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Automated Solar Tracking & Water Pumping System

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Abstract: *Solar energy is an important means of renewable energy resource. Solar tracking urges extreme solar energy to generate out of the solar panel and enables to maintain a profile with the sun rays. The goal of our venture is to increase the amount of usable energy by utilizing a computerized tracking system to capture maximum intensity of the solar rays. This project deals with development of automated water pumping system using solar tracking. The rapidly increasing demand for energy calls a need for substitute for fossil fuels. Renewable energy source exhibits an outstanding figure for producing electricity without any fuel consumption*

Keywords: Solar Panel Tracking, Renewable Energy, Water Pumping, Automation, LDR

I. INTRODUCTION

Energy plays a major role in the development of the nation. Present day scenario, huge amount of energy is produced using non-renewable energy sources. 85% of energy production is dependent on fossil fuels[1]. The resources of the fuels are limited and its usage is resulting to global warming due to emission of greenhouse gases. To provide a sustainable power production and safe world to the future generation, there is a rapid increase in need of energy from renewable resources like solar, wind, geothermal and ocean tidal wave [2]. Solar radiations are converted into electrical energy by solar panels. Solar panel constitutes of semiconductor materials. Major component used in the making of solar panel is Silicon, which is 24.5% efficient.[3].

To have the maximum utilization of the amount of intensity captured it is essential to use the tracking system and hence to maintain accuracy and precession. The control circuit for solar tracker is done by Arduino Uno board. This is programmed to detect sunlight using LDR and actuate the stepper motor to position the solar panel where it can receive maximum sunlight. Stepper motor is controllable, energy efficient, steady and have high tracking accuracy and suffers little environmental affect. The undertaking is expected to develop a programmed water system framework which controls the draw engine ON/OFF on detecting water level sensors. The water pump is attached to the battery. Since the pump works on DC power supply, it is directly attached to the battery. The water pumping system also consists of water level sensors used to detect water levels for automatic turn on and off of the water pump. This helps in the automation of water pumping systems in hospitals, factories, schools, public places etc. hence reducing manpower also maintaining the adequate usage of the resources[4] [5].

Solar based power is a rule progressively used worldwide as an inexhaustible wellspring of vitality. India has tremendous undiscovered sun powered off-frame work openings. This paper gives data about advancement methodology of an installed framework for off grid water system frame work [7]. Resource of water is indispensable for satisfying daily human needs varying, from agriculture to energy production. The demand of water for irrigation purpose is still an issue to be solved in developing countries, mainly rural areas with energy crisis and environmental pollution created mostly by the use of fossil fuel, this problem has unfolded a solution using solar photovoltaic water pumping system. Solar photovoltaic water pumping system has become so popular not only in the agriculture sector but also for drinking water and micro irrigation applications [8].

Abundant water supply in remote locations is required to ensure the grazing evenly. Water pumping is most accepted and admired application of solar energy in developing countries such as India. The proposed system is reliable, simple

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and requires less maintenance [9]. Many villages in India use fossil fuel based water pumping system for irrigation due to a shortage of electricity. Fossil fuel causes great damage to the environment as they release harmful greenhouse gases. In this research work, we propose a solar energy based automated water pumping system is implemented to these villagers in terms of cost and profit. In addition, this can save a lot of water and is environment friendly [10]. Increase in cell efficiency, maximizing the power output and employing a tracking system with solar panel are the three major ways to increase the overall efficiency.

Maximum Power Point Tracking (MPPT) is the process to maximize the output power from solar panel by keeping the solar panel's operation on the knee point of P-V characteristics. MPPT technology only offers the maximum power that can be received from a stationary array of solar panels at a particular time; it cannot, however, increase the power generation when the sun is not aligned with the system. This system is mechanized to track the sun's position that increases the power output of solar panel from 30% to 60% than the stationary system.

To develop single axis solar tracking system which captures maximum intensity from the sun rays efficiently store the generated energy in the battery for the future application to develop automated water pumping system which helps to save water and minimize man power. Overall objective is to build a power conserving, less use of manpower, resource conserving project for the sustainable development and to help the mankind save time.

II. LITERATURE SURVEY

[1] A review of current status of solar photovoltaic water pumping system technology research and applications is presented. The study focuses on update on solar water pumping technology, economic evaluation, environmental aspects and recent advances in materials and efficiency improvement of photovoltaic technology and experience of using solar PV pumps worldwide. Agricultural techniques are changing speedily because of current advancement in renewable energy technology. The current advancements in renewable energy can be successfully applied in the agriculture sector to minimize dependency on conventional crops irrigation techniques. Fields and crops irrigation are usually performed by water pumps (runs on fossil fuels) which can lead to environmental damage and high agricultural costs. The humidity sensors and global system for mobile (GSM) module are installed for automation and wireless control of irrigation to reduce manpower needs.

[2] The paper has discussed about the possibility of implementing a solar based smart irrigation system which has been tested in lab and is to be taken to a village in Coimbatore, India. A system with a solar panel, moisture sensor, Arduino Microcontroller Unit and battery is implemented and tested in the lab. The power requirements for the area of the irrigation field we are covering is calculated and accordingly number of solar panels, battery, microcontroller units, wireless interface modules and moisture sensors are decided. Because of the variable atmospheric situation these conditions sometimes may vary from place to place in the huge farmhouse that makes very difficult to maintain the uniformity at whole places in the farmhouse manually. It is observed that for the first time an android phone-control the Irrigation system, which could give the facilities of maintaining uniform environmental conditions are proposed.

[3] In this proposed system we utilize the solar energy from solar panels to pump water from bore well directly into a ground level storage tank based on the intensity of sun rays. The water is pumped into a ground level tank from which a simple valve mechanism governs the flow of water into the ground. This saves enormous amount of energy and efficient use of renewable energy. A valve is controlled using intelligent algorithm in which it regulates the flow of water into the ground depending upon the moisture fulfilment of the ground. In this system we use a soil moisture sensor that detects the amount of moisture content in the soil.

[4] In this project we developed Solar Tracking for an automated water pump in this project water pump automatically get operated by using soil moisture sensor, here the solar panel is auto tracking which rotate as per the direction of sun. This solar tracking system uses the sunlight for pumping the water to agricultural grounds and farm, when pumping operation not taking place the energy can be stored in battery for other application. [5] This paper presents a low cost automated solar water pumping system for irrigation in developing countries. The programmed sensor module recognize the temperature, humidity, soil moisture content and sends the information to ESP32 microcontroller. A water level sensor also detects the water level and sends the data to the microcontroller unit. Based on the information and boundary conditions, the microcontroller decides either to start or to stop the pump motor. This paper also describes how to decide soil moisture limits for a particular type of soil.

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III. METHODOLOGY

Deciding the specification of the PV panel depends on the need of water tank, followed by rating of pump and battery. Single axis tracking is done using LDR controlled Microcontroller board and the panel is rotated accordingly which is driven by stepper motor using the driver L298N. The I-V and P-V characteristics and other parameters of solar panel is then obtained. Constant voltage which is obtained from the panel is made to store in the rechargeable battery for future application i.e Pumping system. Hence the automated water pumping system with relay protection is developed. The proposed system mainly consists of two parts, solar tracking and water pumping system. The first part of the system, the solar tracking system consists of LDR, stepper motor and solar panel. These LDR's are connected to the two ends of the solar panel. Based on the intensity of light falling on the LDR the Microcontroller will decide the direction of rotation of stepper motor. Stepper motor is in turn connected to the panel. Thus Microcontroller controls the rotation of both stepper motor and solar panel.

The second part of the project namely the water pumping system consists of water level sensors, DC motor and battery. The water level sensor is used to control and detect water level in the tank. The solar energy is stored and it is collected in battery. The absorbed power is then sent to the motor which runs the pump.

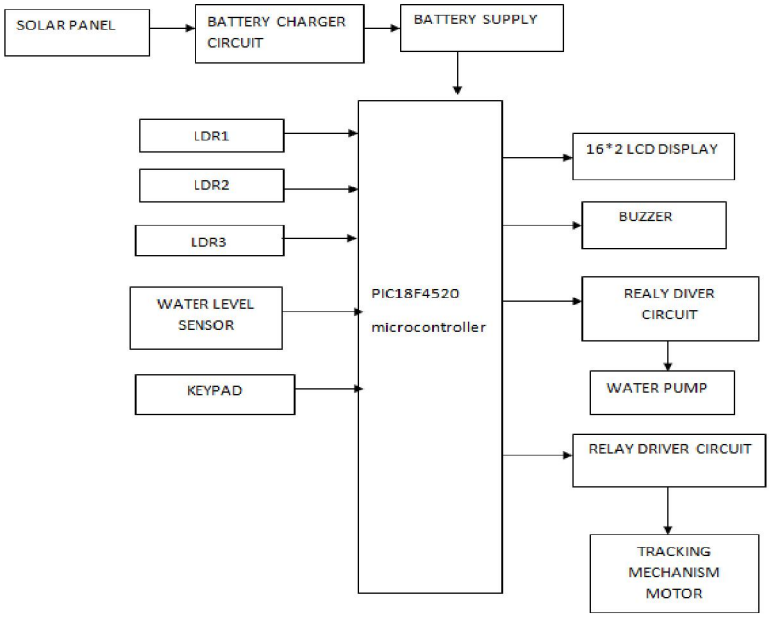

Fig. 1. Block Diagram

PIC18f4520 Microcontroller

- Data Memory up to 4k bytesn Data register map - with 12-bit address bus 000-FFF Divided into 256-byte banks.
- There are total of F banks.
- Half of bank 0 and half ofbank 15 form a virtual (oraccess) bank that is accessibleno matter which bank isselected – this selection isdone via 8-bits.
- Program memory is 16-bits wide accessed through a separate program data bus and address bus inside the PIC18.
- Program memory stores the program and also static data in the system.
- On-chip External
- On-chip program memory is either PROM or EEPROM.
- The PROM version is called OTP (one-time programmable PIC18C) The EEPROM version is called Flash memory (PIC18F)

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- Maximum size for program memory is 2M n Program memory addresses are 21-bit address starting at location 0x000000.

Fig. 2.PIC18f4520

LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD

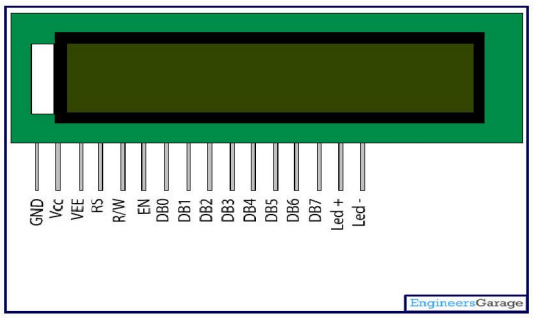

Fig. 3. LCD Display

Lead Acid Battery

These Lead acid batteries are the most common large-capacity rechargeable batteries. They are very popular because they are dependable and inexpensive on a cost-per-watt base. There are few other batteries that deliver bulk power as cheaply as lead acid, and this makes the battery cost-effective for automobiles, electrical vehicles, forklifts, marine and uninterruptible power supplies (UPS). Lead acid batteries are built with a number of individual cells containing layers of lead alloy plates immersed in an electrolyte solution, typically made of 35% sulphuric acid (H2SO4) and 65% water (Figure 1). Pure lead (Pb) is too soft and would not support itself, so small quantities of other metals are added to get the mechanical strength and improve electrical properties. The most common additives are antimony (Sb), calcium (Ca), tin (Sn) and selenium (Se). When the sulphuric acid comes into contact with the lead plate, a chemical reaction is occurring and energy is produced.

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Fig. 4.Lead Acid Battery

Relay Board

Relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts as Shown in diagram.

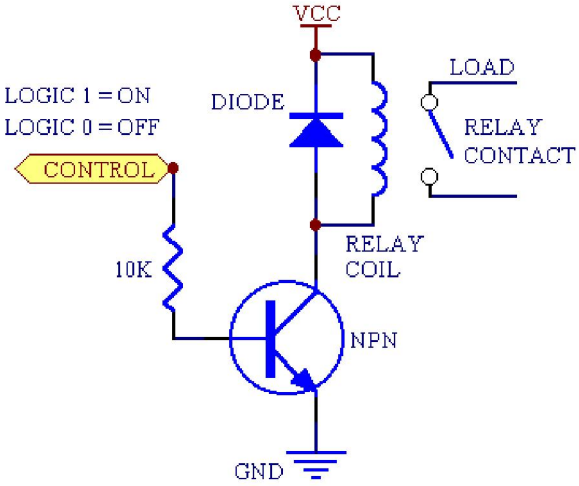

Fig. 5.Relay Driver Circuit

LDR

It is the photo sensor which senses the intensity of light and according to that the panel rotates in maximum intensity of light direction. It is placed on panel in east-west direction. It is controlled by microcontroller.

Fig. 6.LDR

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Solar Panel

Solar panel mainly consists of numerous photovoltaic (PV) cells which is combined to form a module. These PV cells are made up of semiconductor material namely silicon that is usually connected in series or parallel to get additive voltage or current. The solar panel is basically a P-N junction, when sunlight falls on the PV cell; the electrons gain energy and jumps out of the atom hence leading to the flow of electricity.

Fig. 7.Solar Panel

IV. CONCLUSION

In this project the single axis solar tracking system is successfully implemented. The constant DC voltage of 12V is obtained with help of solar charger circuit. The energy obtained from the panel is stored into the rechargeable battery of 4.5Ah. The charge controller circuit prevents over charging and over discharging of the battery. Later implemented automation of water pumping system which senses the water level in the tank and automatically turns on and off the pump, based on the water sensed in the tank which is programmed using Arduino Uno. The production of solar energy by tracking increases its efficiency there by making it more useful. Solar energy is eco-friendly, widely available. The automated water pumping system helps in saving of water and electricity. As the system is automatic manual interaction is not required. The system designed is efficiently used to run the water pump and can be installed at consumer site.

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