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Solar Water Pumping Station for Automated Irrigation

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Abstract:

Major essential for this study included solar panels that used to drive the water pump. The water pump was important to extract water from the source and fed to the reservoir. The specification of solar panels and pump relied on the water amount that needed for proper irrigation of farm products, thus being major study driver. The required power output by the panels was determined by water pump used which specified by the well depth. The goal specification of irrigation system and out of engineering designation were determined by carried out considerable concept and conducted functional decomposition. The detail such as energy storage, water storage and irrigation system was done to evaluate design framework on cost-effective, feasible and study fundamental. The scoring was important to position the concept depended on their advantages and disadvantages. Sequentially, a proper system was chosen to supply water in the arid region was the system that employed the elevated storage of water reservoir that administers potential energy fed to the water lines to a drip irrigation system. This system was chosen for its efficiency. The examination of system and potential of theoretical miniature were analyzed through the scale model that acted concept proof.

Keywords: solar-powered; irrigation; photovoltaic system; reservoir; solar panel

1. INTRODUCTION

There is 97.5% of water on the earth surface is seawater with TDS higher than 35,000 ppm even three quarters of earth surface covered by the water [1,2]. The increment in human population , inefficient of water usage and deforestation in productive sectors has been reduce the water resources availabilities [3]. Meanwhile, water is major limited factor for survival and growth tress in arid and semi-arid regions and lack of water had affected tree physiological and biochemical reactions [4].

There are several alternate methods used in deserts for watering the plants and irrigation system such as porous hose irrigation, deep pipe irrigation, perforated pipe, porous capsule irrigation, wick method and buried clay pot irrigation. The porous hose irrigation method uses vertically placed section of porous hose to wet the soil [5]. This method is installed at planning time or before by drilling a hole in the soil to the desired depth and inserting the hose. The hose is connected to the water tank and work at the low pressure. The water is delivered by porous hose throughout the soil column and porous hose placed in

the soil. The series of porous hoses used to develop wind firmness in windy areas which are being placed in a tri-slotted planting hole.
Meanwhile, photovoltaic water pumping system also is alternative methods for irrigation. This system conserves electricity by decrease grid power usage and conserves water by reducing water losses [6,7]. The photovoltaic cells which collect the sunlight and convert to the electricity and the cells are wired in series, sealed between sheets of glass or plastic and supported inside metal frame [8].

The study aims to develop solar-powered irrigation system model used in the desert which there was no electricity but sufficient in sunlight from the sun. In a society that has agriculture as min economic activity, there is a need for sufficient water in farmer farm so that the food supplies were enough for the family and sales.

2. METHODOLOGY

The irrigation system was proposed had two modules such as solar and pumping mechanism modules. The solar mechanism with specific requirement was escalated near pumping mechanism.

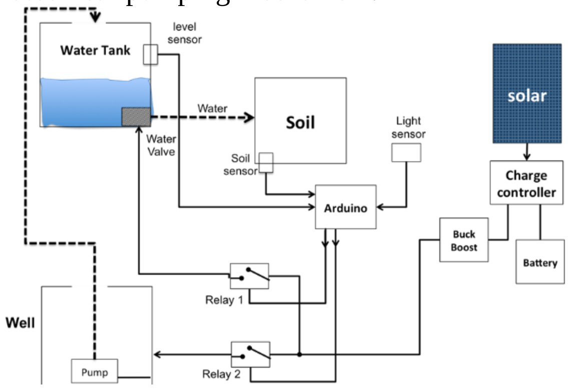

Figure 1. Block diagram of system mechanism.

Based on Figure 1, the power bank which was the battery was charged by control circuit aid. The battery had converter circuit which in, turn facilitate the powering of submerged pump in the well. The water was pumped into the reservoir before released into the irrigation field. The irrigation module was automatically controlled in the tank had outlet valve that was electronically controlled by the soil moisture sensing circuit. The moisture content in the soil was converted into an equivalent voltage by the sensors which are located in the field. The voltage on the sensing circuit was adjusted in setting different levels of moisture for different plants. The water needed in the field was controlled by the difference in voltage triggered by the sensors. The stepper motor had signal control whose rotational angle was correlative to the voltage difference. The valve that controls the water flow was controlled by the stepper motor.

The solar panel was placed at southern part of region faced to the north which reduced the blocking of the sunlight from hitting crops on the farm which achieved by the tilted angle of solar panel depended on the latitude of the region with help of clinometer. The pump was supplied with power from the panel. The pump was extracted water from the well near to the setting. The extracted water was channelled to the elevated water reservoir so that the mandatory potential energy was achieved. The enforcement of full -scale system was determined through the water needs circulation study, the environmental factors such as hydrology, area size on which the study stands and meteorology. Table 1 showed project specifications that used in this study.

Table 1. Project specifications.

User requirement	Relative priority	specifications	Rationale
Pump	High	5Hp	For extraction of water from soil
Solar panel	High	PVL-68	Used to generate electricity from the sun to reduce dependency on traditional power sources.
Amorphous silicon cell	Moderate	25V, 55W with an array capacity of 240 W and irradiance of 570W/m^2	Used to store energy
Store water	Moderate	10001	Used to store maximum amount of water in deserts.
Minimum water usage	Moderate	Solar irrigation	Its limit evaporation losses in an arid environment

There was important to determine PV system size or cells for store maximum energy used the solar system.

For this study, 10MW solar farm was desired size for this study a solar farm was utilized amorphous silicon

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modules in approximately 150 acres of land. The watering plant method had put lot of strain on the pump. The pump was constantly turned on and off which produced a consistent power derived from solar panel and not affected more by power fluctuation in the grid used as a controller. The solar panel portion development of system required the data-driven decisions. The PV system equipment specifications was evaluated on panel selection, wiring configuration design and inverter voltage input window.

The Anker 13W was dual port solar charger had four other separate panels which covered to examine different outputs. The solar chosen was capable charged cell phone thus producing 5V per USB port. Meanwhile, a submersible water pump under test was provided with 5V through USB> The pump was used as non-submersible pump need to be primed.

During small solar panel contacted with solar radiation, the photovoltaic cells in the panel produced electrical energy. The solar panel was directly connected to the pump. The pump was fed with electrical energy power and slowly water was extracted from small bottle that acted as water source and extracted water was fed into small bucket as volume. The small bucket was water reservoir was elevated at different height. The collected water was out through outlet pipe. The water flow rate was done by ball valve connected main pipe to the irrigation scheme to the reservoir.

3. RESULT AND DISCUSSION

Most significant design driver was water required to facilitate crop irrigation. The system component optimization was done while resolved required water at peak phase in the cycle of growing plant. The water requirement depended on the land geometric layout of the land, crop types, plant growth stage and evapotranspiration.

The sunlight conditions was suitable for produced reading on the system for solar panel test as shown in Figure 2. The sunlight was full bright and filled directly onto panel to obtain the output rate of solar panel. The voltmeter was measured output voltage of solar panel and measured with charge controller.

Figure 2. Solar panel was tested on afternoon.

The moisture sensor had tested according to its principle such as the probes of sensor sense any moisturize environment was gave feed back to the Arduino by digital signal “0” or “1”. The Arduino acted as controller of system considered output result “0” as OFF and “1” as ON.

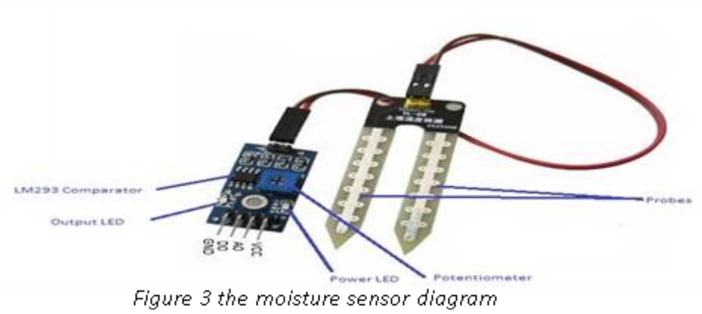

Figure 3. The moisture sensor diagram.

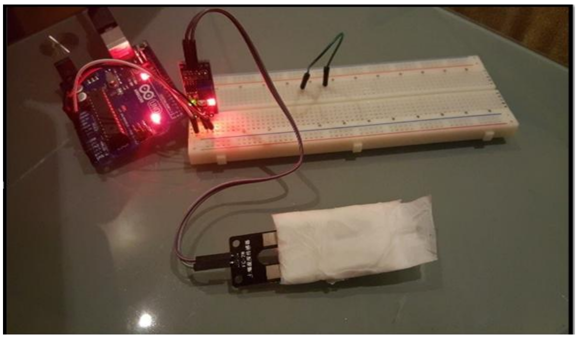

Figure 4. Test circuit of moisture sensor.

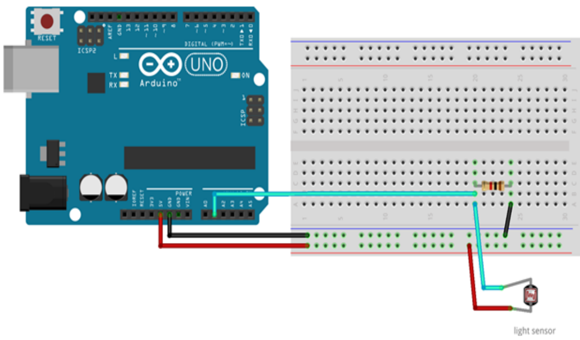

Figure 5. Test circuit of light sensor.

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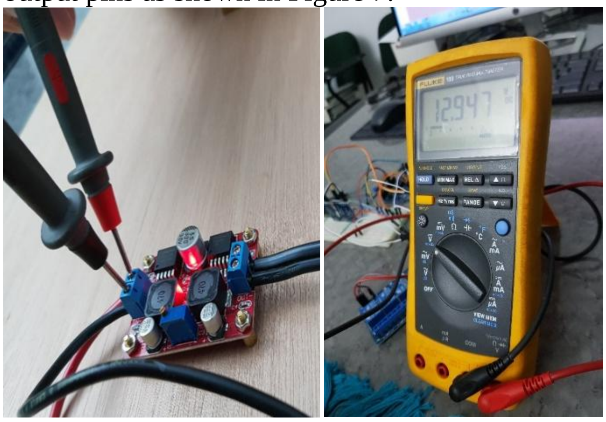
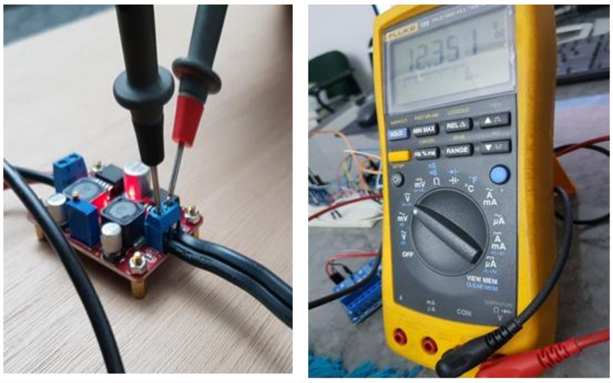
Figure 6. Test result.

The buck boost concept was regulated voltage meant if the input voltage lower or higher than setup point the buck boost was regulated until reached the setup point. The voltmeter was used for measured the input and output pins as shown in Figure 7.



(a) (b)

Figure 7. (a) the input pins of buck boost and input voltage result.



(a) (b)

Figure 8. the output pins of buck boost and (b) output voltage result.

4. CONCLUSION

In conclusions, the solar powered system was played greater role in case of lack in electrical energy. For irrigation in an arid region, the solar photovoltaic pumping systems offered an alternative mean for electricity demand. The proposed solar-powered system was maintenance free and had long lifespan. In future, the drip lines flexible was suggested but strong to withstand external forces and need for increasing solar panel numbers to increase power output. The design and construction of the prototype were possible because readily available components for purchase and possible for the full-scale solar-powered system design.

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