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SOLAR POWERED AUTOMATED IRRIGATION SYSTEM

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Abstract - *To meet the growing demand of irrigation in India due to uncertain climatic conditions it is necessary to focus on sustainable irrigation approaches and improving the efficiency of the existing irrigation systems. Irrigation requirement varies from a couple of life saving watering during the monsoon season to assured year-round water supply. Due to rapid urbanization in India demand for water from urban sector is increasing. The scarcity of water will shoot up with time due to increasing population and growing demands. Agricultural sector in India which consumes around 79 % of the total available water resources should introduce reforms in efficient water management and thus minimizing wastage. Estimation of water requirement, proper scheduling of irrigation and implementation of efficient irrigation system are the key solutions of the above problem. India has huge untapped solar energy potential. One of the most promising sectors for solar utilization is solar water pumping. It is necessary to dimension photovoltaic installation accurately so as to reduce the cost and improve efficiency. The aim of the project work is to incorporate proper solar pumping sizing method with a properly scheduled intelligent irrigation system to make it highly efficient model. The objective is to tackle concerns on water wastage and overwatering by accurately estimating water requirement of any crop, schedule the irrigation process properly and to design an optimum solar photovoltaic powered pumping system along with the development of a prototype intelligent irrigation control facility.*

Key Words: Moisture sensor, Water level sensor, Light dependant resistor, Solenoid valve, Solar tracking

1.INTRODUCTION

India is an agricultural country. India ranks second worldwide in farm output. At present, farmers manually irrigate the land at regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which the crops get dried. As a key solution to this issue, automation in irrigation is achieved through this project. This is done with the help of microcontroller which in turn controls the moisture sensor, solenoid valve and water level sensor based on the input given. According to the moisture content in the soil, water owing from the storage tank is regulated into the field using solenoid valve. This ensures complete automation in irrigation and savings in manual labor.

Thus the concept of automation indirectly results in water conservation. Shortage of water and its wastage are the two major problems faced by the agricultural sector in India. Since this project utilizes moisture sensor that senses the moisture content of the soil, optimum amount of water is pumped as required and thus water wastage is minimum. Thus there is no possibility of over-irrigation or under-irrigation[1].

Also a tropical country like India can effectively harvest solar energy using solar panel modules. This is a very effective method of energy consumption. Solar energy being a renewable source of energy, amount of pollution can be reduced as well as the monthly energy bills for farmers is minimized. Thus it is a suitable alternative for farmers in the present state of energy crisis in India. Hence energy conservation is also bought about in this project. In a nutshell, this project revolves around the integrated ideas of energy harvesting, water conservation and automation in irrigation. As a result, an efficient system of irrigation is proposed in this project, which ultimately backs up the agricultural sector in India.

2. PROJECT AT A GLANCE

This project proposes an efficient system comprising of a solar panel with tracking elements, moisture sensor, water level sensor, relay controls for operating solenoid valve and motor; GSM module and LCD display[2].

Solar energy is the source of energy used which is harnessed through a solar panel, connected to a lead acid battery. 12V supply is stepped down to 5V using a linear voltage regulator 7805 so as to power the microcontroller and other components used. To harvest maximum solar energy, solar tracking is employed through two LDRs along with a dc gear motor. The value of resistance of LDR depends on the amount of light falling on it, which in turn depends on the relative position of the sun and the panel. Based on the ADC values given by the LDR to microcontroller(connected to pin number 38 and 39), the direction of rotation of the panel is determined and hence maximum intensity of light is attained. L293D IC is utilized to control the direction of rotation.

In order to check the moisture content of the soil, moisture sensor is used which is connected to the ADC pin of the microcontroller. Moisture sensor is calibrated in such a way that if its ADC value goes below a preset value, then it means that the moisture content is too low and hence solenoid valve must be opened to allow water owing to the field from the storage tank. If the value is above the preset value, then the valve needs to be closed; thus disrupting the water supply to the fields. Relays are used to operate the solenoid valve and the motor to pump water. A high/low on pin number 7 of the microcontroller makes the transistor assosciated with the relay forward biased/reverse biased and relay operates to turn on/off the solenoid valve. The motor relay also operates in the similar manner.

The water level sensor is made using three resistances placed at three different levels in the storage tank. Depending on the level of water in the tank, high or low values will be given to the ADC pin of the microcontroller(pin number 35,36 and 37). When the level of water is very low, there is no continuity of the conducting path formed and hence microcontroller receives a signal which turns on the motor, so as to pump water into the tank. Similarly when the water level is high, motor is turned off by the microcontroller. Thus water level in the storage tank is maintained between a minimum and maximum level.

GSM module is employed in order to ensure proper working of the system. The transmission and reception pins(pin number 14 and 15) are connected to the MAX232 IC, which is an interface between microcontroller and the GSM module. GSM module informs the user at the start and end of irrigation process as well as when the system encounters some errors in its operation[3]. The port C pins are connected to a 16x2 alphanumeric LCD. This displays the sensor values, status of motor and direction of panel.

As a result, this strategy provides an effective solution to the problems faced by the farmers in agricultural sector and hence efficiency is improved. Though the initial cost is high, this system proves to be more economical in the long run.

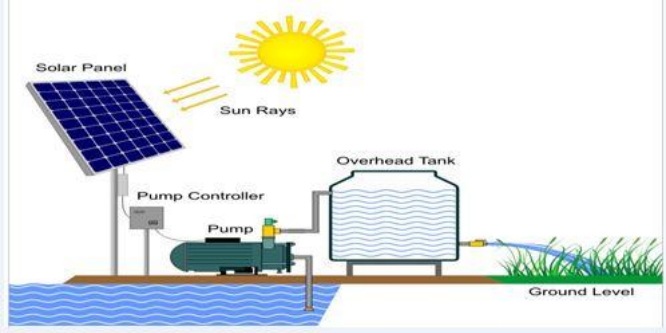

Fig -1: Proposed Idea

3. SYSTEM DESIGN AND COMPONENTS

Block diagram here depicts the components that is mainly being used in this project. ATmega32 is the heart of the system. Since solar energy is the main source of energy, a solar panel along with LDR and solar tracking components(LDR and L293D IC) are incorporated to obtain maximum intensity of light. Solar panel is connected to a 12V DC battery and this voltage is regulated to 5V using 7805 regulator. Moisture sensor, water level sensor and LDR are connected to microcontroller via ADC pins. These ADC values governs the condition of operation of these components. Solenoid valve is operated using relay control which is connected to the microcontroller. GSM module is connected via MAX 232 IC so that it is compatible with the microcontroller. Output is displayed using LCD[4].

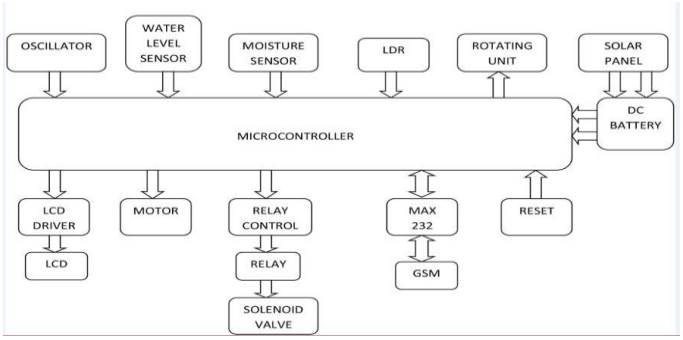

Fig -2: Block Diagram

The major components are given below:

Atmega32

The Atmel AVR Atmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. It has 8 ADC pins that is why it is used for load control. Eight analog values can be given to the controller at the same time, while PIC has only two.

Lead-Acid battery

The electrical energy generated by solar panel is used to charge a battery, from where supply is given to the transmitter and microcontroller. Solar panel is connected to battery through a diode. The diode is provided to restrict the reverse current flow from battery to solar panel. A 12V, 7.2Ah battery is used in this system, which is sufficient to supply the entire system. Overcharging of battery above 13V and discharging below 10V causes damage to the battery, so we are providing a relay in between the charging circuit.

Solar Panel

Whenever the sun light hits on the solar panel with photons (particles of sunlight), the panel converts those photons into electrons of direct current (DC) electricity. Naturally, the sunnier it is, the more energy is produced by the panels. Solar energy is a resource that is not only sustainable for energy consumption, it is indefinitely renewable. Solar power can be used to generate electricity, it is also used in relatively simple technology to heat water.

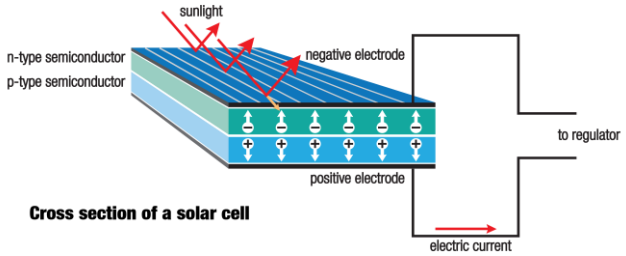

Fig -3: Working of a Photovoltaic cell

Moisture Sensor

Two copper leads can be used as moisture sensor. This is dipped in the soil and checks the moisture content present. Measuring soil moisture is important step in deciding the duration of the irrigation. Advanced versions of moisture sensor have options to set the desired moisture level with the rotary knob and also features wireless transfer of collected data from the field to the control unit. The current is passed through the probes. The resistance of the soil varies with the moisture content in it. Thus the amount of the current owing increases with the moisture in the soil. The prototype design included resistor type sensor with the desired moisture level included in the program of the microprocessor. The microcontroller is programmed in such a way that if this value is less than 100 at a time prior to irrigation, then the solenoid valve will be turned ON. After the prescheduled irrigation time, again moisture condition is tested. If the irrigation is not satisfactory (still sensor value less than 100), a feedback SMS will be sent to the farmer. In this way only the required amount of irrigation is given to the crops.

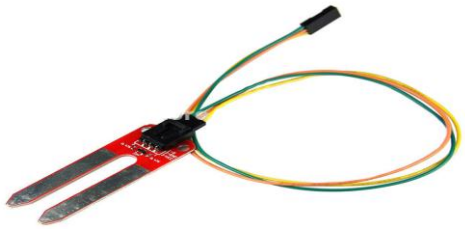

Fig -4: Moisture sensor

Water level sensor

Water level sensor employs three metallic contacts which are placed in the tank at three different levels. The sensor works on potentiometric measuring principle. Current is made to flow through the resistance. Voltage drops linearly across this resistance. Thus with the varying fluid levels, output voltage varies. If the water is at the low level, then microcontroller senses the ADC value and turns on the motor to pump water into the tank and once it exceeds the high level, microcontroller turns on the motor.

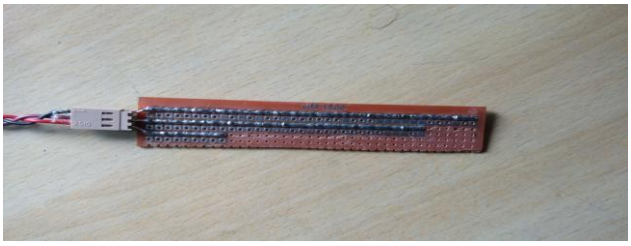

Fig -5: Water level sensor

Solenoid valve

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the out flow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life,

good medium compatibility of the materials used, low control power and compact design. Besides the plunger-type actuator which is used most frequently, pivoted-armature actuators and rocker actuators are also used.

Fig -6: Solenoid Valve

GSM Module

GSM is a mobile communication modem; it stands for Global System for Mobile communication (GSM). It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

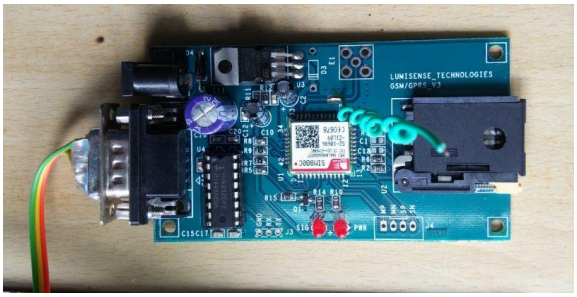

Fig -7: GSM Module

LCD Display

The LCD display is used to display various voltages and instructions to users. A liquid crystal is a material (normally organic for LCDs) that will own like a liquid but whose molecular structure has some properties normally associated with solids. A 16*2 LCD means it can display 16 characters per line and there are 2 such lines.

4. PROJECT HARDWARE

Project is fully completed by combining the software and hardware part. Thus the proposed project was designed as shown below. Ensure that 5V supply has reached all components for its effective operation. Place the setup under proper sunlight, so that panel can be tilted in such a way to obtain maximum intensity of light. Water level sensor has to be carefully placed in the tank and the moisture sensor should be dipped in the soil. Solenoid valve needs to be opened/closed properly at the required time. GSM module is inserted with a SIM card so that messages based on its operation are received. Thus efficiency is increased through improved irrigation system. The prototype designed aims at completely automating the irrigation procedures and providing status feedback facility through SMS[5].

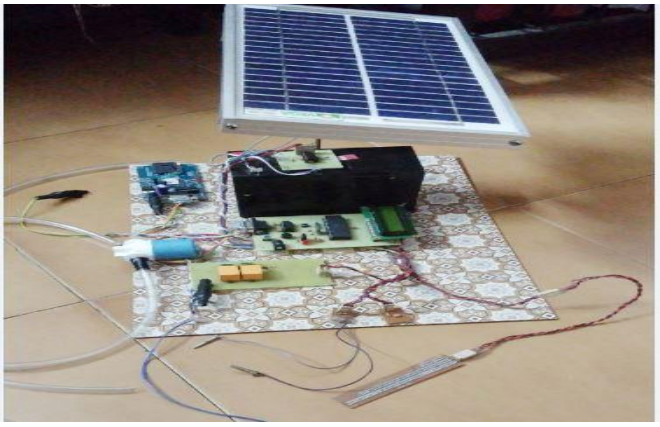

Fig -8: Project Hardware

5. CONCLUSION

The proposed project is a model to modernize the agriculture industries at a mass scale with optimum expenditure. Using this system, one can save energy, water and manpower, to improve production and ultimately profit. As the entire system will be powered by solar energy, which will be stored in the rechargeable batteries, one need not think of the electricity consumption, as life of solar panel which is available these days is 25 years. By using the automatic irrigation system, it optimizes the usage of water by reducing wastage and also reduce the human intervention[6]. Thus no worries regarding over-irrigation or under-irrigation. Moreover, the entire system is being monitored by GSM module; thus the farmers are made aware of the problems caused during operation. The proposed system is easy to implement and provides an environment friendly solution for irrigating the fields. This system requires minimal maintenance and attention as it is self starting. Even though high capital investment is required for this system to be implemented, the overall benefits are high and in the long run this system is economical[7].

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