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IoT based Smart Farming for Live Measuring Sensor and Water Level Controlling System

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***Abstract*: This paper proposes perceptive and intelligent Irrigation system that can be used to control flowering plants watering or irrigation. It controls the irrigation of plants automatically where the need of human intervention can be reduced. This mainly focused on wastage of water, which is a major concern of modern era. It also aids time saving, cost effectiveness, environmental protection, and low maintenance and operating cost and efficient irrigation service. The design of the prototype model in making the system compact and sustainable. The system has sensor which measures the moisture of the soil and switches relay which controls solenoid valve according to the requirement. The model demonstrated gave expected results at the different moisture levels.**

***Keywords*: Sensor, water pump, irrigation.**

1. Introduction

Agricultural sector is one of the trademarks of India's economy. Agriculture plays a crucial role in the country's development. But in today's world, agricultural areas are getting reduced due to laziness of mankind in irrigation. Apart from that irrigation which is of current technology is time consuming and also frivols away large amount of water. India has surplus amount of water resources. This proposes an intelligent, dynamic and automated irrigation system for the agricultural crops. The system concentrates on controlling the irrigation process automatically using the device PIC controller. The automation part the system consists of soil moisture sensors which monitor the moisture content of the soil. The mainly focuses on conservation of water resources through automated system. Once installed, the system was cheaper and easier to use. The major leverage of the system is that the irrigation process can be easily monitored and controlled at anytime, anywhere by anyone having an internet connection.

In the present area one of the greatest problems faced by the world is water scarcity and agriculture being a demanding occupation consumes plenty of water. Therefore, a system is required that uses water judiciously. Smart irrigation systems estimate and measure the reduce of existing plant moisture in order to operate an irrigation system, restoring water as necessary while minimizing the use of excess water. The soil moisture based irrigation control uses Tension metric and volumetric techniques, which are relatively simple but these quantities are related through a soil water characteristic curve that is specific to a soil type. Also the sensors used require routine maintenance for proper performance. Intelligent automatic plant irrigation system concentrates watering plants regularly without human monitoring using a moisture sensor. The circuit is built around a comparator and a timer which drives a relay to switch on a motor. The system uses a hardware component that varies with the conditions of the environment. Real-time wireless smart sensor array for scheduling irrigation prototyped a real-time, smart sensor array for measuring soil moisture and soil temperature that uses off-the-shelf components was developed and evaluated for scheduling irrigation in cotton. This crop- specific system and its use is therefore limited. Proper irrigation scheduling is critical to the efficiency of crop water management, especially under water scarcity conditions. Particularly important are the effects of the amount of irrigation frequency and water use applied. A Proper irrigation scheduling strategy must be in place to improve water efficiency. Agriculture has been the spine of the Indian economy and it will continue to remain for the long time. One-third of our National income comes from farming. The economic improved, started off in the country during the early have put the economy on a higher growth rate trajectory. Sensor-Based irrigation system has been studied in much application. These sensors send real time values to microcontroller and microcontroller send these values to serial communication.

2. Literature review

The agricultural sector is rapidly shifting towards the future of automated and embedded systems with a range of sensors for monitor and controlling growing plants to protect workers, the environment and profits associated with it. The continuous monitoring and controlling of distantly located plants is lab our intensive and technically challenging business. A Wireless Sensor Network (WSN) provides a simple cost effective solution for monitoring and controlling in modern precision agriculture. Temperature and humidity (moisture content in soil) are the basic parameters to be monitored. A smart low cost WSN system for precision agriculture is proposed for monitoring and control using open software and electronic In India, the agriculture sector plays a key role in demand driven economy and contribute to its GDP. The agriculture industry is

drastically changing and there is a need to develop automated systems to monitor and control the growing plants. In agricultural and environmental sciences, it is important to be able to easily monitor filed and gather environmental information over long periods of time, but such monitoring is difficult and requires much effort. Monitoring and controlling the remotely and distantly located growing plants is lab our intensive and technically challenging business. A Wireless Sensor Network (WSN) provides a simple cost effective solution for monitoring and controlling in modern precision agriculture. Employing the WSN would enable the users to monitor and control the environmental parameters influencing the plant growth. The role of WSN is to sense the remote data from the desired location and transmit the same through the wireless network which can be viewed by the receiver. WSN is a collection of various sensors that are deployed at location where the parameters are to be sensed, monitored and controlled. A WSN has the capability to send the correct and accurate information to the observing station. The sensed parameters are transmitted to the observing station through wireless network. If the measured values are above a threshold or critical value an alarm can be generated or process can be actuated which reduces the risk of disaster. The deployment of WSN nodes in agriculture the low cost, low power WSN node is developed to monitor the agriculture farm. The parameters are monitored and sent to the base station using ZIGBEE protocol. The main contribution of this paper is the development of the WSN system to monitor the agriculture farm. Irrigation in agricultural areas through the use of fresh water resources is of the crucial importance. Due to highly increasing demand for freshwater, automation technology and its devices, such as solar power, have provided greater optimal use of water resources irrigation, sensors and remote control. Traditional instrumentation based on discrete and wired solutions, presents many difficulties in measuring and control systems, particularly across large geographical areas. This paper describes a wireless sensor application for low-cost wireless controlled irrigation solution and real time soil water content monitoring. Using solar powered wireless acquisition stations for the purpose of controlling valves for irrigation, data acquisition is carried out. The system designed consists of three units: base station unit (BSU), valve unit (VU) and sensor unit (SU). The obtained irrigation system not only prevents the moisture stress of trees and scarification, but also provides an efficient use of fresh water resource. Furthermore, the method of irrigation development eliminates the need for flood irrigation workmanship. The designed system was applied to an area of 8 declares in a venue located in central Anatolia for controlling drip irrigation of dwarf cherry trees. Agricultural irrigation is of great importance throughout the world in crop production. In Turkey, of the current fresh water is consumed in the agricultural irrigation Therefore,

Efficient water management plays an important role in the irrigated agricultural cropping systems. The demand new water saving techniques for irrigation is rapidly increasing. In order to produce “more crop per drop”, growers in (semi) arid regions currently explore irrigation techniques in the range from using less fresh water It has been seen over the past several decades many irrigation scheduling methods have been developed by wireless sensors. Many of the commercially available sensors, valves and modules assembled for irrigation system networks are too complex and/or expensive to be feasible for site-specific fixed irrigation system management. Producer adoption was limited due to costs, installation time, maintenance, and system complexity. The main aim of the research is to develop and to test an autonomous, low- cost and feedback type controller for site-specific management of solar-powered wireless acquisition stations. Such a system can provide farmers with cost effective monitoring systems. Moreover, this irrigation method can remove work man power that is needed for flooding irrigation. It can also prevent moisture stress of trees and scarification which comes from the main water reservoir.

3. Proposed architecture

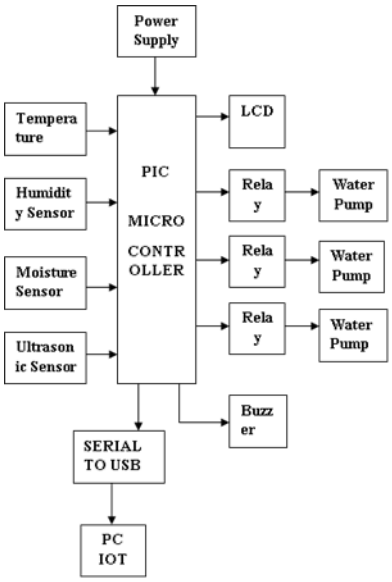

Fig. 1. Block diagram of smart irrigation system

Development procedure of an embedded system for solar based off-grid irrigation system. Solar power is perfect for irrigation systems. This is achieved by using a programmed microcontroller to deliver signal to the motor to rotate the mounted panel as desired. The microcontroller used in this system is from PIC microcontroller. On temperature sensor values, motioning to PIC microcontroller due to motor output produced to the water pump is switched on and off automatically. The plants coming to ultrasonic sensor using distance analysis to microcontroller into alert is buzzer. When temperature level to low, and temperature sensor is sending the signal to microcontroller to start the pump by using stored solar energy. Same time, using IOT technique microcontroller is pc server connected to irrigation monitoring. The proposed system

uses Solar power panel to energies the system and soil moisture sensor to sense the water level for crops.

Constant voltage from boost converter to 12V Battery is stored; 500W inverter is used to convert 12V DC to 230V AC for ac pump. Regulator IC 7805 positive regulator are used to regulate the 12V DC to 5V DC with the help 1000µF and 100µF with current limiting resistor 330Ω. 5V from regulator are used to operate the PIC microcontroller, microcontroller act as a control circuit to control the overall process. It has 40pin IC each pin is connected for respective operation, temperature moisture sensor are dipped in the to sense the distances. Soil humidity value for different crops are selected by 4x4 matrix keypad, programming for crop selection and respective humidity value are programmed in the PIC16F877A microcontroller. Signal from microcontroller to 12V relay are operate to on/off the motor pump. The pump's water flow depends on the PIC microcontroller signal. The PIC microcontroller controls the system. When the temperature sensor sense the low level of the ultrasonic then a signal is send to the microcontroller then the controller check for the condition given in program. In program stored in the microcontroller is different for different crops. The temperature needed to grow the crop is varies from one crop to another. According to the growth of crop water is supplied. The irrigation is automated with temperature sensor and the relay unit. When temperature level is low then a signal send to the relay to switch ON the motor and when the temperature is wet then motor is in OFF condition. Relay gives the ON/OFF condition to the motor.

A. Power supply

Due to economic consideration but for operation of most of the electronic devices and circuits, electrical power is generated, transmitted and distributed almost exclusively in the form of ac, dc supply is required. Dry cells and batteries can be used for this purpose. No doubt, they have the advantages of being portable and ripple free but their voltages are low, they need frequent replacement and are expensive in comparison to conventional dc power supplies. Now day, almost all electronic equipment includes a circuit that converts ac supply into dc supply. The part of the device that converts ac to dc is called the DC power supply. A power transformer is generally available at the input of the power supply. A rectifier (a diode circuit) is followed by a smoothing filter and then a voltage regulator circuit. From the block diagram, the basic power supply is constituted by four elements via transformer, a rectifier, a filter, and a regulator put together. The dc power supply output is used to supply a constant dc voltage throughout the load. Let's outline briefly the function of each of the dc power supply elements. Transformer is used to step-up or step-down the supply voltage as required by the electronic solid-state devices and circuits supplied by the dc power supply. It can provide an important safety consideration from the supply line isolation.

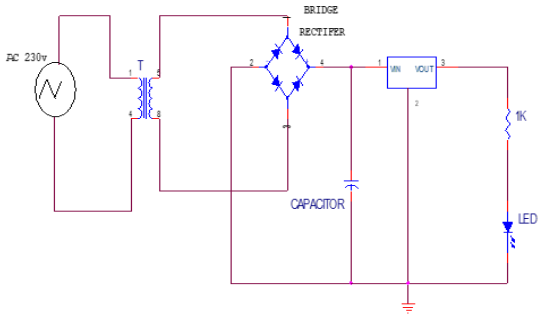

Fig. 2. Power supply circuit

It may also include internal shielding to prevent undesirable electrical noise signal from entering power supply on the power line and potential disturbing the load.

B. Micro controller (PIC16F877A)

The PIC Microcontroller PIC16f877A is one of the most renowned microcontrollers in the industry. this controller is very convenient to use, the coding or programming of this controller is also easier. one of the main advantages is that it can be write-erase as many times as possible because it uses flash memory technology. it has a total number of 40 pins and there are 33 pins for input and output. pic16f877a is used in many pic microcontroller project. pic16f877a also have many applications in digital electronics circuits. pic16f877a finds its applications in a huge number of devices. it is used in remote sensors, security and safety devices, home automation and in many industrial instruments. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. the cost of this controller is low and its handling is also easy. it's flexible and can be used in areas where microcontrollers have never been used before as in coprocessor applications and timer functions etc.

C. Pin configuration and description of PIC16F877A

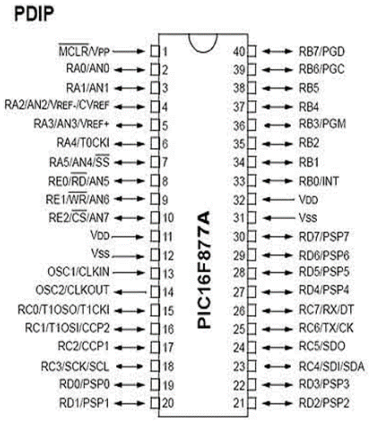

Fig. 3. Pin configuration

PIN 1: MCLR

The first pin is this IC's main clear pin. It resets the microcontroller and is active low, meaning that it should

constantly be given a voltage of 5V and if 0 V are given then the controller is reset. Resetting the controller will return it to the program's first line that was burned into the IC.

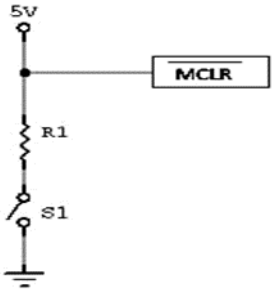

Fig. 4. *PIN 1: MCLR*

The pin is connected to a push button and a resistor. The pin is already being supplied by constant 5V. If we want to reset the IC, all we need to do is press the button that will bring the MCLR pin to 0 potential and reset the controller.

PIN 2: RA0/AN0: PORTA consists of 6 pins, all bidirectional input/output pins from pin2 to pin7. Pin 2 is the port's first pin. This pin can also be used as an analog pin AN0. It is built in analog to digital converter.

PIN 3: RA1/AN1: This can be the analog input 1.

PIN 4: RA2/AN2/Vref: It can also act as the analog input2. Or negative analog reference voltage can be given to it.

PIN 5: RA3/AN3/Vref+: It can act as the analog input 3. Or can act as the analog positive reference voltage.

PIN 6: RA0/T0CKI: To timer0 this pin can act as the clock input pin, the type of output is open drain

PIN 7: RA5/SS/AN4: This can be the analog input 4. The controller also has a synchronous serial port and this pin can be used to select the slave for that port.

PIN 8: RE0/RD/AN5: PORTE starts from pin 8 to pin 10 and this is also a two-way input and output port. It can be the analog input 5 or for parallel slave port it can act as a 'read control' pin which will be active low.

PIN 9: RE1/WR/AN6: It can be the analog input 6. And for the parallel slave port it can act as the 'write control' which will be active low.

PIN 10: RE2/CS/A7: It can be the analog input 7, or for the parallel slave port it can act as the 'control select' which will also be active low just like read and write control pins.

PIN 11 and 32: VDD: These two pins are the positive supply for the input/output and logic pins. Both should be connected to a 5V connection.

PIN 12 and 31: VSS: These pins are the ground reference for input/output and logic pins. They should be connected to 0 potential.

PIN 13: OSC1/CLKIN: This is either the input of the oscillator or the input pin of the external clock.

PIN 14: OSC2/CLKOUT: This is the oscillator output pin. To provide the microcontroller with an external clock, a crystal resonator is connected between pin 13 and 14. ¼ of the frequency of OSC1 is outputted by OSC2 in case of RC mode. This indicates the instruction cycle rate.

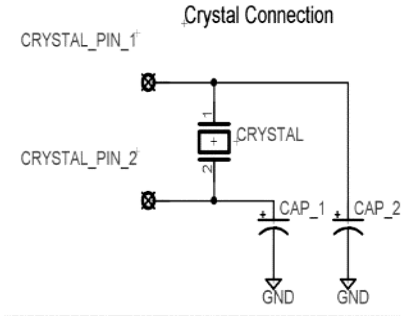

Fig. 5. Crystal connection

PIN 15: RC0/T1OCO/T1CKI: PORTC consists of 8 pins. It is also a bidirectional input output port. Of them, pin 15 is the first. It may be either the timer 1 clock input or the timer 2 oscillator output.

PIN 16: RC1/T1OSI/CCP2: It can be the oscillator input of timer 1 or the capture 2 input/compare 2 outputs/ PWM 2 output.

PIN 17: RC2/CCP1: It can be the capture 1 input/ compare 1 output/ PWM 1 output.

PIN 18: RC3/SCK/SCL: It can be the output for SPI or I2C modes and can be the synchronous serial clock input/output.

PIN 23: RC4/SDI/SDA: Pin SPI data may be used. Or it may be a data input/output pin in I2C mode.

PIN 24: RC5/SDO: It can be the data out of SPI in the SPI mode.

PIN 25: RC6/TX/CK: It can be the synchronous clock or USART Asynchronous transmit pin.

PIN 26: RC7/RX/DT: It may be the pin of synchronous data pin or the received by USART.

PIN 19, 20,21,22,27,28,29,30: All of these pins belong to PORTD, again a bidirectional port for input and output. It can act as the parallel slave port when the microprocessor bus is to be interfaced.

PIN 33-40: PORT B: All these pins belong to PORTB. Out of which RB0 can be used as the external interrupt pin and RB6 and RB7 can be used as in-circuit debugger pins.

We have studied 5 input and output ports namely PORTA, PORTB, PORTC, PORTD and PORTE which can be digital as well as analog. We will configure them according to our requirement. But the pins or ports can only act as inputs in the case of analog mode. In such cases, there is a built-in A to D converter that is used. Cicuits with multiplexers is also used. But in digital mode, there is no restriction. The ports can be configured as input or output. Through programming this is done. For PIC the preferable compiler is micro C pro which can be downloaded from their website. There is a register named as 'TRIS' which controls the direction of ports. Different registers such as TRISA, TRISB etc... are available for different ports.

- If we set a bit of the TRIS register to 0, the corresponding port bit will act as the digital output.
- If the TRIS register is set to 1, the corresponding port bit will act as the digital input.

D. Temperature sensor

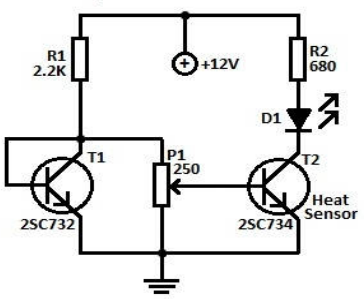

Fig. 6. Temperature sensor

These types of temperature sensor range from simple ON/OFF thermostatic devices that control a hot water heating system at home to highly sensitive types of semiconductors that can control complex furnace process control plants. We remember from our school science classes that the movement of molecules and atoms produces heat (kinetic energy) and the greater the movement, the more heat that is generated. Temperature Sensors measure the amount of heat energy or even coldness generated by an object or system that allows us to "sense" or detect any physical changes to that temperature that produce an analog or digital output. Many different temperature sensor types are available and all have different characteristics depending on their actual application. A temperature sensor is a device that provides temperature measurement through an electrical signal, typically a thermocouple or RTD. A thermocouple (T/C) is made up of two dissimilar metals that produce directly proportional electrical voltage to temperature changes.

E. Relay

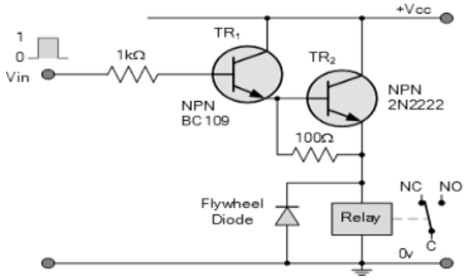

Fig. 7. Relay

Relay is an electromagnetic device used to electrically isolate and magnetically connect two circuits. They are very useful devices, allowing one circuit to switch another while being totally separate. They are often used to interface an electronic circuit (working at low voltage) with an electrical circuit operating at high voltage. For example, to switch a 230V AC mains circuit, a relay can make a 5V DC battery circuit. So a small circuit of sensors can drive, say, a fan or an electric bulb. It is possible to divide a relay switch into two parts: input and output. The input section has a magnetic field coil when applied to it by a small voltage from an electronic circuit. This voltage is called the operating voltage. Commonly used relays are available in various operating voltages configurations such as 6V, 9V, 12V, 24V etc. The output section is made up of contactors that mechanically connect or disconnect. There are three contactors in a fundamental relay: normally open (NO), normally closed (NC) and common (COM). The COM is connected to NC at no state of input. The relay coil is energized when the operating voltage is applied and the COM changes contact to NO. Various relay configurations are available, such as SPST, SPDT and DPDT etc…, which have different number of contacts for the changeover. The electrical circuit can be switched on and off by properly combining contactors. Get inside details about a Relay switch's structure.

F. Pump motor

Fig. 8. Pump Motor

As the name implies, water pumps pump water. Whether that is in a vehicle, at a business, in the home, or in a well, shoppers can probably find a water pump to fit their vehicle or to help them to draw water from the ground in a self-cut well for use in location pressure tanks. Reduced noise available in DC and AC Supply voltage: +12VDC Supply voltage: 230V AC Vehicle water pumps help regulate the flow of water through a vehicle's cooling system; the entire pump must be replaced if the seal on these pumps goes badly. Located within the home or business, pressure water pumps regulate the water pressure year round, controlling water flow to different areas of the location. A pump engine is a fluid-moving DC motor device. A DC motor transforms electrical direct current into mechanical power. DC or direct current motor works on the main; it experiences a torque and has a tendency to move when a current carrying conductor is placed in a magnetic field.

G. Buzzer

A buzzer is a small but efficient component for adding sound to our project/system. It is very small and compact 2-pin structure hence can be easily used on bread board, Board and even on PCBs which makes this a widely used component in most electronic applications. There are two types are buzzers that are commonly available. The one shown here is a simple buzzer which when powered will make a Continuous Beep. Sound, the other type is called a ready-made buzzer that looks more bulky than this, producing a Beep. Beep. Beep. Sound due to the internal oscillating circuit present inside it. But, the one shown here is most widely used because it can be customized with help of other circuits to fit easily in our application.

This buzzer can be used simply by powering it with a 4V to

9V DC power supply. It is also possible to use a simple 9V battery, but a regulated +5V or +6V DC supply is recommended. Usually the buzzer is associated with a switching circuit that turns the buzzer ON or turn OFF at the required time and requires interval.

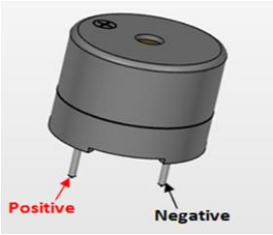

Fig. 9. Active passive buzzer pinout

H. Introduction of IoT

The main focus falls on designing a novel IDM system which involves the 'things' in IoT (human user and different devices such as computing and smart devices, sensors, actuators etc.) and expresses the communication between them. The system is analyzed in relation to the identified user and system requirements. The first step is to conduct a theoretical analysis of the different proposed IDM and communication systems for heterogeneous networks of M2M and IOT. We derive the user and system requirements on the basis of this analysis. A use-case scenario is defined to describe how the system is applicable in a real-life situation. Then, a novel user-centered IDM system architecture is proposed. A UML diagram and a class diagram scheme explain the system communication flows. The general STSO connection and authentication procedures are given by UML sequence diagrams.

I. LCD

To display the supplied voltage reading, the LCD display is used. It first flashes initial messages showing the application name when the project is powered ON. Once the controller sketch initializes the circuit, the voltage supplied to the street light is displayed on the LCD screen. The 16X2 LCD display is connected to the controller board by connecting its data pins to pins 3 to 6 of the controller board. The RS and E pins of the LCD are connected to pins 13 and 12 of the Micro Controller respectively. The LCD's RW pin is ground.

J. Working principle of LCD

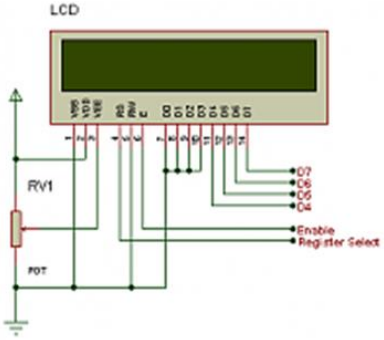

Fig. 10. Working principle of LCD

The principle behind the LCD's is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. This causes the angle of light that passes through the polarized glass molecule and also causes the top polarizing filter angle to change. As a result, a small amount of light is allowed to pass through a particular LCD area through the polarized glass. Thus that particular area will become dark compared to other. The LCD works on the principle of blocking light. While constructing the LCD's, a reflected mirror is arranged at the back. The electrode plane consists of an indium-tin oxide that is stored on top and a polarized glass with a polarizing film.

4. Circuit diagram

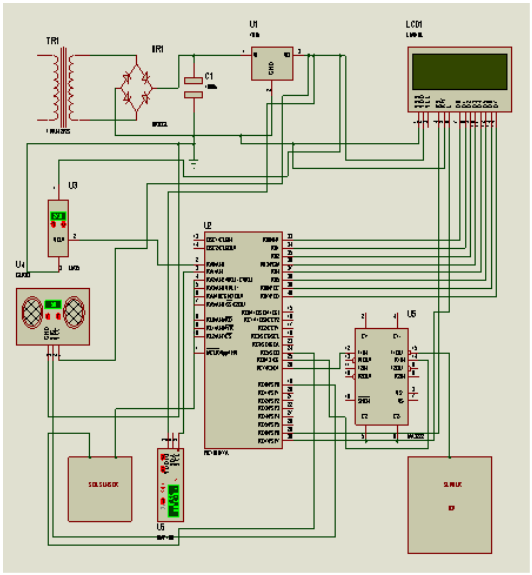

Fig. 11. Circuit diagram

The project's idea is to implement a system of automatic irrigation by sensing soil moisture. The circuit works as follows. The temperature sensor is inserted in the soil. Depending on the sensor's quality, it must be inserted near the plant's roots. The ultrasonic sensor measures the conductivity of the distances. The voltage from the prongs and the predefined voltage are compared and the output of the comparator is high only when the soil condition is dry. This output from the temperature sensor is given to the analogue input pin (Pin 2 – RA0) of the microcontroller. The microcontroller continuously monitors the analogue input pin. When the soil moisture is above the threshold, the microcontroller displays the same message and the engine is off. When the output from the temperature sensor is high i.e. the moisture of the soil is less. This will trigger the microcontroller and displays a suitable message on the LCD and the high microcontroller output, connected to the transistor base. The relay coil is energized when the transistor is turned on and turns on the motor. The LED is activated as well and acts as an indicator. When the moisture of the soil reaches the threshold value, the output of the temperature sensor is low and the motor is turned off. The

system is also designed to warn when the threshold of moisture is very high and the soil is too wet, which is dangerous to the plant.

5. Result and discussion

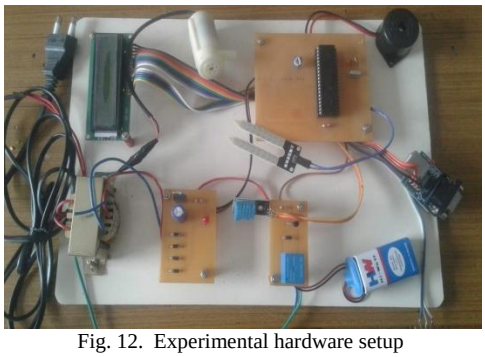

Fig. 12. Experimental hardware setup

A. *Advantages*

- Highly sensitive.
- Works according to the soil condition.
- Fit and forget system.
- Low cost and reliable circuit.
- Complete elimination of manpower

B. *Application*

- It can be fields of agriculture, lawns & as a system of drip irrigation.
- It can be used for growing purposes.
- In nursery planting arena, it can be used to supply water.

6. Conclusion

In the farmers use irrigation technique through the manual control, in which the farmers irrigate the land at regular intervals. This process seems to consume more water and results in water wastage Moreover in dry areas where there is inadequate rainfall, irrigation becomes difficult. We therefore need an automatic system that monitors and controls the water requirements in the field accurately. Smart irrigation system installation saves time and ensures the proper use of water. Moreover, this architecture uses microcontroller which promises an increase in system life by reducing power consumption.

7. Future scope

An Intelligent IoT based Automated Irrigation system can be extended not just for irrigating the field with water but also for deciding on spraying appropriate chemicals for proper growth of crop. By examining water level in tank before irrigating the field, the same work can be secured while transmitting the control signal for actuation for analysis to predict and send.

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