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RESEARCH ARTICLE OPEN ACCESS

Advanced Irrigation System Using Solar Energy

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Abstract: *This paper proposes a model of variable rate automatic microcontroller based irrigation system. Solar power is used as only the source of power to control the overall system. Sensors are placed on the paddy field and these sensors continuously sense the water level and give the message to the farmer informing the water level. Without visiting the paddy fields, farmers can get the information about the water level. Based on the water level, a farmer can control the motor by sending a message from his cellular phone even from a remote place. However, if the water level reaches to the danger level; the motor will automatically start without confirmation of farmer to ensure the proper water level in the site. At the end of this paper, a complete hardware implementation of this proposed automated irrigation system is presented.*

Keywords':Solar Energy, Irrigation solar energy, solar water pumping, drip irrigation solar power.

INTRODUCTION

Farmers have always played a significant role in our society as they provide the world's population with food. However, one may forget that, not only do they provide food but they also provide energy, which nowadays, is of paramount importance, especially as in light of renewable energies. Indeed, farmers can produce energy from the wind, the sun or the biomass and they can use it for their own farm, or, if they have a surplus, resell it to companies.

Solar energy might be one of the easiest ways for farmers to produce energy. Indeed, farmers usually have several large buildings whose roofs are directly under the sun, without being hindered by the shadows of the trees, turning them into an ideal place to settle a photovoltaic system. Therefore, the use of solar energy in agriculture is becoming increasingly popular and the energy produced from this renewable source can be used either on the farm or in the local power grid, providing the farmer with an additional income.

CONCEPT DEVELOPEMENT

To develope an optimized solar power irrigation system ,several concepts were analyzed and subsequentli ranked for there positive and negative attributes.

Below is a description on the concept generation and selection process.

1.Concept generation

Developing concepts for the solar powered irrigation system was done as individually and in a group during brainstroming session .some research was conducted before these sessionsto understand the all the components should be required in the impliment of an irrigation system .

Some of these factor as a photovoltaic solar pannel , water pump, and an inverter and controller are crucial to design requirementsin mind, functional decomposion was lay out the critical action that the various components would need to perform.

The components with a most flexible in implimentation would bwe the irrigation system attached to the water

pump , spray furrow, floodig, above and below ground drip system were the major concepts analyzed.

And tyese all things are perticulearly available in good cost and including all advantages and disadvantages and system having a good climate ,one unique system is wll desined.

One of the concepts to be generated was to inclde all of the key factor needed to syccesfully irrigated the plot and preferably optimized the model.the system included a photovoltaic solar panel that powers a water pump through an inverter and controller as to not damage the pump due to power fluctions.

From there water would be pumped into an elevated water storage container at a height approriate to a network of drip irrigation lines.

While these system holds the most potential for our application other concepts were also evaluated thesen all require the water pump be powered by a solar pannel but differ in the irrigation system. Both of the inefficient in their water usage and not well adopted for arid regions. Additional features can also be added to the system to make it more automated but add cost to the project and may not be necessary.

Battery storage that would allow the pump to be run when solar is low is being considered but may be unnesecssary with a large enough water storage container. A float sensor, on the other hand , which is designed to shut off the water pump when the storage container is full may be one item that is cheap and easy to implement and reduces the risk of the pump running for too long and wasting water and energy.

2.Concept selection.

With a user determined task of providing water through an irrigation system to a small farm utilizing a solar panel to power the well water extraction process, we had the opportunity to create an array of solutions that would help us accomplish this task.our concept selection began by acknowledging various combinations of components that would help us accomplish these task.

Our concepts selection began by acknowledging various combination of componets that would utilized solar power to irigate a garden .some environmentaldatails considered when creating concepts included:no standars galayout and the system will be managed by four individuals.with these information we kneew our system would have to be flexible in its ability to water different location while still being able to perform reliably. Still unclear is who will be building the fianal system.

Our concept selection process was focused on the layout , eficiency, cost and easy of implimentation of our system ,rather than establishing individual component specification .since the solar panel and pump can be optimized for the specific application, these detail would be determined after the water use requirements were established . in order to determine our system layout ,a plug chart was created with various criteria of different weights. Criteria such as adaptability and low mainteanance were weighted the most valuable. This is because we want oursystem to be able to adapt to the farm and the plants our users decide to harvest. Since our location is on the other side of the globe with inconsistent , our ability to provide assistance on our system is very difficult; thus having a robust design that has a long life span is important .

We choose the system that is compared of a solar panel and water pump that floods the cuttert farming technique with the exception of a solar powered pump which is a user requirement .

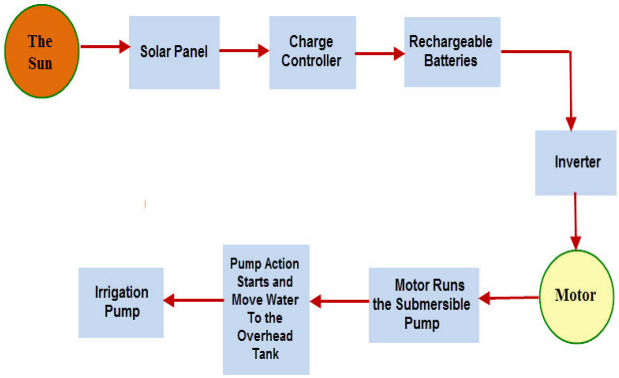
3.Chosen Design Mockup

For our mock up we used materials that we found in the 350/450 lab room as well as materials we had collected from home and other design courses. Though it is not to scale we wanted to show the overall design of what our system would look like.

Figure: Concept Mockup showing the major components

As seen above there is a solar panel, the rectangle of duct tape, connected to the pump which is an old broken motor which feeds the storage tank which is just a cylindrical piece of foam. The pipes are drinking straws and the drip tape is old bits of wire. This model shows

how condensed the whole system could be depending on available space in the existing garden. We also see how our design can be changed and have different options for growing rows as the drip tape could be arranged in different sections depending on the grouping of plants.



METHODOLOGY

This project is based on sustainable and economical development for the farmers by utilizing natural resouces. The methodologies in this project solar panel for the drip irrigation system and also using solar panel for street lighting for small village.

1.Solar Radiation

The amount of energy received from the sun at a given location. This determines how much power each solar module will generate in a day and the size of array needed to pump a required volume of water.

The amount of solar radiation according to:

1. Geographic location
2. Time of day
3. Season.
4. Weather

Peak Sun Hours

It is the number of hours where the earth receives 1000 W/m2. During this few hours the Solar Panel shall be sized to overcome all the Derate Factors and operate the pump at maximum speed with maximum frequency 50 Hz and minimum frequency 20 Hz.

2.Solar Array

A solar array is the electrical combination of a number of solar modules. The power output of this array will be the sum of the power outputs of the combined solar modules.

Fixing the array in the optimal tilt and orientation,

Fixing the array so it has the optimal tilt and orientation is generally the cheapest option and the one that involves the least maintenance.

Variable Manual tilt angle,

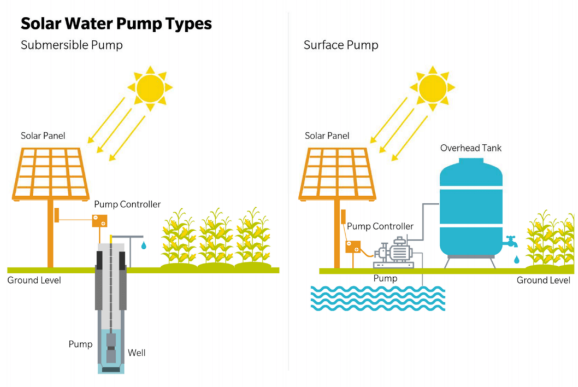
The optimal tilt angle for each month/set of months is calculated according to changes in the altitude of the sun over the months. Single- or dual-axis tracker that follows the sun, we can extend the time of available maximum power and thus produce with greater capacity more hours a day.

3.Control Systems And BOS

The variable speed drive system is probably the most adequate for the agricultural sector. This system uses a variable speed drive that connects and regulates PV Panels and the diesel generator if found . Depending on solar irradiation and the size of the power plant, the diesel generator can be turned off completely. VSD acts as inverter and at the same time as the controller of the pump.

4.Pump

The variable speed drive system is probably the most adequate for the agricultural sector. This system uses a variable speed drive that connects and regulates PV Panels and the diesel generator if found . Depending on solar irradiation and the size of the power plant, the diesel generator can be turned off completely. VSD acts as inverter and at the same time as the controller of the pump.



COST ANALYSIS.

With over nine hundred thousand tube wells being used in every state of india, around Rs.18 million of energy is used for pumping water for irrigation. This amount of money used for electricity can be saved with help of solar water pump. Annually thecost of nearly five million kilo watt hour of energy can be spared. That is around Rs.27 million per annum can be redeemed which comes around 40% of the total amount of investment.

Even though the initial investment is high, it can be earned back in 2 and a half years' time. If assume the cost of poer is Rs.1.5 million per kilo watt hour, Rs.18 million is used for pumping water alone in year. By using the solar water pump, we can save up to 4.8 million KWh of energy annually which saves a lot of energy. The excess energy can also be given to grid with small modifications and investment in the circuit, which can add to the revenue of the farmer.

Components	Unit cost	quantity	Total cost
Solar panel(1.4m^2)	96000	4	Rs.96000
Converter circuit	400	1	Rs.400
Battery 24V,100Ah	8250	1	Rs.8250
		Overall cost	Rs.104650

CONCLUSION

By implementing the proposed system there are various benefits forthe government and the farmers. For government a solution for energy crisis is proposed. By using the automatic irrigation system it optimizes the usage of water by reducing wastage and reduce the human intervention for Farmers.

To further enhance the daily pumping rates tracking array can be implemented. This system demonstrate the feasibility and application of using solar PV to provide energy for the pumping requirements for sprinkler irrigation. Even though there is a high capital investment required for this system to implemented, the overall benefits are high and in long run this system is economical.

In present days the available sources of fossil fuel gradually decreasing resulting, the increase in their cost. The electricity is being generated by thermal power plants using coal.

The cost of commercial electricity is very high in these days, resulting unaffordable cost of electricity for a poor farmer,while solar energy is natural source power generation. It is more reliable and also conservative in nature and easily available free of cost.

Introducing Drip irrigation system with solar energy, it shows efficient work and reduced losses of water and cost of commercial energy about 90%..

The Battery with the solar panel gives a backup of 2-4 days, therefore when its winter or rainy season when sun hides ,it would be good enough to get through the day till the next day or else will use regular power as a backup.

Drip irrigation can help you to use water efficiently. The immediate benefits of drip irrigation are reduced water use by 30-40% as compare with Furrow Irrigation and 50-60% as compare with Flood Irrigation system , and gives opportunities for maximizing the production while minimizing the cost. The maintenance cost of Drip irrigation systemis low and is reliable for 4-5 year.

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