Smart Irrigation System using Solar Power and Cost Effective Moisture Sensor

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***Abstract*— In the field of agriculture, use of proper method of irrigation is important because the main reason is the lack of rains & scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of unirrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes waste. For this purpose, we use this automatic plant irrigation system. The system derives power from solar energy through photo-voltaic cells. Hence, dependency on erratic commercial power is not required. The main objective of this project work is to make possible Irrigation Automatic using solar power and cost effective self built moisture sensor.**

I. INTRODUCTION

The continuously increasing demand of the food necessitates the rapid improvement in food production technology. In most of the developing countries such as India, national economy mainly depends on the Agriculture. But these countries do not able to make proper use of agricultural resources due to the high dependency on rain. Nowadays different irrigation systems are used to reduce the dependency of rain and mostly the existing irrigation systems are driven by electrical power and manually ON/OFF scheduling controlled. Farmers usually control the electric motors observing the soil, crop and weather conditions by visiting the sites. These manually controlled irrigation systems cannot ensure a proper level of water in the site. Due to the lack of electricity and mismanagement in the manually controlling systems, sometimes their fields become dry and sometimes flooded with excess water. These unplanned and manually controlled irrigation systems also cause a significant amount of water wastage. Automatic irrigation system is usually designed for ensuring the proper level of water for growing up the plants all through the season. Even when the farmers are away, these automatic irrigation systems always ensure the proper level of water in the sites. In addition, it provides maximum water usage efficiency by monitoring soil moisture at optimum level. The solar powered smart irrigation system are the best solution to the Farmers[1]. The auto irrigation system using solar power is also discussed by Balaji, V R., 2016[5].

Several research works have reputed aspects of development of automated irrigation system. With the development of technology in water saving irrigation and automation, automatic irrigation is going to be more popular in the farms. For example, a GSM based automatic irrigation water control is proposed. A mobile irrigation system[11] has been developed which improves water efficiency by saving the water. Artificial Neural Network (ANN)[3] based intelligent control system is proposed for effective irrigation scheduling in paddy fields. Automated irrigation system using solar power is proposed for paddy field [2]. Automization of Agriculture Irrigation System Using Raspberry Pi and Android Apps is discussed by Sadolkar Nilesh Shamrao & B.E. Shinde, 2016 [6].

Application of a wireless sensor network is discussed [3] for low-cost wireless controlled irrigation solution and real time monitoring of water content of soil. Wireless sensor networks to precision irrigation system is discussed in [8] and Design and Implementation of real time irrigation system using wireless sensor network is discussed [11]. In the past, most of the proposed irrigation models are driven by electricity and their corresponding automated hardware are fixed rate. And these models are highly expensive as those were made of expensive devices. Thus, due to higher cost, the general farmers cannot buy it for their use; usually these models are used in the farms only for experiment or demonstration funded by government or any private organization. The use of photoirrigation arrangement to improve the output of socially significant crops like olives and wine grapes, optimizing the use of water and solar energy resources at the same time as preserving the environment is discussed[4].

On the other hand, the variable rate automated controlling approach [10] improves the overall irrigation system reducing the total cost and increases the production of crop yield. Therefore, low price, alternative source of electricity and variable rate automated operation are the key concerns in the design of an irrigation system for

the common farmers. Automatic registration of optical and IR images is discussed [7] for constructing an automated irrigation control system where plant water information is sensed via thermal imaging. An automated irrigation system based on temperature, humidity sensors and soil moisture sensor which are interfaced to the microcontroller unit are discussed [10].

In this paper, a solar power controlled automated irrigation system[5] is proposed. Sensors collect the information about the water level of the fields and update the microcontroller. If the water level reaches the danger level, then the motor will automatically start to ensure the proper water level in the field.

One of the new methods adopted here is that instead of directly using sensors, we use the diffential voltage generated from the Comparator and directly send the data to the microcontroller. Solar power is utilised here. So,it is a green and clean source of energy and does not cause any damage to the environment.

The rest of the paper is organized as follows. Section II describes the proposed model with a block diagram; circuit components with detail description are presented in Section III. Finally, Section IV concludes the paper.

II. PROPOSED MODEL

Here, the design of the circuit is simple and not too complicated. For running of the circuit, Solar power is utilised. It is directly connected to the motor and the microcontroller. A Voltage regulator is used here which maintains the voltage and makes sure excess or under voltage is not sent to the circuit.

Here, two wires or leads are taken and they are inserted into the soil. The depth of immersion depends on the type of soil and the plant used. When the soil is wet, electrons pass from one lead to another and the display reads wet. It is not necessary to turn ON the motor as enough water is present. The electrons flow only in wet condition

When the soil is dry, there is no flow of electrons and the differential voltage is not present and the display reads dry condition. The motor is turned ON automatically and water is pumped into the soil at that location.

The use of solar power makes sure that power consumption is low and erratic usage of electric power is minimised.

Initially, the components are analyzed according to their function. The various components are to be interfaced on a PCB board are connected and the corresponding values of resistors, capacitors and inductors are noted down. The components are soldered to the board The microcontroller is pre-programmed accordingly and the components are then tested on a timely basis for their working .The setup is then placed under different soil conditions and the running of motor is monitored. The process flow is shown in Fig.1

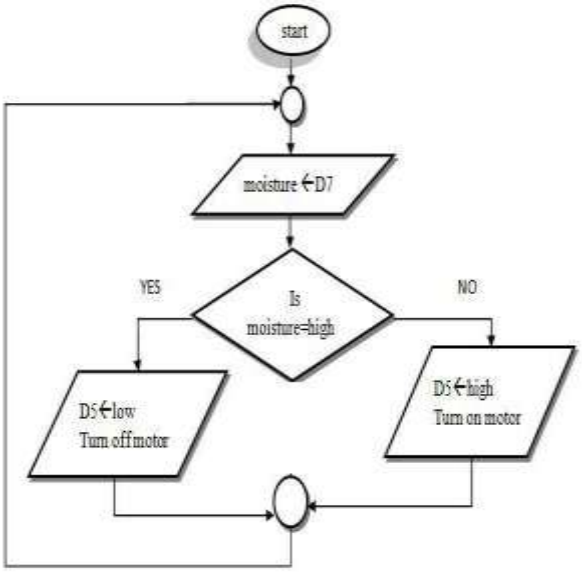

Fig.1 Process Flow

III DESIGN

In this project solar energy is used to operate the Irrigation pump. Fig.2 shows the block diagram of the solar powered auto irrigation system.

- The circuit comprises of sensor parts built using op-amp IC.
- Op-amp's are configured here as a comparator.
- Two stiff copper wires are inserted in the soil to sense whether the soil is wet or dry.
- A microcontroller is used to control the whole system by monitoring the sensors and when sensors sense dry condition of soil, then the microcontroller will send command to relay driver IC the contacts of which are used to switch on the motor and it will switch off the motor when the soil is in wet condition.
- The microcontroller does the above job as it receives the signal from the sensors through the output of the comparator, and these signals operate under the control of software which is stored in ROM of the microcontroller.
- The condition of the pump i.e., ON/OFF is displayed on a 16X2 LCD which is interfaced to the microcontroller.

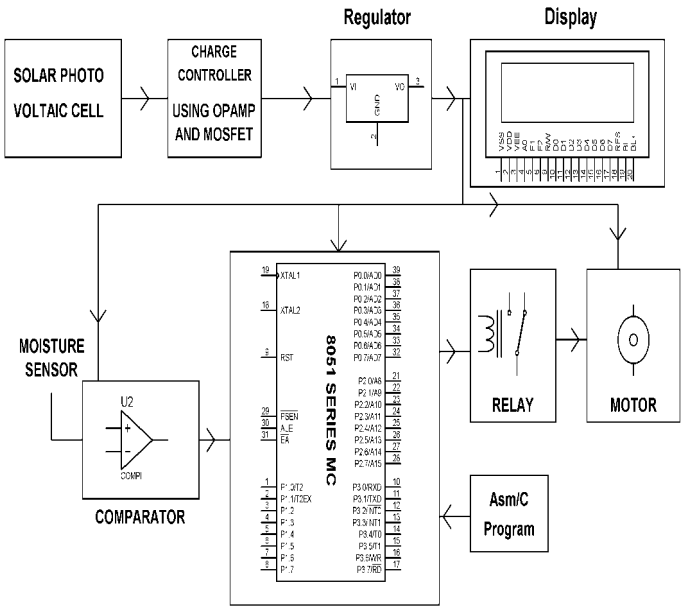

Fig.2 Block diagram of circuit.

Fig. 3.MICRO CONTROLLER

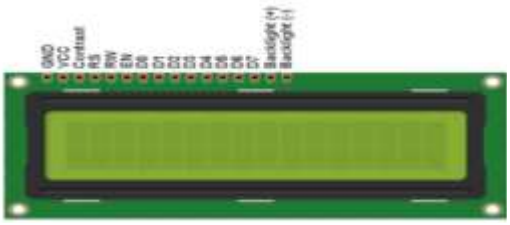

Fig.4 LCD

Fig.5 LED

III. DESCRIPTION OF PROPOSED MODEL

A) HARDWARE IMPLEMENTATION

- **SOLAR PANEL**
  Solar panels are designed with solar cells of semiconductor materials. The Main function is to convert solar energy to dc electrical energy.

- **MICROCONTROLLER**
  A microcontroller in this project is used to control the whole system by observing the Sensors. The status of soil and water pump is displayed on LCD interfaced to microcontroller. Fig. 3 shows the microcontroller pin diagram. Fig.4 shows the LCD display. Fig.5 shows the diagram of LED.

- **OPERATIONAL AMPLIFIER:**
  The sensor parts are assembled using Op-amp. They are designed as a comparator. Two copper wires are Injected into the soil to sense the condition of soil, whether it is wet or dry.

- **COMPARATOR**:
  The comparator acts as an interface between the sensing arrangement and Microcontroller.

- **RELAY:**
  The relay switch helps in turning on and off the motor during generation of Water. It turns on the motor when the Soil is dry and vice versa. Fig.6 shows the relay.

Fig.6 RELAY

- **MOTOR:**

  The running of motor helps in generation Of water. Normally a 12V DC motor is used.

Fig.7 shows the hardware model of the solar powered automatic irrigation system.

Fig.7 Hardware model

SOCIAL RELEVANCE AND BENEFITS

- Reduction in electricity consumption.
- Using clean and green energy.
- Water resources are used efficiently.

IV. CONCLUSION

In this paper, an automated irrigation model is proposed and successfully implemented as demonstrated in different figures. We designed and implemented this model considering low cost, reliability, alternate source of electric power and automatic control. As the proposed model is automatically controlled it will help the farmers to properly irrigate their fields. The model always ensures the sufficient level of water in the field avoiding the under-irrigation and over-irrigation. Solar power provides sufficient amount of power to drive the system. To overcome the necessity of electricity and ease the irrigation system for our farmers, the propose model can be a suitable alternative.

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