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SOLAR TRACKING FOR AUTOMATIC IRRIGATION SYSTEM

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Abstract: Rural areas don't have the direct utility grids or assessing the grid may not be possible. Direct access to an electric power will not be possible. In this type of situation the accessibility of rich solar irradiance shows the most potential solar energy. For the use of solar energy, Photovoltaic (PV) off-grid solar system will be the possible solution for the irrigation system. The main objective of the work is to develop an automatic irrigation system by the use of photovoltaic panels. Humidity and temperature sensors are utilized to check the soil and air, respectively, which is required to operate the water pump in order to maintain the proper irrigation conditions. The pump can be operated by the photovoltaic system. A microcontroller system will track the position of the sun and is utilized to maintain the perpendicularity between the sun and the photovoltaic panels. The experimental investigation has been conducted to analyze the performance of the tracking system. The outcome of the experimentation validates the control of the irrigation system.
Keywords: irrigation system, solar tracking, microcontroller, agricultural system

1. INTRODUCTION

Distributing the water to the required region is may be defined as irrigation system. The type of system is used will have an influence on the efficiency of the irrigation. Since ancient times, the life on earth is depends on the agriculture. The type of irrigation system used will be the tool that makes better agriculture. In the world, many types of irrigation systems are in practice, in one or the other way each irrigation systems have encountering many problems. Actually, there are few modern irrigation system which are in practice will mostly fail in one or the other way. The automation in the area of irrigation will play a vital job; consequently, engineers battle to turn out with consolidated automated devices with the end goal to make complex systems that assistance humans in its exercises so the system should processes itself automatically with no human mediation.

For the irrigation system atomization is very much essential because of the shortage of water in soil and lack of rain. Automatic irrigation system with solar tracking is the alternative solution for this type of situation. Agricultural system in world is always in need and depends on the presence of water in the soil. The continuous pulling out of soil water will reduce the moisture level of the soil. To overcome this issue intended irrigation system has to be followed. The better utilization of the available water will reduce the amount of wastage of water significantly. For this reason, automatic irrigation system is to be designed which will use the solar energy.

The automatic irrigation with solar tracking system receives sun light through photo-voltaic cells. Therefore this system is not dependent on electric power. This automatic irrigation with solar tracking system uses solar energy to power the irrigation pump and the circuit comprises of sensors which will sense the soil for its dry or wet condition.

Programmable logic microcontroller is utilized to control the automatic irrigation system. The sensor available in the system will detect the level of moisture in soil and provide the signal to the microcontroller unit connected to the pump. The signal from the sensor received from the comparator and it is processed by the microcontroller by the use of program stored. The pump remains off in wet condition of the soil and on in the dry condition.

Sunil Nalamala et al [1] designed and implemented the real time irrigation system using a wireless sensor network. The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. Marie France Leroux et al [2] designed and developed the automated irrigation system with the feedback system to resolve the complexity and stability issues. The design has consumed less power and shows the reducing consumption of water. M Lincy Luciana et al [3] designed the automated drip irrigation system which uses the programmable interrupt controller. This system uses temperature and moisture sensors which senses and condition of the soil and act according. Mahesh et al [4] automized the irrigation for an agricultural system which utilizes the ARM7TDMI core, which is a 32-bit microprocessor, and GSM which serves as an controlling the irrigation on field and sends them to the receiver through coded signals. Mahir Dursun et al [5] developed the wireless application for drip irrigation. To use the water optimally they used soil moisture sensors. The main objective of this work is to describe an application of a wireless sensor network controlled irrigation system and real time monitoring of water content of soil. Pranita A Bhosale et al [6] developed automatic irrigation and measured the different parameters such as atmospheric temperature, humidity, wind speed and direction, temperature of soil, rain fall etc. Their main objective of their work is to develop low cost time based microcontroller based irrigation system.

Venkata Naga et al [7], and Shiraz Pasha et al [8] developed micro-controller based automatic irrigation system. The system developed is based on the 8051 micro controller programmed to give interrupt signal, and temperature and humidity sensors are connected to internal ports of the micro controller via comparator. Tahur Boutraa et al [9] developed the automatic irrigation system. The main aim of this work is to design and develop the automatic irrigation system in comparison with the manual system. This system was implemented in the different regions of Saudi Arabia for the wheat field. Plant growths were recorded under two different conditions, 80% and 40% of the field capacity which are controlled by sensors which are connected to micro-controllers. The sensors detect the water quantity and compensate the water loss in the soil.

From the literature review it is clear that much work has been carried out on the development of automatic irrigation system. All the automatic irrigation systems consist of the temperature and humidity sensors which sense the condition of soil and acts accordingly. The signal send by the sensors will be processed by the microcontrollers. Thus the irrigation system is controlled by the microcontrollers. The whole system will use the electric power to operate the motor or pump to maintain the suitable conditions of soil. Irrigation to growing plants will take lot of time and resources. The resources may include water, power, human resources etc. Technology advances reduces the man power but some of the energy is still wasted. One more drawback of the available automated irrigation system is the use of electric power. In the rural areas there is a lack of availability of the electric power. With this constraint the use of automated irrigation system will not be possible in the rural areas. Technology is probably a solution to reduction of costs and prevents loss of resources.

In this background, it intended to use the effective utilization of the available resources such as sunlight i.e., solar energy. In this work an attempt has been made to develop the solar tracker to operate the motor/pump. Solar tracker is the system which tracks the sunlight for solar panels.

2. SOLAR TRACKING SYSTEM

It appears you can't stroll down the road nowadays without running over a sunlight based board. You can discover them illuminating crosswalk signs, portable power for development, and additionally basic little walkway path lights. Sun based is anything but easy to utilize, promptly accessible, and inexpensive. So for what reason aren't we utilizing it to control our homes? Figure 1 shows the principle of solar stracking.

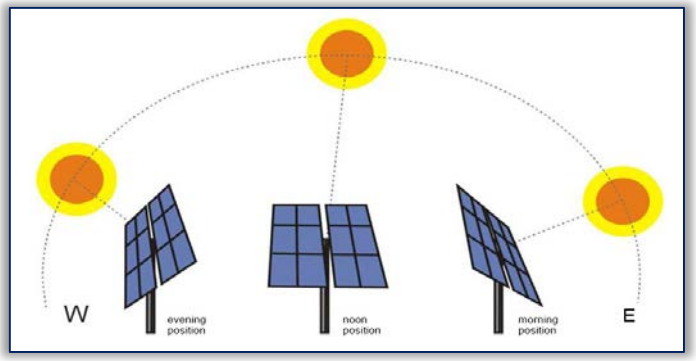

Figure 1: Principle of Solar Tracking

Generally our regular consistently sun oriented cells keep running at an effectiveness of 18-20%, which means they convert 18-20% of the ordinary get into power. While this is much better than the 3-6% effectiveness that most green plants wind up with, it doesn't exactly meet our capacity needs. To acquire adequate power we either need to enhance the proficiency of our boards or discover methods for getting more from our current sun based boards. Each board you find in your everyday life is in a settled position, in all probability confronting south at a 45 degree point. While this methodology is amazingly basic and addresses the issues of most little applications, it isn't delivering as much vitality as it could be. The single most straightforward method for obtaining more vitality out of a sun based board is to have it track the sun. In reality solar oriented boards that track the sun make around 30% more vitality every day than a fixed board.With that sort of intensity increment you'd Figure everybody would do it, however there are some valid justifications why it's not excessively normal: (a) setup requires the higher initial cost because of many moving parts, (b) continuous maintenance due to exposed to outside environmental conditions throughout the year, and (c) this system requires power to operate. There are different classifications of present day solar tracking methods are incorporate, active and passive solar tracking, Chronological solar tracking, and Single and Dual axis trackers.

3. FABRICATION OF SOLAR TRACKING

The way to this undertaking is having a practical structure to put it on. To do this we'll require access to a laser cutter and some quarter inch wood or acrylic (or we can stick two 1/eighth inch sorts out). To begin we will connect the Servos to their mounts. Line the servo up with the screw openings, and afterward thoroughly utilize the two Servo screws to anchor it put. Once set up give it a little pull to ensure it's protected. Locate the second wooden Servo mount. We'll be doing likewise here with our second Servo. Mount it on the "back" of the mount with the two screws it accompanied. Figure 2 shows the assembly of components of the solar tracking device.

We'll be appending the Servo Arm to two of these openings utilizing two Size 2 Wood Screws at ¼th inch length. Begin by laying the round wooden piece on the table with the etched arrow facing down. The bolt side is our "top" side, and we need the Servo Arm to be screwed into the "base" side. Make certain that the crown of the Servo Arm is looking up, and not covered in debt and line up the little gaps of the Servo Arm with two of the openings in the wood. For our situation this brought about us utilizing the second gap on one side and the third opening on the other. By hand (without utilizing

a screw driver), gradually curve the screw into the coveted gap. When it's shortly you can utilize your screw driver to get it completely through. Go slowly as to not break the arm.

First append the four legs to the round servo holder. The Servo should be inside every one of the legs, between the base plate and the round servo holder. Try not to fix the screws the distance, leave them somewhat free (as shown in Figure 3). Now fit the four legs into the base plate. Ensure that when you do this the servo wire is situated with the goal that it's returning out towards the where all our gadgets will be. When every one of our legs is screwed into the base plate return and fix the four screws that join the legs to the round servo holder. In conclusion, put the four elastic feet on the base of the base plate so the spoil heads don't scratch your work surface.

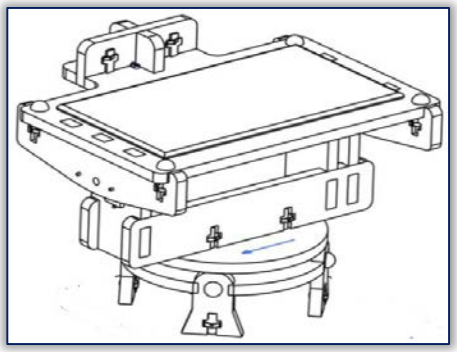

Figure 2: Components of Solar Tracking

Take the two long pieces, the second servo mount, and the two different pieces that resemble your Servo mount. Pop them together, and after that instituted them on the round board. Focus. The Servo ought to be "within", and the bolt side of the round piece ought to look up. Now you ought to have three wooden structures collected autonomously of one another, one expansive and long screw, and the two minimal servo machine screws remaining.

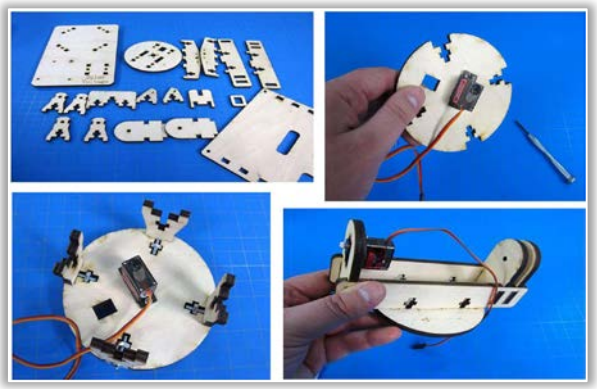

Figure 3: Fabrication of Solar Tracking device

The basic components of the automatic irrigation system are shown in the Figure 4. Some of the components used here in the design of automatic irrigation system are along with solar tracking system, servomotor, temperature sensor, soil moisture sensor, water Pump, LCD Panel, Arduino UNO micro-controller, Arduino software (IDE) etc.

The automatic irrigation with solar tracking system accepts sun light through photo-voltaic cells and hence not depends on the electric power. This automatic irrigation with solar tracking system uses solar energy to power the irrigation pump and the circuit comprises of sensors which will sense the soil for its dry or wet condition. Arduino UNO microcontroller will control the automatic irrigation system. The sensor available in the system will detect the level of moisture in soil and provide the signal to the microcontroller unit connected to the pump. The signal from the sensor received from the comparator and it is processed by the microcontroller by the use of program stored. The pump remains off in wet condition of the soil and on in the dry condition.

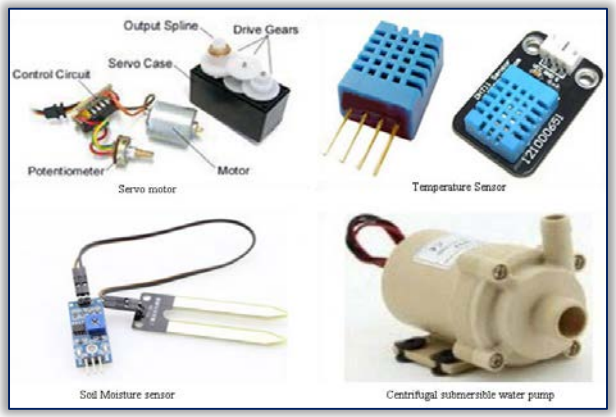

Figure 4: Components of automatic irrigation system

4. METHODOLOGY

The circuit of the sun based tracker structure is separated into three segments. There is the input organizes that is made out of sensors and potentiometers, a program in inserted programming in the microcontroller and finally the driving circuit that has the servo motor. The input organize has two LDRs that are so masterminded to frame a voltage divider circuit. A C program stacked into the Atmega 328P forms the embedded software. The block diagram of solar tracking system is displayed in Figure 5. There is a metallic casing that houses the segments. The three phases are planned autonomously before being joined into one system. This methodology, like stepwise refinement in secluded programming, has been utilized as it guarantees an exact and sensible methodology which is straight forward and straightforward. This additionally guarantees if there are any errors, they are freely considered and adjusted.

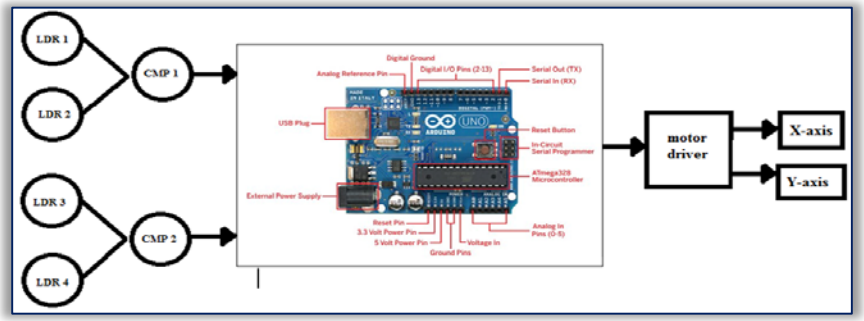

Figure 5: Block diagram of solar tracking

5. RESULTS AND DISCUSSIONS

After construction of the automatic irrigation system with solar tracking, the whole setup is tested for its performance. To check its performance, two experiments were conducted. The whole system is first simulated by ISIS simulation software to validate the final control algorithm to be implemented. A specific consideration has been given to the solar tracking system. Exploratory examination is completed to assess the execution of the tracking system in research center by utilizing a light source to reproduce the sun. The outcomes demonstrate the legitimacy of the control of the irrigation system.

From the software simulation of the whole system, the data power produced with respect to the time has been recorded. The data recorded on the bright sunny day on 2nd May 2018. The plot of the recorded data is plotted as shown in the Figure 6. Form the graph, it can be observed that fixed panel will start producing its maximum power i.e above 100W after 10am. It will maintain the same power till 3pm in the evening. Whereas single axis and dual axis solar tracking system have produced the 110W before 9am and maintain the same till 5pm in the evening. Also dual axis solar tracking system will produce more power as compared to single axis solar tracking system.

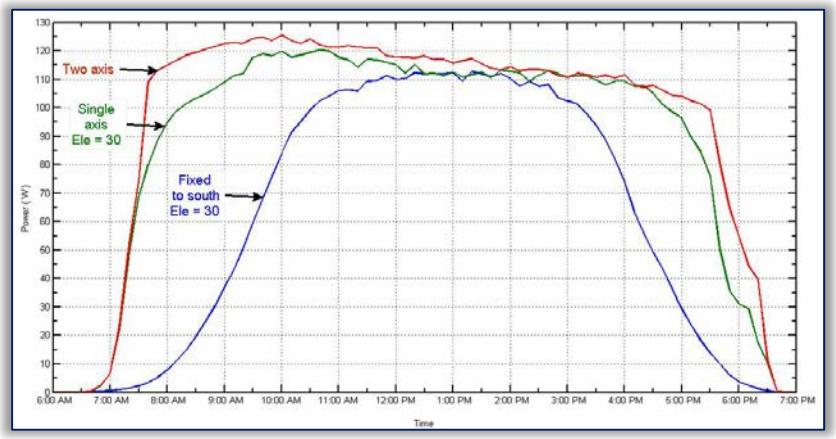

Figure 6: Power v/s Time graph

6. CONCLUSIONS

The automatic irrigation system with solar tracking is advantageous to the agriculturists when this system is actualized. At the point when the soil needs water is specified by the sensor by this automatic irrigation system is executed. When the crops require the water it can be automatically supplied by the system. The energy expected to the water pump and controlling system is given by sun powered board. Automatic irrigation system is utilized to optimize the use of water by diminishing wastage and decreases the human work. The system requires insignificant support and consideration since they are self-beginning. To additionally upgrade the everyday pumping rates tracking arrays can be executed. This system exhibits the attainability and utilization of utilizing sun oriented PV to give vitality to the directing necessities for sprinkler water system. Even though this system requires more investment but it solves more irrigation problem after long run of this system.

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