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An Efficient Solar Powered Irrigation SystemUsing MPPT

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***Abstract*— This paper proposes a model of variable rate automatic microcontroller based irrigation system using solar power with MPPT charge controller. As, Solar poweris used as only the source of power to control the overall system, MPPT charge controller used along with PV Cell. Sensors are placed on the field and these sensors continuously sense the water level and give the message to the farmer informing the water level. Without visiting the fields, farmers can get the information about the water level through GSM module.**

***Index Terms*- Automated Variable Rate Irrigation System, Solar Power, Maximum Power Point Tracking (MPPT) Charge Controller, Sensor and GSM Module.**

I. INTRODUCTION

Agriculture uses 85% of available freshwater resources worldwide, and this percentage will continue to be dominant in water consumption because of population growth and increased food demand. There is an urgent need to create strategies based on science and technology for sustainable use of water, including technical, agronomic, managerial, and institutional improvements [1].

In most of the developing country like 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 [2]. 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 [3]. Farmers usually control the electric motors observing the soil, crop and weather conditions by visiting the sites [4]. These manually controlled irrigation systems cannot ensure a proper level of water in the site [5-8]. Due to the lack of electricity and mismanagement in the manually controlling systems, sometimes their fields become dry and sometimes flooded with excess water [9]. These un planned and manually controlled irrigation systems also cause a significant amount of water waste [10].

Automatic irrigation system is usually designed forensuring 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 [11]. In addition, it providesmaximum water usage efficiency by monitoring soil moistures at optimum level [12].

In this paper, we propose an efficient solar power controlledautomated irrigation system using MPPT. Sensors collect the information about the water level of fields and update the farmer as well as the microcontroller. The farmer can switch ON andOFF the motor based on the water level even from distant places using a cell phone. However, if the water level reaches to the danger level, then the motor will automatically start to ensure the proper water level in the field.

II. PROPOSED MODEL

A complete block diagram of proposed automated irrigation systemis illustrated in fig.1. The area of field usually may cover up several hundreds of hectares,to cover whole area we need to place different sensors in the field. The sensors will always sense the water level of the field and will send a message to the users' cell phone to inform the condition of irrigation through the GSM modem. Farmer will control the motor sending assigned code to the microcontroller.

A Photo Voltaic (PV) cell is the only source of energy to derive this proposed system. so, it requires continuous energy for that we use MPPT Controller. The energy will be stored in the DC battery through supply. The sensors, microcontroller and GSM interface are driven by DC power. However motor is driven by AC power, inverter is used to convert DC to AC power and relay switch ensures the proper AC power supply to the motor.

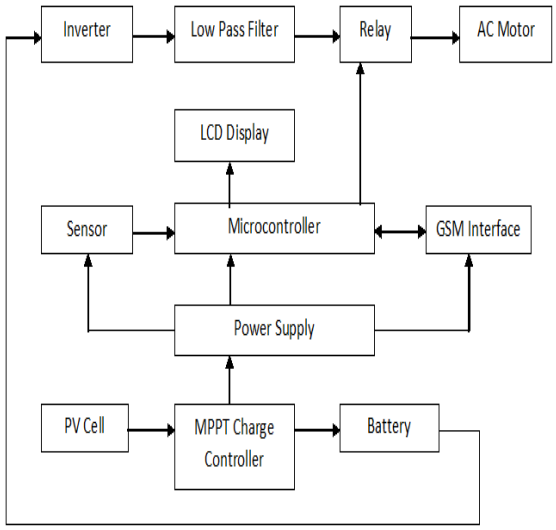

Fig. 1 Block diagram of proposed circuit model

III. DESCRIPTIONOF PROPOSED MODEL

A. Soil Moisture Sensor

Normally sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer/instrument. In this paper, we proposed a model of designing sensor as presented in fig. 2. Two metal plates such as A and B are used to form a sensor; at where 5V Dc power is attached with plate A, and plate B is connected with a microcontroller. Normally plate A and plate B are isolated from each other andvoltage signal passes to the microcontroller. When the water fills the gap, the metal plates A and B gets connection and voltage signal passes to the microcontroller.

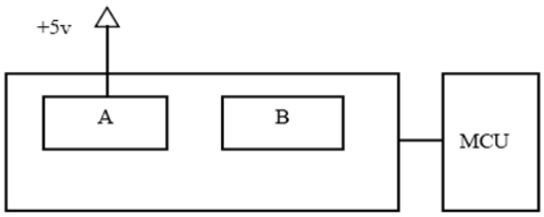

Fig. 2 Soil Moisture Sensor

According to our design model, if the water level reaches to 0%, the microcontroller will automatically start the motor through relay switch according to the command of the microcontroller pin. The farmer will be confirmed by a message.

B. Relay

Relay switch is operated by the microcontroller and used to control the motor. The motor will remain switched ON until the water level reaches to the secured level i.e. 100%. When thesensors sense the water level is above 100%, microcontroller will make the motor to be switched OFF; as it is receiving the status of water level from the sensors. At the secure level(100%) the microcontroller will not operate. However, if thewater level goes down to mid level (30%) the sensors willsend a signal to the microcontroller. After receiving the signal themicrocontroller will send a message (for example, WATER LEVEL LOW) to the user's cell phone through the GSM interface.[14]

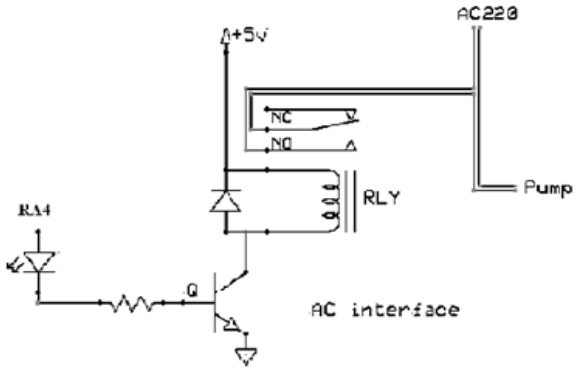

Fig. 3 Relay

C. Microcontroller

AT MEGA 8 is 8 bit microcontroller, it is very robust controller that suits this particular application. It is low power AVR, RISC based microcontroller. It gives high performance. It is 28 pin IC of which 23 are programmable input output lines and 3 PWM channels. It is having 16 kb ISP flash memory, 1KB SRAM, 512B EEPOM. It is having 8 channels of 10 bit A to D converter. It is having throughput of 20 MIPS at 20MHz, and operates between the ranges of 2.7 to 5.5V.

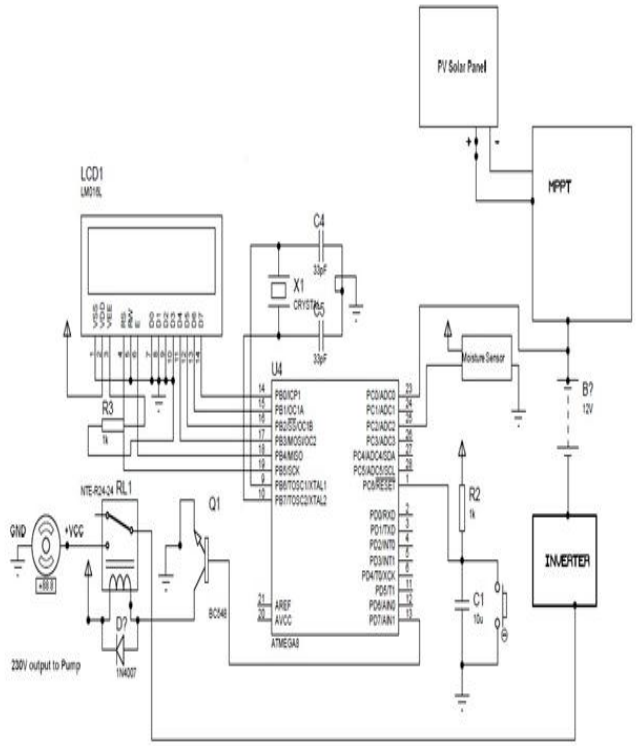

Fig. 4 Control module of the system

D. Liquid Crystal Display

The LCD will display the alphabets, numbers, characters and symbols. The LCD used here is eight bit parallel type and the display size is 16*2. Liquid Crystal Display is used for displaying the moisture value.LCD consists of three control pins and eight data pins. Based on the commands given to the control pins, data can be read from or write to the LCD. The eight data pins of the LCD are connected to the PORTB pins RB0-RB7. Three control pins are connected to PORTC pins. RC0, RC1, RC2 are used for register select (RS), read/write (R/W) and enable (E) respectively.

E. Solar Panel

PV Cell converts sunlight into electricity, this is physical process known as Photo Voltaic effect. Sunlight consists of energy in the form of packets, this is also known as Photons. Photons which strikes on the PV panel,some light gets reflected and some gets absorbed.[5% get reflected and 95% get absorbed] Since, we are using anti reflecting glass surface on the PV cell. Only the absorbed light is responsible for the generation of current.

In this project we have used Mono crystalline solar panel of 60 watt power having open circuit voltage 22v and short circuit current of 4 Amp. Panel efficiency is high (20%) as compared to Poly crystalline and Amorphous. Cell efficiency is high (25%), Area required for 1KW of power is 6m2, Life of panel is 50 to 60 years, it gives high performance in low light condition. Cost of Mono crystalline is little high as compared to Poly crystalline.

F. Maximum Power Point Tracking (MPPT)

It is needed to optimize the amount of power obtained from the PV array to the power supply. It compares the panel output with battery voltage and fixes it at best power that PV module can produce and convert it into the maximum current for battery. It is effective under cold weather and battery is deeply discharge.

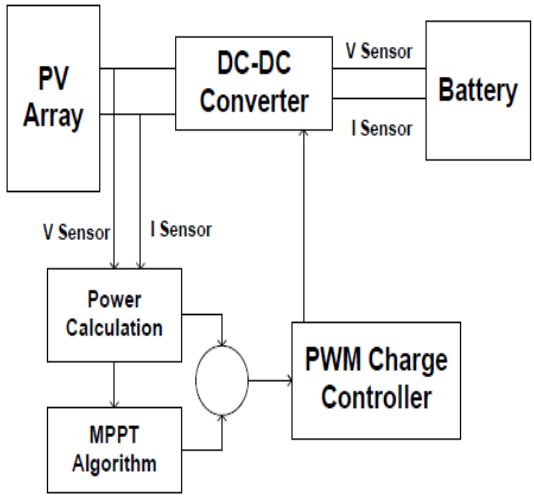

Fig. 5 Block diagram of MPPT Charge Controller

G. Battery

Electrical storage batteries are commonly used in PV system. The primary
Functions of a storage battery in a PV system are:
1) Energy Storage Capacity and Autonomy: to store electrical energy when it is produced bythe PV array and to supply energy to electrical loads as needed or on demand.
2) Voltage and Current Stabilization: to supply power to electrical loads at stable voltagesand currents, by suppressing or smoothing out transients that may occur in PV system.
3) Supply Surge Currents: to supply surge or high peak operating currents to electrical loadsor appliances

We have selected 12v 80AH lead acid battery. Since the lead acid battery withstand against the variable amount of current.

H. *GSM*

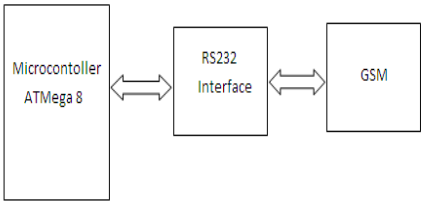

Fig. 6 GSM modem

Global System for Mobile Communication (GSM) system in [13] proposes monitoring and controlling system based on GSM.GSM modem is Interface using RS232 and accessed using AT commands. GSM is used for remotely monitoring and controlling the devices via mobile phone by sending and receiving SMS via GSM network.

IVCONCLUSION

The automated irrigation system implemented was found to be feasible, reliable, low cost, alternate source of electric power and automatic control. As the proposed model is automatically controlled it will help farmers to properly irrigate their fields and avoid under-irrigation and over-irrigation.

This system can be adjusted to a variety of specific crop needs and requires minimum maintenance. Also ON/OFF of the motor using cell phone even from different place or away from that place is possible. This system is secured with password for restricted number of users.

To overcome the necessity of electricity and ease of irrigation system, the propose model can be suitable alternative. So it is our wish to make the P-V system more efficient so that it can help for betterment of life.

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