Soil Moisture and Temperature sensor based intelligent irrigation water pump controlling system using PIC 16F72 Microcontroller

SWATI DEVABHAKTUNI*,D.V.PUSHPA LATHA**
*Associate Professor,Dept.of EEE,Gokaraju Rangaraju Institute of Engineering and Technology,Hyderabad.
**Professor,Dept.of EEE,Gokaraju Rangaraju Institute of Engineering and Technology,Hyderabad

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Abstract: - This paper aims in providing a user friendly, reliable and automated water pumping system. The paper aims in designing a system which is capable of detecting moisture level in the soil and capable of taking the decision of switching ON/OFF water pump. The system also uses temperature sensor to detect the temperature and automatically the fan speed can be controlled like coolants. In this paper we make use of one microcontroller PIC16F72, which is dedicated at the water pump. The microcontroller forms the heart of the device and there are also soil-moisture sensors, which are meant - for detecting the moisture in the soil and is programmed with the proteus software. The system also uses temperature sensor based fan speed control system using DC fan. The proposed technique can help in reducing deaths of people due to current shocks at fields and also to on/off the motor automatically by using soil moisture sensors at fields which avoidsthe need of a human being.

Key-Words: -Soil moisture, temperature, sensor ,PIC16F72, D.C fan, Proteus software.

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1 Introduction

Now a day's technology is running with time, it completely occupied the life style of human beings. Even though there is such an importance for technology in our routine life there are even people whose life styles are very far to this well known term technology[1]-[3]. So it is our responsibility to designfew reliable systems which can be even efficiently used by them.Using the water in the farm for irrigation is one of the most water consumptions in the planet. Irrigation water management requires timely application of the right amount of water. Competition for water, high pumping coasts, limited water resources and concerns for environment are making good irrigation management more important[4][5]. In the world, water development for agriculture is a priority, but poorly designed and planned irrigation water management procedures and practices undermines efforts to improve livelihoods and exposes people and environment to risks. By far, one of the largest losses of the plant materials in the farm is the direct result of the improper irrigation scheduling[6][7].Irrigation too little can cause bad or weak yields; on the other hand, irrigation too frequently can cause water runoff and leaching of nitrates and fertilization materials bellow the root zone. There are many types of irrigation control systems available in the market. The most common types are digital controllers using microcontrollers and analog controllers[8]. These controllers are based on the measurement of the soil water tension. Soil water tension, soil water suction, or soil water potential are all terms describing the energy status of soil water. Soil water tension is a measure of the amount of energy with which water is held in the soil and represents the energy required to extract water from the soil. This is expressed in negative pressure. There are many types of sensors in the market that can be used to measure the soil tension. Some of these sensors are based on resistance principle and some based on capacitance principle[9][10].

This paper deals with the PIC16F72 microcontrollerto switch on/off the water pump automatically when the soil moisture sensor detects the water level to the plant. The system also includes temperature sensor based fan speed control system.The proposed controlling technique can be used to reduce deaths of people due to current shocks at fields and also to on/off the motor automatically by using soil moisture sensors at fields which avoids need of a human being. Embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers.Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only acceptsthe data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result.

2 Embedded systems

An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs.Embedded systems control many devices in common use today.Embedded systems are controlled by one or more main processing cores that aretypically either microcontrollers or digital signal processors (DSP). The key characteristic, however,is being dedicated to handle a particular task, which may require very powerful processors. Forexample, air traffic control systems may usefully be viewed as embedded, even though they involvemainframe computers and dedicated regional and national

networks between airports and radar sites.Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.Physically embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

3 HARDWARE DESCRIPTION

In this section the block diagram of the project and design aspect of independent modules are considered. Block diagram is shown in fig:1.

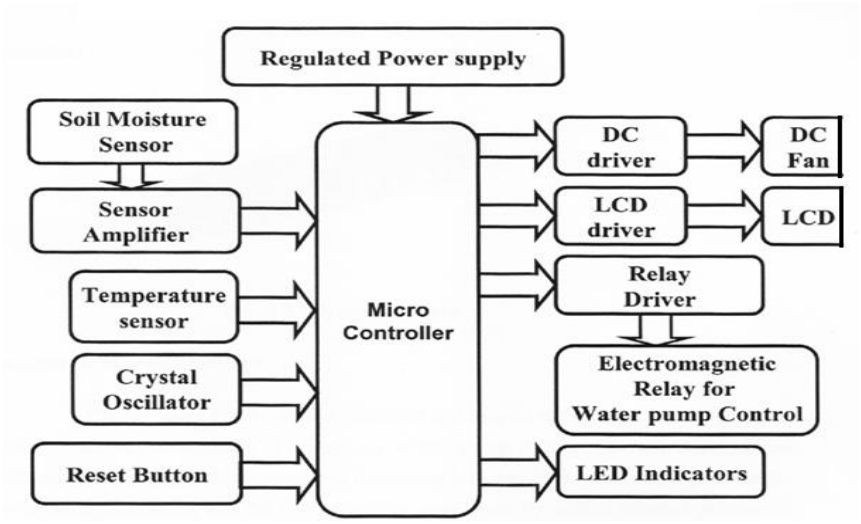

Fig.1. Block diagram of Industrial Process control and automation System

The main blocks included in the hardware design are:

1. Microcontroller
2. Regulated power supply
3. Crystal oscillator
4. Reset button

The basic circuit used for the regulated power supply is as shown in Fig.2.

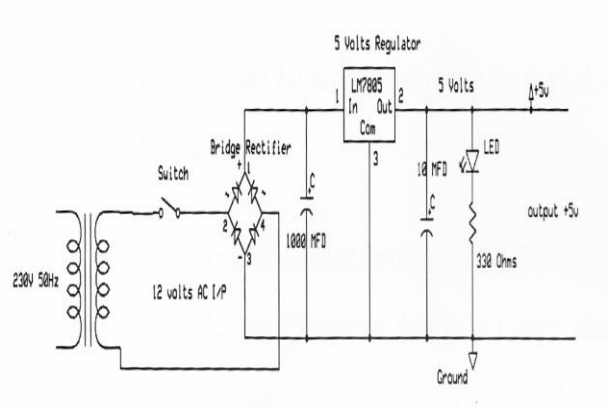

Fig.2. Circuit for the regulated power supply

The process of transforming energy from one device to another is called transformation. For transforming energy we use transformers.Now -a -days Bridge rectifier is available in IC with a number of DB 107. In our project we are using this IC in place of bridge rectifier.

The schematic diagram and interfacing of PlC16F72 microcontroller with each module is considered which is as shown in Fig.3.

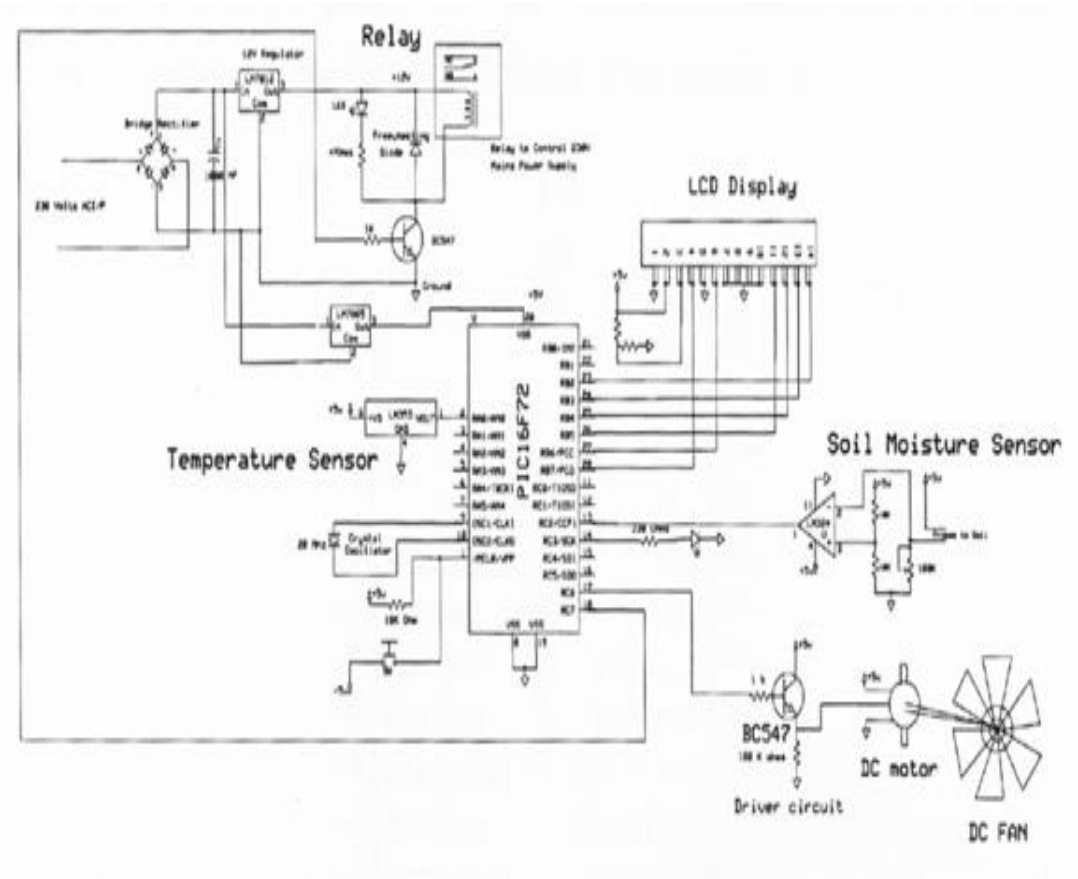

Fig.3.Schematic diagram of the proposed System

The hardware setup for the proposed paper is as shown in Fig.4.

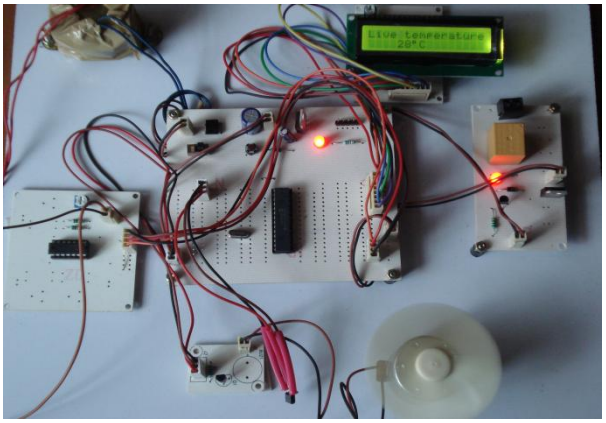

Fig.4 .Hardware setup

The above schematic diagram of System explains the interfacing section of each component with micro controller and LM324, LM35 sensor. Crystal oscillator connected to 9th and 10th pins of micro controller and regulated power supply is also connected to micro controller and LED' s also connected to micro controller through resistors.Crystal oscillator and reset button which are connected to micro controller. The two pins of oscillator are connected to the 9th and 10th pins of micro controller; the purpose of external crystal oscillator is to speed up the execution part of instructions per cycle and here the crystal oscillator

having 20 MHz frequency. The Vt pin of the microcontroller referred as MCLR ie.., master clear pin or reset input pin is connected to reset button or power-on-reset.

4 SOFTWARE DESCRIPTION

The software used in this project is proteus software.Proteus is software which accepts only hex files. Once the machine code is converted into hex code, that hex code has to be dumped into the microcontroller and this is done by the Proteus. Proteus is a programmer which itself contains a microcontroller in it other than the one which is to be programmed. This microcontroller has a program in it written in such a way that it accepts the hex file from the pic compiler and dumps this hex file into the microcontroller which is to be programmed. As the Proteus programmer requires power supply to be operated, this power supply is given from the power supply circuit designed and connected to the microcontroller in proteus. The program which is to be dumped in to the microcontroller is edited in proteus and is compiled and executed to check any errors and hence after the successful compilation of the program the program is dumped in to the microcontroller using a dumper.

4.1. Compilation ,simulation and dumping steps:

For PlC microcontroller, PlC C compiler is used for compilation.

The compilation steps are as follows:

- **i.** Opening PlC C compiler.
- **ii.** It will be prompted to choose a name for the new project, as shown in Fig.5.So after creating a separate folder where all the files of the project will be stored and the file is saved with the file name.

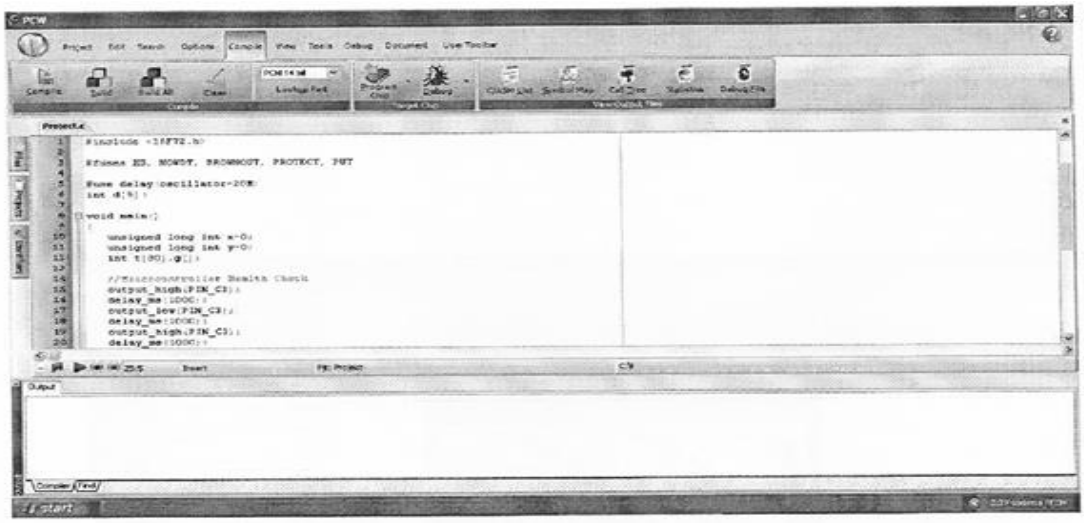

Fig.5.Compling a new file using PIC C compiler

iii. Then the source code is written inthe window titled ‘project.c’ then before testing source code; the source code is compiled, and correct eventual syntax errors as shown in Fig.6.

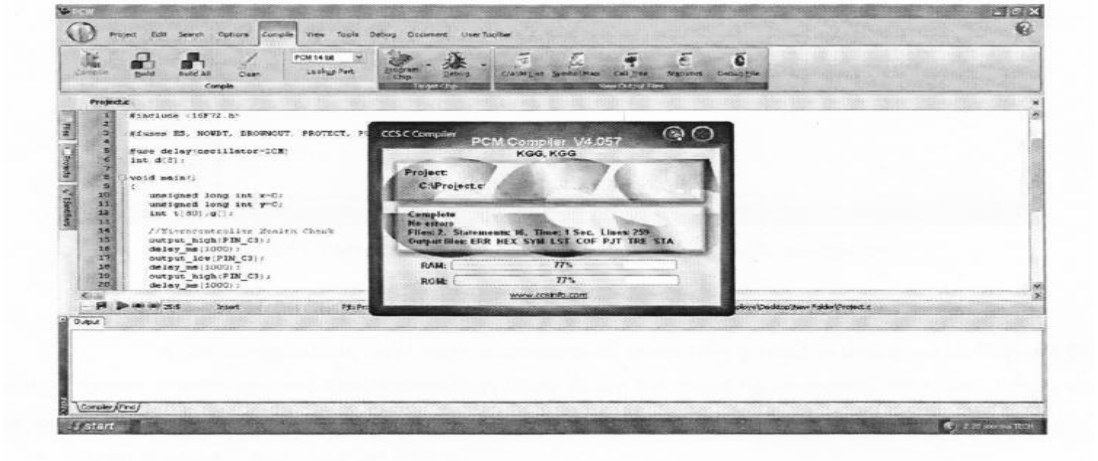

Fig.6.Checking errors and warnings using PlC C compiler

iv. By clicking on compile option .hex fileis generated automatically.
v. This is how compilation of a program for checking errors and hence the compiled program is saved in the file where the program is initiated.
vi. After compilation, next step is the simulation. Here first circuit is designed in Express PCB using Proteus 7 software and then simulation takes place followed by dumping.

The simulation steps are as follows:

After opening Proteus 7 and clicking on IS1S6.

a. It displays PCB where circuit is designed using microcontroller.
b. To design the circuit, components are required. So component is clicked .
c. Now clicking on letter 'p', then under that selecting PlC 16F72 ,other components related to the project and then OK is selected. The PlC 16F72 will call the "Target device ", which is the final destination of the source code.

TheDumping steps are as follows:

The steps involved in dumping the programedited in proteus 7 to microcontroller are:

- Initially before connecting the program dumper to the microcontroller kit the window isappeared as shown in Fig.7

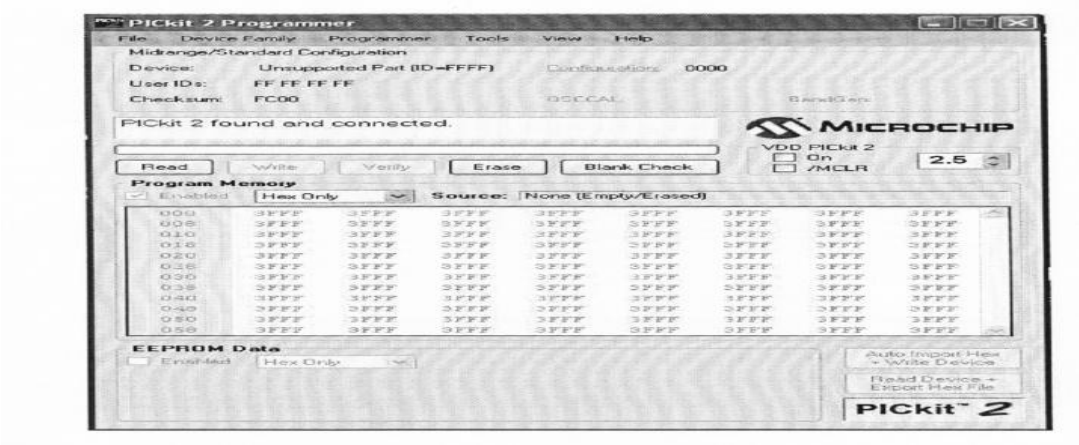

Fig.7.After connecting the dumper to microcontroller

- Again by selecting the Tools option and clicking on Check Communication the microcontroller gets recognized by the dumper and hence the window is as shown in Fig.8.

Fig.8.Dumper recognition to microcontroller

- Import the program which is '.hex' file from the saved location by selecting File option and clicking on 'Import Hex' as shown in Fig.9.

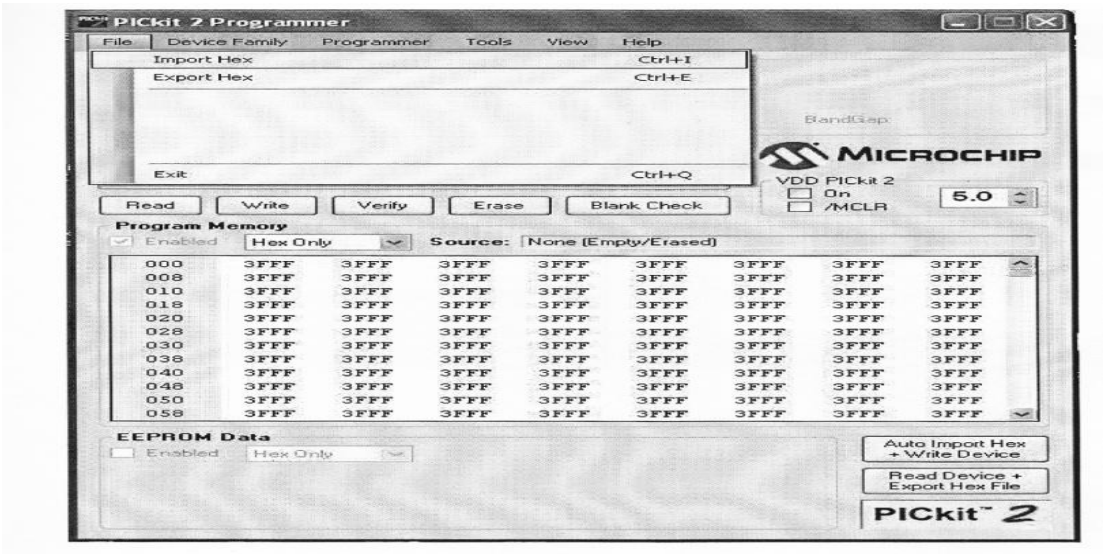

Fig.9.Program importing into the microcontroller

- After clicking on 'Import Hex' option the location of our program is browsed and cthe 'prog.hex'is selected and clicking on 'open' for dumping the program into the microcontroller.
- Now once it is opened total program is dumped into the microcontroller which is as shown in Fig.10.Once the program is dumped into the microcontroller now the hardware starts working as per the program. The result is as shown in Fig.4.

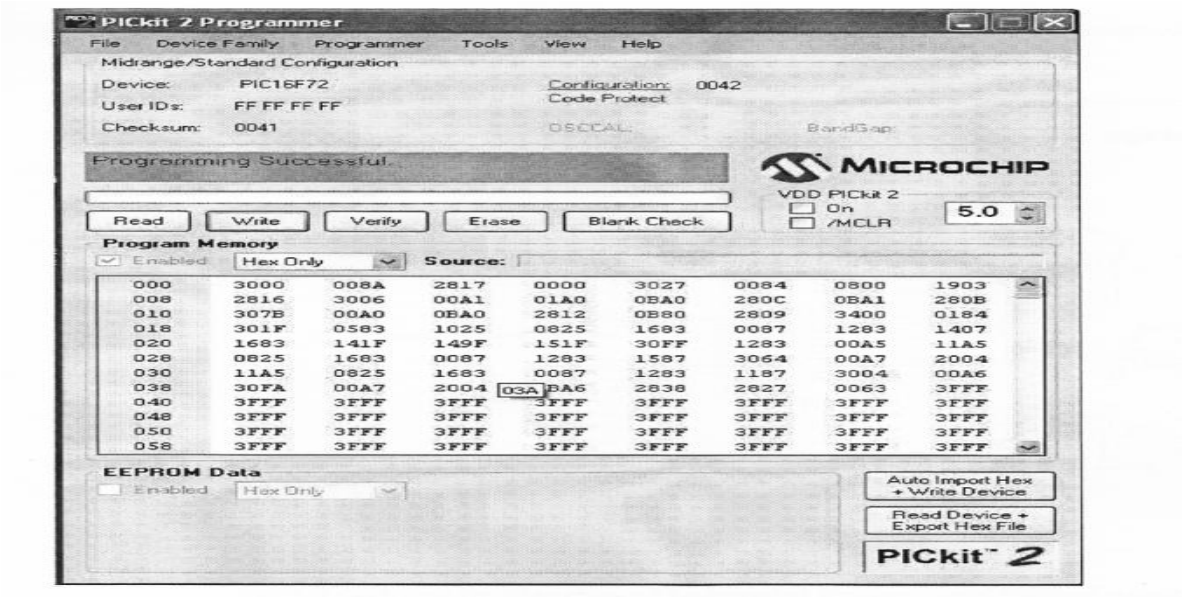

Fig.10. Program dumped into the microcontroller

5. Advantages And Disadvantages Of This Project

The advantages and disadvantages of this project are discussed which are as follows:

5.1. **Advantages:**

i. This system reduces the risk of electric shocks, deaths due to poisonous creatures in the fields.
ii. Temperature sensor based fan speed control.
iii. Visual display using LCD display unit.

iv. Watering depends on the moisture level present in the field.
v. Automatic controlling of water pump.
vi. Efficient and low cost design.
vii. Fast response.
viii. User friendly.

5.2. Disadvantages:

- Placing of the soil moisture sensor in the fields is very sensitive.

CONCLUSIONS

This proposed technique is designed to operate a water pump automatically based on the soil moisture sensor detection of sufficient water to the plant or in fields and also temperature sensor based fan speed control. The switching mechanism can be done automatically with the help of microcontroller using relays. The proposed controller eliminates the manual switching mechanism used by the farmers to ON/OFF the irrigation system. The system is also designed for temperature sensor based fan speed control.Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented.

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