A Research Paper on Solar Powered Irrigation System

Jitesh Kumar
Department of Electronics and Communication Engineering
Faculty of Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

ABSTRACT: ***The main purpose of this paper is to provide automatic irrigation device which senses the level of soil moisture itself. And this level of sensing is achieved by a sensor of soil moisture, which senses the level of moisture and also provides a regulated level of moisture to various crops. If the soil's moisture level falls below a certain amount then the sensor sends the detected value to the microcontroller. The water is supplied to the crops automatically to the desired level according to the value sensed by the sensor in order to preserve the moisture content in the soil. The theme of this paper is to minimize human interference (farmers) and use solar energy for irrigation purposes which is one of the non-renewable sources. PIC microcontroller managed overall system. This system uses a 4X4 keypad for control of various crops. If the soil's moisture content is reduced then the sensor sends the microcontroller the detected value. The water pump then automatically ON depending on the level of humidity. This paper aims at minimizing human interference for farmers and using solar energy for irrigation purposes. The entire device that the PIC microcontroller controls.***

KEYWORDS: ***Solar power, Auto irrigation, Energy sensor, Soil, Moisture sensor, Water pump, Panel, PIC microcontroller.***

INTRODUCTION

The proper approach for the irrigation scheme is to be applied due to a shortage of rain and water scarcity in the soil. Agricultural fields are always in need and dependent on soil water level. But continuous extraction of soil water decreases soil moisture levels to avoid this problem should be pursued by expected irrigation system [1]. Yet inefficient use of water contributes to large amount of water being wasted. Automatic plant irrigation system is designed for this purpose using humidity sensor and solar energy. The device proposed draws power from sunlight via photovoltaic cells. Therefore, the machine cannot rely on the electricity. In this proposed model, power the irrigation pump by using sunlight energy. The circuit contains a soil moisture sensor, which is inserted into the soil to determine whether the soil is wet or dry. The entire device is managed through a PIC microcontroller.

When the soil's moisture level is low, the sensor senses the soil condition and the relay device connected to the motor switch is given condition. In dry condition it will ON and turn off the motor when the soil is in a wet state [2]. The soil moisture level is sensed by the sensor inserted into the soil which gives the microcontroller a signal as to whether or not the soil requires water. The signal received from the sensor via the comparator output is followed by instructions from the software that are stored in the microcontroller. When the ground is dry motor ON and engine is OFF in wet weather. This motor state, ON and OFF, is seen on a 16X2 LCD.

PV cell

Photovoltaic cell is a device where light energy is transformed into electricity. Photovoltaic cells are otherwise called solar cells. This is used in complicated and basic applications. Small calculators and wrist watches are the simplest collection of photo voltaic cells in daily use. Most complicated network supplying electricity to pump water, power communications equipment,

lights to the homes and run our appliances. This is held as a small grid by the PV cells which take sunlight and convert it into electricity. More generally referred to as photovoltaic, or PV, panels, solar electric panels transform sunlight into electricity. The power is used to operate machines and electrical equipment, or to be stored in batteries for later use. Solar Thermal Panels are used to heat the water for commercial purposes [3].

Solar collectors are the foundation of most active thermal solar energy systems. The collector absorbs the light energy of the sun and transforms that energy into heat. It thermal energy used for industrial and domestic uses to heat water and to save electricity. Solar building technology is useful for buildings that use more power to operate applications for man. Solar thermal collectors are the key component of active solar systems and are designed to meet the unique requirements of temperature and climatic conditions for the various endues.

Flat-plate collectors, Evacuated-tube collectors, condensed collectors, transpired air collectors are several types of solar system collectors. The device being proposed uses solar energy to Power the water pump. Irrigation here maintained via the sensor of soil moisture and solar energy. There are several plants that need a minimum level of humidity [4]. If the correct water level is not provided then the plant will die and result in low output. The soil moisture sensor is provided by irrigating the crop according to the level of moisture they need. Since sensor crops are present they irrigate properly.

LITERATURE REVIEW

Cost efficient solar power can be the solution to all our energy requirements. The Indian farmer's solution is solar powered intelligent irrigation systems. This device consists of solar-powered water pump and an automated monitoring of the water flow using a moisture sensor. It's the suggested solution for the Indian farmers to the ongoing energy crisis. This device saves electricity by reducing grid power use, and by reducing water losses, it conserves water [1]. Developing and implementing an automated SCADA managed system that uses PLC as controller is essential for purposes of agricultural, oil, and gas monitoring and control. The system is also powered by an adaptive solar array, in which the solar panel absorbs the Sun's radiation. Rather than that, the solar system has high both the electricity and emission costs.

The system features four input sensors; two sensors for soil moisture, two sensors for level detection. The soil moisture sensor tests the soil moisture, while the level detection sensors detect the water level in the tank. The output sides are composed of two solenoid valves, operated by two moisture sensors respectively [2]. A simple but effective, low-cost solar-powered water pumping system is developed in this paper which provides a drip irrigation system with the required pressurized water. The results of the theoretical and field studies of photovoltaic panels and other elements, the overall system modeling techniques and their elements using the Systems Modeling Vocabulary, are discussed. The demonstration site of the project covers an area of 1,000 square meters which includes over 100 trees [3]. The overview of feedback on a system of photovoltaic irrigation is provided in this paper. Photovoltaic water pumping system represents one of the best alternative irrigation methods. The variability in the spatial and temporal distribution of available irrigation water allows considerable demand for water conservation techniques. Thus solar powered Automated Irrigation System offers a sustainable solution to improve the efficiency of water usage in agricultural fields by using renewable energy system to remove the workmanship needed for flooding irrigation. Using this photo-irrigation system may contribute to the socio-economic evolution [4]. This work centered on work on solar photovoltaic (PV) and solar thermal technologies to generally pump water for irrigation of remote rural farms especially considering the Sub-Saharan African region.

Owing to the rise in oil prices and the increase in the marketing of PV technology, solar PV systems have been extensively researched for irrigation purposes. Based on the literature, the most effective PV system in terms of cost, pumping capacity and system efficiency is presented for the irrigation of a small scare remote rural farm. In the same way, solar thermal systems are checked and defined as the most effective system. Solar powered water pump efficiency was as equal as traditional one powered pump efficiency. The solar-based water pump has a much higher performance than traditional power-based water pump. For traditional power system, the average flow rate obtained was 69 LPM against 65 LPM. MPPT was used to map the best Solar PV array operating point. The results of the recorded study make socio-economic effect on the Indian agricultural sector significant[5]. This paper describes a wireless sensor network framework for low-cost wireless managed irrigation solution, and real-time monitoring of soil water content. Data collection is achieved by the use of solar powered wireless collection stations for irrigation valve control purposes. The machine has 3 units: Base Station Unit (BSU), Valve Unit (VU), and Sensor Unit (SU), respectively. The irrigation system obtained not only avoids tree moisture stress and salification but also makes an effective use of freshwater energy [6].

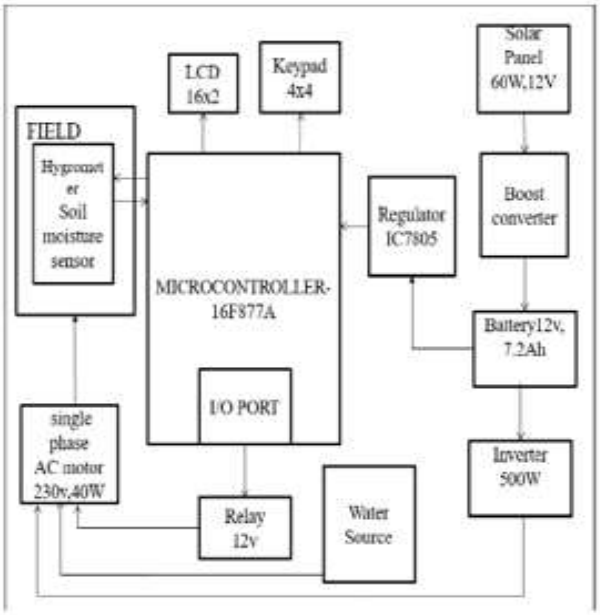

FIGURE 1: Irrigation system diagram

METHODOLOGY

This device consists of a solar panel, which is the main source of energy and is provided to the charging controller to extract controlled power from the solar panel at different irradiation, as well as maintaining the correct charging voltage and current to charge the battery and increase its life. Conservation of water in farmland is managed using a soil moisture sensor microcontroller. The boost converter is used to convert DC to DC power to increase the solar panel's output power because if solar panel receives less light then boost converter gives higher voltage compared to input voltage. Boost converter is a power supply in the switch mode that contains a diode and a transistor with one energy storage part, the capacitor. Filters are used to decrease ripple output voltage.

When the switch is closed the current flows through the inductor in clockwise direction and it stores some energy through the creation of a magnetic field. The current will be decreased when

the switch is opened, because the impedance is higher. The previously created magnetic field will be destroyed to preserve the current flow toward the charge. The polarity must be reversed for this. As a result, there will be two sources in series which will cause a higher voltage to charge the condenser via diode D. Automatic irrigation system comprises solar panel, boost converter, inverter, motor supply, soil moisture sensor, LCD monitor, 4×4 key pad, microcontroller, controller. The soil moisture sensor is inserted into the soil to measure moisture levels, and it also shows specific levels of moisture for different crops. Crops such as paddy, maize, and sugarcane can be irrigated in this scheme. In this device 4×4 key pad is used for the selection of crops. The next important part of the device is solar panel here the solar panel drives the electricity.

The solar panel that converts this converted energy to sunlight is sent to power the converter and the battery. The Converter's power is governed by the regulator. Here the microcontroller requires 5v power supply so the device uses IC7805. Also connected to the single AC motor is the power supply. The 12v motor relay is connected to the motor to ON/OFF.

Proposed system

The proposed system uses Solar Power Panel to sensing the water level for crops to the system and soil moisture sensor. Solar power is used only as power source to operate the whole device, supply from the 12V solar panel to improve the converter circuit. The boost converter circuit has a resistance of R1, R2 (1 km, 330 mm) which is used to control the voltage from the solar panel. IN4007 Diode (d1) is used as a voltage control system, inductance (100μH) is connected in series. PWM pulse is produced via MOSFET system to increase the capacitance voltage stored (1000μF) relative to the T/2 period.

Constant voltage from boost converter to 12V battery is placed, 500W inverter is used to convert 12V DC to 230V AC for ac pump. The positive regulator IC 7805 is used to control the 12V DC to 5V DC with the help of 1000μF and 100μF with the current limiting resistor of 330. The PIC microcontroller is operated with 5V from the regulator, the microcontroller acts as the control circuit for the overall operation. For the respective process, it has 40pin IC each pin is attached, soil moisture sensor is dipped into the soil to sense the humidity value. In the PIC16F877A microcontroller, soil humidity values for different crops are selected by 4x4 matrix keypad, crop selection programming and respective humidity values are configured. Microcontroller-to-12V relay signal is worked to/from the motor pump. The pump's water flow depends on the PIC microcontroller signal. The PIC microcontroller controls the device.

If the soil moisture sensor senses the low soil moisture level then a signal is sent to the microcontroller then the controller tests for the condition stated in software. For different crops is different in software stored in the microcontroller. The amount of humidity required for the crop to grow varies from crop to crop. It is supplied according to crop water production. Irrigation with Soil Moisture Sensor and Relay Unit is automatic. When the level of soil moisture is low, a signal is sent to the relay to turn ON the engine and when the soil is warm, the engine is OFF. Relay gives the motor the ON / OFF status. The entire device is powered by energy from solar panels. If the machine uses solar energy so it is possible to save the electricity. The PIC microcontroller requires 5v supply, and 230v supply is needed for the motor. To regulate the power supply from the solar panel the regulator is linked to the PIC microcontroller.

Hardware and Simulation

This device consists of a solar panel, which is the main source of energy and is provided to the charging controller to extract controlled power from the solar panel at different irradiation, as well as maintaining the correct charging voltage and current to charge the battery and increase its life.

Conservation of water in farmland is managed using a soil moisture sensor microcontroller. This device simulation consists of PIC microcontroller connected to LCD monitor, relay, 4X4 key pad, Transistor and solar panel power supply.

Boost converter

This charging controller is ideal for charging batteries of the flooded lead acid, gel cell, or sealed lead acid (SLA), and Absorbed Glass Sheet. While charging the battery, the Boost Converter Charging Controller holds the solar panel current and voltage at the controlled power point. Boost converter helps keep the output from the solar panel to the battery constant [7].

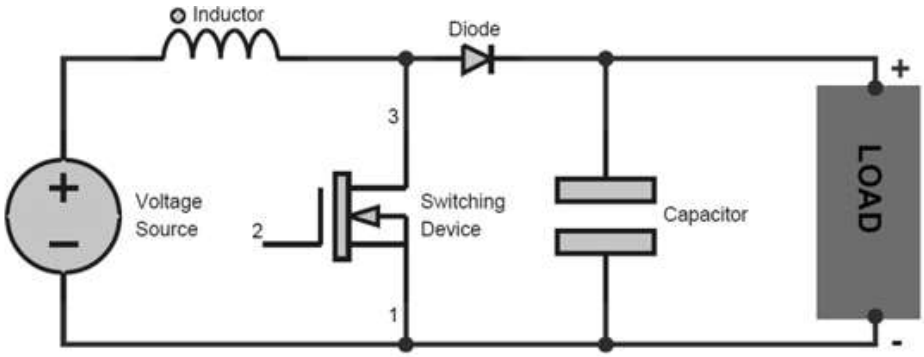

FIGURE 2: Boost Converter.

Regulator

In this regulator IC 7805 is used to convert the 12v supply from battery to 5v supply through the 16F877A microcontroller and the soil moisture sensor to hygrometer [8].

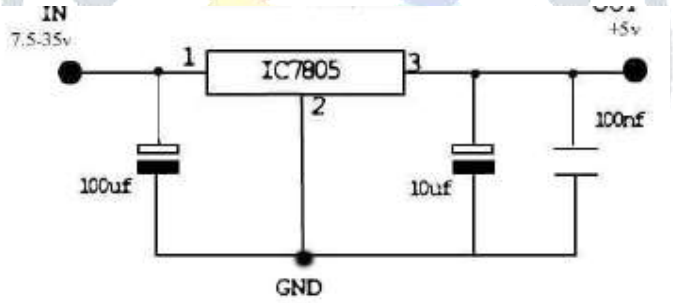

FIGURE 3: IC 7805

4X4 Keypad

There are many features on the MCP23X08 devices that make them suitable for controlling a 4x4 matrix keypad. These features were split into two main groups:

- The input and output characteristics of the ports.
- Interrupt-on-change feature, an essential part of the main scanning method used [9].

CONCLUSION

When this program is introduced, the program proposed benefits the farmers. And with solar panel energy also useful to the government, addressing the energy crisis is a challenge. This automatic irrigation system is implemented when soil needs water is indicated by the sensor. Then the various crops also got irrigated by turning on the button with this device. The irrigation system measures the crop's humidity level according to the pressed button. For example, soil moisture content in

Wheat, Paddy, Sugarcane crops is automatically detected and irrigated. Automatic irrigation system is utilized to maximize water usage by reducing waste and reducing human activity.

Solar panel gives the energy needed to the water pump and control system. Small grid solar panels which can generate excess energy. By using solar energy it reduces the issue of the energy crisis. The device needs minimal maintenance and care, as they start themselves. Tracking arrays may be implemented to further enhance the daily pumping rates. This device shows the feasibility and application of using solar PV to provide energy for the sprinkler irrigation pumping demands. While this system needs more investment but after a long run of this system it solves more irrigation problem.

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