Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 12, December-2020

Solar Powered Cattle Dip Spray

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Abstract: **This paper describes a dip spraying system which can be used to spray dip nixture on livestock such cattle for control of parasites. The system is designed such that it can be used at remote locations where there is no extension of national electricity grid. The system uses solar power as its energy source to drive electrical equipment. It is an automated and is designed such that it detects the oncoming animal and triggers the main power circuit to operate booster pump to spray dip mixture through the nozzles. Once the animal has passed the sprays stops operating. The results obtained show that the system is effective and can be installed at places without any access to electric grid. The results also showed the effectiveness of the system by showing that it can spray the whole body of the animal at once within a short period of time. The work is still ongoing as the results was obtained by using a prototype. The next stage would be to build the system at one of the farms and demonstrate it under real life environment.**

Keywords— Dip spray, photovoltaic, automated system

I. INTRODUCTION

Cattle dip spray is where cattle are passed through with a purpose to activate a mechanism which would spray dip solution all over the body on an animal. It is meant for the control and killing of parasites such as ticks which would otherwise stick to animals if not controlled. Besides killing of parasites it controls the parasites by breaking down its live cycle and this will in the long run clear the place of parasites. Dip sprays can be of different sizes and complexities depending on so many factors. Such factors can be whether the system is used for commercial purposes or for normal household purposes. Accessibility to amenities such as electricity is another factor. Considering that some places do not have access to electricity, operating some actuating mechanisms which are electricity driven become difficult or impossible. To address this challenge the proposed dip spray is designed to use solar energy as its main source thus utilizing solar photovoltaic energy system as its electric generator. Another important reason of opting for solar photovoltaic energy system over other energy sources such as diesel generators was to promote environmentally friendly energy sources. Solar energy is one of the clean energy source which does not impact negatively on ozone layer or does not have adverse effects of the environment. Solar energy is also abundant and renewable [1, 2]. This system once fully implemented would improve overall returns of farmers and improve the overall economy of countries particularly those whose farming, beef and diary, contribute significantly to their gross development products.

This paragraph outlines how the remaining sections of this paper are arranged: Section II deals solar photovoltaic energy system for powering dip spray, Section III details the design and components used to build a prototype, Section IV explains operations concept of the proposed system, Section V deals with equipment setup and the results, Section VI covers conclusion and future work

II. ENERGY SOURCE OF THE SYSTEM

Solar photovoltaic energy system is used as an electric generator to provide electricity to the system. The general principle of operation of the PV system is that solar photovoltaic energy system is used to convert solar power into electrical power through the use of photovoltaic modules. A general schematic diagram of solar photovoltaic energy system is shown in in figure 1. [1. 3, 4].

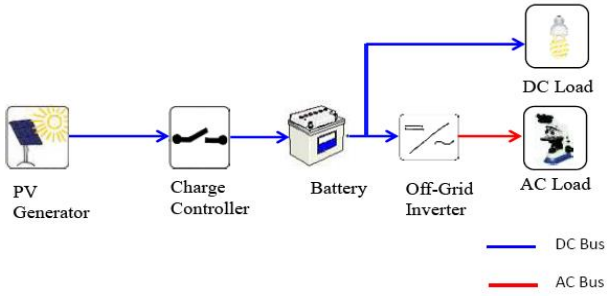

Figure 1 – schematic diagram of solar PV energy system [1]

The solar power which is incident on the solar PV module is converted into an electric power by the module. The output parameters of the module being voltage, current and power are depended on many factors such as environmental factors being temperature, wind velocity, humidity, solar irradiation, and many other factors such as geographical factors. However, the key factor or variable is the solar irradiation. It is important to get as much as possible to have more electric power from the module. To harness the solar power, most of the PV modules when installed in a fixed position, they are installed at a fixed tilt facing towards the sun. Different countries have different tilt angles because the angle is affect by different parameters such as angle of latitude of a place where the module is installed. Other factors include, example, module temperature, whereby the installed module requires enough ventilation to reduce the module temperature.

The power can be used directly as DC power or can be used as Ac power after having passed through inverters. When used to power DC load the battery supplies power directly to the load without any involvement of the inverter. Also another way of powering dc load is when the PV panel supplies power the load directly without necessarily being supplied through to the battery. It would automatically connect the battery if the power from the PV module is not enough. The importance of

International Journal of Engineering Research & Technology (IJERT)
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Vol. 9 Issue 12, December-2020

the battery is that it functions as a power storage and that at the time of cloud cover when there is not enough sunlight, the load can be powered from the battery.

The system has a charge controller whose primary function is to protect and prolong life span of the battery. It protects the battery against over charge and over discharge.

When the system is used to supply ac power, an inverter is introduced to invert a dc power to an ac power and thereafter being supplied to the load. In case of the dip spray system under design, the load is the booster pump.

III. SYSTEM OPERATION

The flow diagram in figure 2 outlines the principle of operation of the dip spray with a design layout as shown in figure 3.

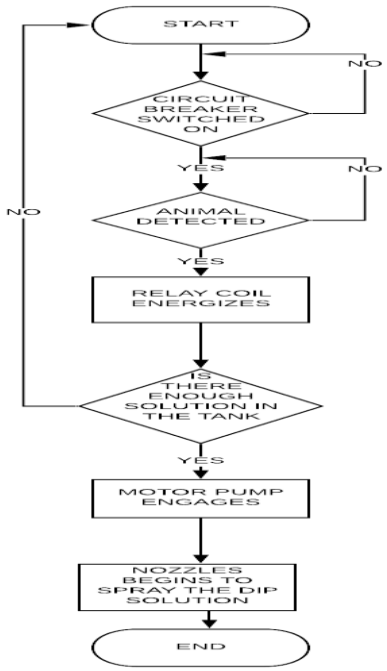

Figure 2 – Flowchart illustrating the operation of solar powered dip spray

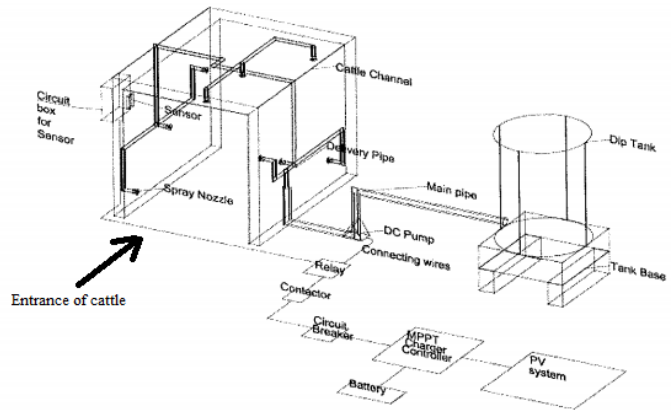

Figure 3 – schematic diagram of the design layout of dip spray

An enclosed walk-through structure is designed such that cattle are to walk through by entering at one end and exiting at the other end. The structure is equipped with spray nozzles at the roof, on the sides and at the lower ends all pointing towards the centre. The positioning of the nozzles is such that they much spray the animal on the entire body it walks past through the structure. Another component of the system is tank or reservoir containing the dip solution or mixture. Connected to the tank is an air-cooled booster pump which sucks dip mixture from the tank and pass it to the nozzles through piping which connects nozzles to the tank. The pump ensures that dip mixture comes out of the nozzles under high pressure. This is also assisted by nozzle design whose heads-mechanism can be adjusted vary angle of divergence of the spray leaving the nozzles.

The system is also equipped with instrumentation measurement and monitoring system. There is a motion sensors which detects the presence of animal as it enters a walkthrough platform. The sensors triggers the suction pump to operate thus operating the nozzles to spray animal with dip mixture as it walks through. With a delay time being one of the characteristics of the employed motion sensor system, after a predetermined period of time it de-energised pump's main circuit.

Another sensor employed as part of measurement system is the level switch located inside the tank to monitor the level of dip mixture. When the dip mixture has reached a mixture predetermine level, it stops the filling of the tank by de-energising the circuit responsible for filling up the dip mixture. The sensor also de-energises the power supply to the pump to protect the pump. The operation and integration of both the power and process measurements circuit are further elaborated on figure 4.

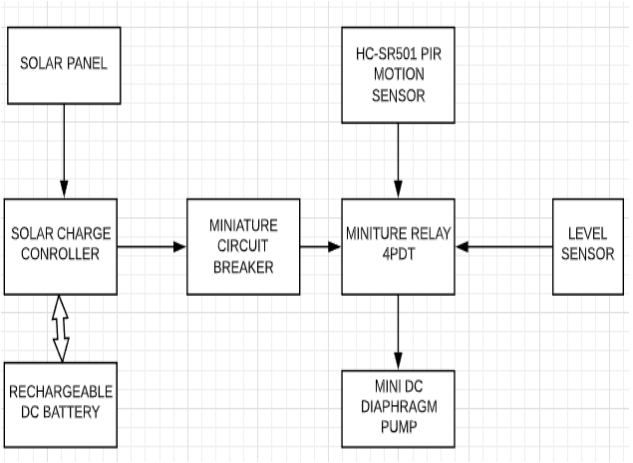

Figure 4 – Schematic block diagram showing power and process measurement circuits [5]

EXPERIMENTAL SETUP

The dip spray system prototype was built as shown in figure 5

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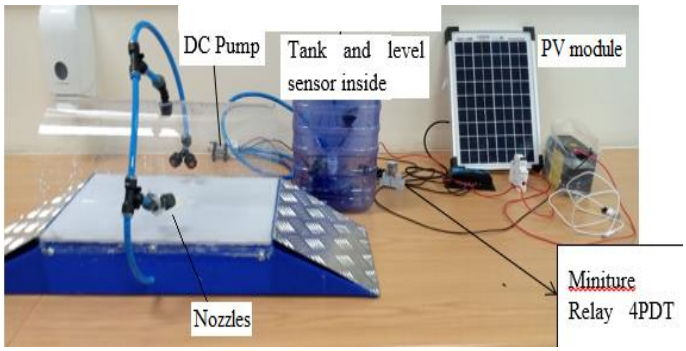

Figure 5 – prototype of dip spray system

The dip spray casing was made from acrylic material. To make the casing more durable the acrylic was moulded to have a ramp shape at the ends. The spray nozzles were arranged in four positions which were top, bottom and on the sides. The spray nozzles were arranged in four positions which were top, bottom and on the sides and fixed to the roof top and to the sides. Figure 6 shows the power circuit used to drive pump. The PV panel charged the battery through a controller which is there to protect the battery against overcharging and over discharging. From the battery the pump is power through a miniature circuit breaker.

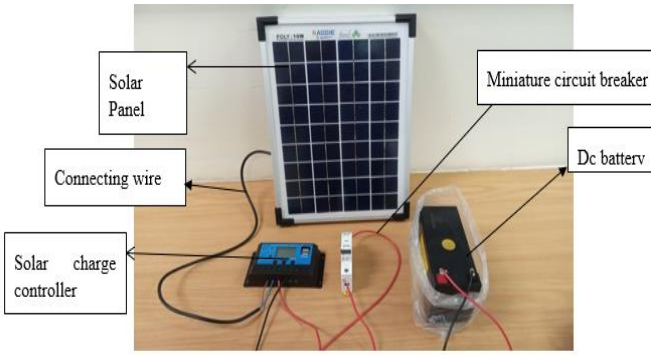

Figure 6 – Solar photovoltaic energy system used to power dip spray power circuit

IV. RESULTS AND ANALYSIS

The sensors were able to detect the movement which was made to resemble entrance of an animal into the walkway. This activated the measurement sensor which in turn also activated the power circuit through the relay, 4PDT. This resulted on the pump pumping the mixture from the tank to the walkway through the nozzles. The drizzle from the nozzle can be seen on the surface of the walkway as in figure 7. The drizzle continued for a period few seconds as depended on predetermined time delay. The time delay was set to cater for the average to be taken by an animal as it passes through the walkway.

Another property of the system also demonstrated during the experiment was the level of solution in the tank. The taken was emptied and the movement was made in front of the motion sensor. The power circuit was not activated by motion sensor because it was overridden by the signal from the level sensor which makes the power circuit to remain deactivated when the tank is empty.

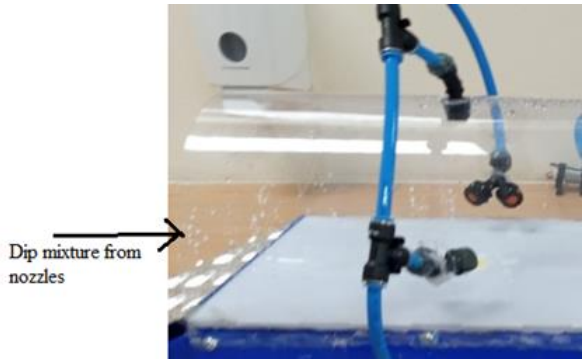

Figure 7 – Shows drizzles of dip mixture from nozzles

V. CONCLUSION AND FUTURE WORK

These results show that the designed dip spray operated according to the expectations because it was the intent of the design to sense the presence of animal entering the walkway and activate the power circuit to pump dip mixture. The design was also such that if the tank is empty the power circuit must not start the pump to protect it from damage. The result showed that the pump did not start when the tank was empty. Going forward with the project, the next phase would be to build a real system as a pilot project. When it is operating satisfactory it can then be rolled out on a wide scale.

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