. Power Supply

Power supply is the circuit from which we get a desired dc voltage to run the other circuits. The voltage we get from the main line is 230V AC but the other components of our circuit require 5V DC. Hence a step-down transformer is used to get 12V AC which is later converted to 12V DC using a rectifier.

The output of rectifier still contains some ripples even though it is a DC signal due to which it is called as Pulsating DC. To remove the ripples and obtain smoothed DC power filter circuits are used. Power supplies are designed to convert high voltage AC mains to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function. Each of the blocks has its own function as described below:

1. Transformer – steps down high voltage AC mains to low voltage AC.
2. Rectifier – converts AC to DC, but the DC output is varying.
3. Smoothing – smoothes the DC from varying greatly to a small ripple.
4. Regulator – eliminates ripple by setting DC output to a fixed voltage.

Almost all electronics circuit required DC power supply. DC power supply is the circuit which converts the AC wave form of power lines to direct voltage of constant amplitude. An ideal regulated power supply is designed to provide a pre-determined Dc voltage which is independent of the current drown from the source. These circuits are special class of feedback amplifiers. All the benefits of TCs' are thus obtained: excellent performance small size, ease of use, low cost, and high reliability .unregulated power supply has many disadvantages due to which it is not sufficient for many application.

- Poor regulation
- Dc output voltage varies with the AC input
- DC output voltage variation varies with temperature because of semiconductor use to overcome the above disadvantages.

A 5V-dc power requirement will be used as input supply to the system. The choice of using a transformer is due to the low voltage requirement of the system. A transformer of 240/12V in conjunction with a regulator will be able to provide the needed input 5Vdc. This means that the RMS value of the transformer secondary is Vrms = 12Vac. The whole section of the project is powered from a 5V dc power source. To achieve this 5-volt output, a variable output adapter is used. The adapter takes in 240Vac and gives out from its variable tapped output V dc, 4.5Vdc, 9Vdc, 12Vdc; the output to the required 5Vdc, the output of the adapter is passed through the regulator that makes sure that at any point in time, the output it gives is 5V. For convenience, we tap the output of the adapter and hence the input to the regulator at 6Vdc.

5.3. Bridge Rectifier

A rectifier is a circuit that converts AC signals to DC. A rectifier circuit is made using diodes. There are two types of rectifier circuits as Half-wave rectifier and Full-wave rectifier depending Upon the DC signal generated. Here Full-wave bridge rectifier is used to generate dc signal.

A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

Smoothing: Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as reservoir, supplying current to the output when the varying DC voltage from the rectifier is decreasing. The diagram shows the unsmoothed varying DC and the smoothed DC. The capacitor charges quickly to the peak of the varying DC and then discharges as it supplies current to the output.

Working Principle: First the system starts and select humidity mode then,

- If the moisture value less than the desired value, the motor will pump water.
- If the moisture value greater than the desired value, the motor will stop pumping water.

6. Hardware Design

6.1. Control Unit

ATMega328 microcontroller on arduino platform: Arduino uno is the most common arduino type. This arduino type uses ATmega328 AVR microcontroller.

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The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

GND: short for 'Ground'. This ground pin on the Arduino can be used to ground our circuit.

5V&3.3V: the 5v pin supplies 5volts of power and the 3.3v pin supplies 3.3 volts of power.

Analog: The area of pins under the 'Analog in' label (A0 through A5 on the UNO) is analog in pins. These pins can read the signal form analog sensors (like a temperature sensor) and convert it into a digital value that we can read.

Digital: Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input (like telling if button is pushed) and digital output (like powering an LED).

PWM: Some of the digital pins (3, 5, 6,9,10 and 11 on the UNO). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM). These pins as being able to simulate analog output (like fading an LED in and out). PWM signal is needed for the buzzer to generate sound.

AREF: Stand for Analog Reference. Most of the time we can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 volts) as the upper limit for the analog input pins.

TX RX LEDs: TX is short for transmit, RX short for receive. These marking appear quite a bit in electronics to indicate the pins responsible for serial communication. In our case, there are two places on the Arduino UNO where TX and RX appear-once by digital pins 0 and 1, and a second time next to the TX and RX indicator LEDs. These LEDs will give as some nice visual indication s whenever or Arduino is receiving or transmitting data (like when we are loading a new program on to the board).

ATMega328 microcontroller on arduino platform was selected the control unit of the microcontroller. Arduino Uno was selected from the expansive arduino family. Arduino Uno has a total of 20 inputs pins of which 14 are digital and 6 are analog inputs. The digital pins can be used as either inputs or outputs and also 6 of the 14 pins can be utilized as PMW. The board has a 16 MHz ceramic resonator, a USB connection and a power jack.

In the design of the system analog pins were selected as the arduino input and digital pin was selected as the arduino output pins.

The pins on the arduino were selected as shown below.

Table 3.
Selected pins on Arduino.

Pin	Connections
Analog Pin 1	Connection to soil moisture sensor
Analog Pin 2	Connection to battery 1.5v
Digital pin 2	LCD D7 pin
Digital pin 3	LCD D6 pin
Digital pin 4	LCD D5 pin
Digital pin 5	LCD D4 pin
Digital pin 8	LED-RED
Digital pin 9	LED-GREEN
Digital pin 10	LED-YELLOW
Digital pin 11	LCD Enable
Digital pin 12	LCD RS pin
Digital pin 13	Connection to water pump
VCC	5VDC
GND	Ground

7. Sensing Unit

7.1. YL-69 Soil Moisture Sensor Connection to Arduino

YL-69 soil moisture sensor was interfaced to the arduino through a digital a PCB drive. The PCB drive has a digital potentiometer and a LM393 comparator. The LM393 comparator is used to compare the voltages across the sensor probes and the set Vcc voltage. The dig pot is used to alter the sensitivity of the sensor when connected in digital mode.

7.2. Light Emitting Diode (LED)

A light-emitting diode (LED) is a semiconductor light source which is used as indicator lamps in many devices and is increasingly used for other lighting purposes. The color of the light (corresponding to the energy of the photon) which is determined by the energy gap of the semiconductor pattern. LEDs are cheap and faster switching.This stage of the system consist light emitting diodes (LEDs) that display when executing the operation. Each phase consists of three patterns of LEDs.

7.3. Principle Operation of Light Emitting Diode

Light emitting diode (LED) is a semiconductor device that operates in forward bias. It consists of two pins, the long pin which is positive and the short one which is negative.

7.4. Benefits of LED

- Low power requirement: most types can be operated with battery power supplies.
- High efficiency

Long life: when properly installed, an LED function for decades.

The three LEDs were connected to the microcontroller

Water pump connection to the Arduino: The water pump is used to artificially supply water for a particular task. It can be electronically controlled by interfacing it to a microcontroller. It can be triggered ON/OFF by sending signals as required. The process of artificially supplying water is known as pumping.

To implement the final bit of the automated irrigation system an electric motor (240VAC) was selected as the water pump. The first two units of the system i.e. sensing unit and the control unit (microcontroller) are powered by 12VDC. To interface the two units a 12VDC relay was used as the isolation unit. The microcontroller was connected to the relay via an NPN transistor (2N2222). To protect the transistor; while turning it on, a resistor was used. The resistor limits the current flowing through the transistor.

7.5. Working Principles of RELAY

All relays contain a sensing unit, the electric coil, which is powered by AC or DC current. When the applied current or voltage exceeds a threshold value, the coil activates the armature, which operates either to close the open contacts or to open the closed contacts. When a power is supplied to the coil, it generates a magnetic force

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that actuates the switch mechanism. The magnetic force is, in effect, relaying the action from one circuit to another. The first circuit is called the control circuit.
There are three basic functions of a relay: On/Off Control, Limit Control and Logic Operation.

- On/Off Control: Example: Air conditioning control, used to limit and control a "high power "load, such as a compressor
- Limit Control: Example: Motor Speed Control, used to disconnect a motor if it runs slower or faster than the desired speed
- Logic Operation: Example: Test Equipment, used to connect the instrument to a number of testing points on the device under test.

To protect the microcontroller from back e.m.f during switching a diode was connected across the relay.

7.6. Liquid Crystal Display (LCD)

Liquid Crystal Display (LCD) screen is an electronic display module. An LCD has a wide range of applications in electronics. The most basic and commonly used LCD in circuits is the 16x2 display. LCDs are commonly preferred in display because they are cheap, easy to program and can display a wide range of characters and animations.

A 16x2 LCD have two display lines each capable of displaying 16 characters. This LCD has Command and Data registers. The command register stores command instructions given to the LCD while the Data register stores the data to be displayed by the LCD.

The voltage needed is preferable 2-20 V A.C. The voltage threshold for watch type LCD display is 1to 2V. It is a16 pin device with 16*2 displays. LCD used to display the state of the motor and the value of relative humidity. When using 8-bit configuration all 8 data pins (DB0-DB7) are used while only 4 data pins (DB4- DB7) are used in a 4-bit configuration.

7.7. Over All Circuit of Automatic Plant Watering System

Working Principle: An automatic plant watering system using microcontroller ATMEGA328P is programmed such that it gives the interrupt signals to the motor via the relay.

Table 3.
LCD Pin configuration.

Pin number	Function	Symbol
1	Ground (0V)	VSS
2	Supply voltage (5V)	VDD
3	Contrast adjustment; through a variable resistor (Potentiometer)	V0
4	Selects command register when low; and data register when high	RS
5	Low to write to the register; High to read from the register	RW
6	Sends data to data pins when a high to low pulse is given	E
7	8-bit data pins	D0
8	8-bit data pins	D1
9	8-bit data pins	D2
10	8-bit data pins	D3
11	8-bit data pins	D4
12	8-bit data pins	D5
13	8-bit data pins	D6
14	8-bit data pins	D7
15	Backlight VCC (5V)	A
16	Backlight Ground (0V)	K

Soil sensor is connected to the Arduino board which senses the moisture content present in the soil. Whenever there is a change in the moisture content of the soil, the sensor senses the change, giving signal to the microcontroller so that the pump (motor) can be activated. This concept can be used for automatic plant watering system. The circuit Diagram works as a sensor the POT meter or variable resistance measures the moisture level depending on the amount of water in soil. When the amount of water in the soil high the conductivity is high and resistivity low vice versa. Depending on this way the moisture sensor measures the amount of Relative Humidity (RH) in the soil. The output of POT connects to analog input pin of Arduino Uno.

8. Results Analysis and Discussions

ATMEGA 328P micro controller is the brain of the project which initiates the Relay and LED signal at a junction. The LED's are automatically on and off by making the corresponding port pin of the microcontroller high. So the sequence of the lights determines the moisture level in the soil. An automatic plant watering system using microcontroller ATMEGA328P is programmed such that it gives the interrupt signals to the motor via the relay. Soil sensor is connected to the Arduino board which senses the moisture content present in the soil. Whenever there is a change in the moisture content of the soil, the sensor senses the change, giving signal to the microcontroller so that the pump (motor) can be activated. This concept can be used for automatic plant watering system. The circuit Diagram works as a sensor the POT meter or variable resistance measures the moisture level depending on the amount of water in soil. When the amount of water in the soil high the conductivity is high and resistivity low vice versa. Depending on this way the moisture sensor measures the amount of Relative Humidity (RH) in the soil. The output of POT connects to analog input pin of Arduino Uno. If the soil or plant needs the water, POT sends the signals to Arduino Uno R3 then the relay become energized. When the relay energized the motor pump start to pump water to plant until the required moisture level is reached. The three LED indicates that RH ranges, RED LED indicates high range of RH, GREEN LED indicates that suitable RH range and YELLOW LED shows that low ranges of RH values. The LCD display RH values in the soil and the motor pump state or condition. There are three results that the system implements.

8.1. Result 1

This is the normal condition meaning the soil moisture is at suitable to the plant. In this condition the motor pumper off and yellow and Green LED indicates this condition. The RH range for this condition is that greater than 70.

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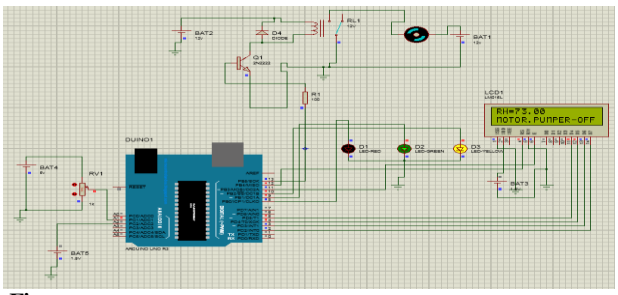

Figure 4.1.
First condition of simulation results.

8.2. Result 2

This is the condition to which pumping activity takes places, meaning the soil moisture is low or the temperature is above the desired point.so the plant needs water. In this condition the motor pump on the water pump until the desired point reached. Green LED indicates this condition.
The RH range for this condition is than 40-69.

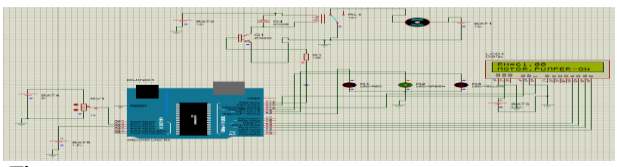

Figure 4.2.
Second Condition of simulation result.

8.3. Result 3

This condition is problem indicator by Red LED. Even if the moisture sensor sends a signal to arduino to pump water but there is no response to signal, in this time the temperature rises above the desired ranges. The Rh range for this condition is that less than 40.

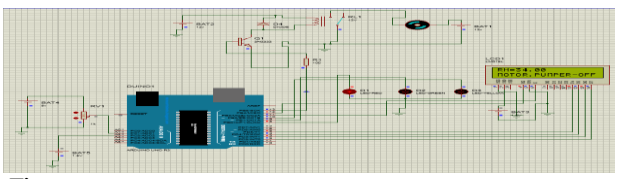

Figure 4.3.
Third Condition of simulation result.

9. Discussion

Now a days, farmers couldn't water their agriculture fields, it's because they have no enough knowledge about when the power is available so that they can pump water .Even after they need to wait until the field is sufficiently watered, which makes them to don't doing other activities. So I represent this work to minimize their sufferings.

10. Conclusion

A system to monitor moisture levels in the soil was designed. The system was used to switch on/off the watering system/pump according to set soil moisture levels. The moisture content of the soil is continuously measured by the sensor. It's value and the status of motor i.e. ON or OFF condition of motor is displayed continuously on the LCD. If there is a enough moisture in the soil i.e. there is no need to irrigate the field then the motor is not switched on but if the moisture content is very less i.e. there is a need of irrigation then the motor is switched on automatically and after the field attains the required moisture content, then the motor is switched off automatically. The control unit the prototype was implemented using a microcontroller on arduino platform while the sensing bit was implemented using a SMS YL-69. Three LEDs and an LCD were used to implement the display of the motor pump state or condition. To switch between the control and the irrigation systems a relay switching circuit was used.

11. Recommendation

The project enhanced in way that controlling automatically the signals depending on relative humidity using moisture sensors. Water pump motor automatic turn off when RH range value at high level because RH value and soil moisture directly relation which helps in power consumption saving. Farther work needed to aware and inform people about the system. This can be done through Data transfer between the microcontroller and computer can also be done through telephone network, data call activated SIM this technique allows the operator to gather the recorded data from a far end to his home computer or phone without going site and also used to GSM technology for fault indication.

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