SOLAR FED BOOST CONVERTER FOR WATER PUMP APPLICATION

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***Abstract*---Solar Energy has been drawing more and more attention than any other grid connected system.Photovoltaic power system found a wide application to meet the need of small essential loads. Solar power is used as only the source of power to control the overall system. The boost converter is used for increasing the voltage obtained from the panel and it is stored in a battery. The power for both microcontroller and relay to operate is utilized with the help of battery. Moisture sensors are being placed on the field and these sensors continuously sense the water content in the soil. Based on the level of water content, microcontroller will turn on and off the motor with the help of relay. Without visiting the field, farmers can receive the information about the status of the motor such as "MOTOR ON" and "MOTOR OFF". However if the moisture level reaches to the low level, the motor will automatically start**.

Keywords—photovoltaic panel; interleaved boost converter;moisture sensor;GSM;agriculture

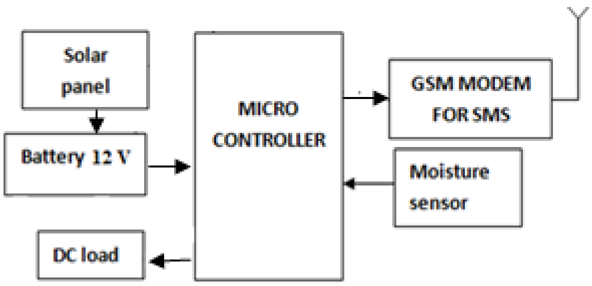

Fig. 1Main Outlook of the System

I. INTRODUCTION

The project is implemented for the irrigation system because of lack of rain and scarcity of water in soil. Agricultural field always depends on the water level of the soil. But continuous extraction of water from soil reduces the moisture level of soil. To avoid this problem, planned irrigation system should be followed. Improper use of water leads to wastage of significant amount of water. For this purpose, solar powered irrigation system is designed using moisture sensor. This system derives power from sunlight through photo-voltaic cells. By using sunlight energy the power can be gained for the irrigation pump. But the amount of voltage from solar cells needs to be boosted. For this purpose a boost converter is used. Each MOSFET in the boost converter is switched at the same frequency. This helps in boosting the voltage greater than the input voltage. The moisture sensor is inserted in the soil to sense whether the soil is wet or in dry condition. A microcontroller is used to control the whole system. When the moisture level of the soil is low then the sensor detects the soil condition and gives signal to the relay unit. Relay will turn ON the motor in dry condition and turn OFF the motor when the soil is in wet condition. The signal from the sensor received through the output of the comparator and it is preceded with instruction from the program stored in the microcontroller. Due to the presence of sensor crops will irrigate properly. Further the project includes a GSM modem to gain knowledge over the switching operation of the motor.

Astrand. B et al (2008), proposed automatic irrigation technique irrigated using wireless sensor network i.e. Zig-bee and internet technology.Zigbee also have disadvantage i.e. low transmission rate. It is only use for smaller distance[7].

JouquinGitierroz et al (2013), proposed that the automatic system was tested for 136 days and save 90% compared with traditional irrigation system. Three replicas of the automated system have been used successfully in other places for 18 months. Because of its energy autonomy and low cost, the system has the potential to be useful in water limited geographically isolated area[6].

Eaton. R et al (2008), proposed design a model of automatic irrigation system. Farmer controls the motor using cellular phone without going to the field. If the water level reaches at danger level, automatically motor will be off without confirmation of farmer[8].

The main objective of this project is to design a boostconverterforsupplyingthepowertotheDCmotor, driving a water pump andtoprovideaneffectiveway of pumpingwatertothecrops based on the moisture level in the soil, whichwillbeveryusefulfor farmers.

II. SYSTEM DESIGN

This system consists of a solar panel, which is the main source of energy and is given to the charge controller for extracting regulated power from solar panel at different irradiation and also to maintain correct charging voltage and current in order to charge the battery and increase its life. Water conservation in farm land is controlled using microcontroller with soil moisture sensor

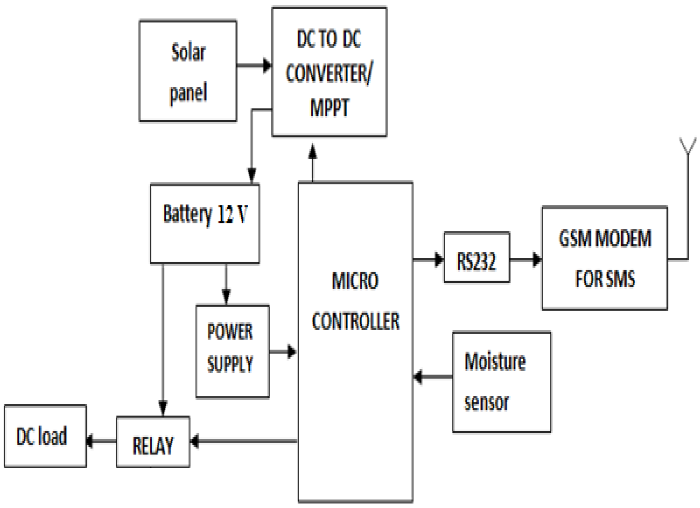

Fig. 2Block Diagram of Solar powered irrigation system

The boost converter is used to improve the output power of the solar panel.The boost converter gives higher output voltage compared to input voltage. Boost converter is a switch mode power supply contains a diode and a transistor with one energy storage element, capacitor. Filters are used to reduce output voltage ripple.

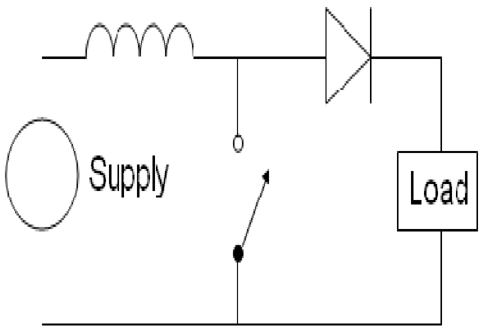

Fig. 3 Basic circuit of boost converter

When the switch is closed then the current flows in clockwise direction through the inductor and it stores some energy by generating a magnetic field. When the switch is opened, current will be reduced as the impedance is higher. The magnetic field previously produced will be destroyed to maintain the current flow towards the load. For this the polarity will be reversed (means left side of inductor will be negative now). As a result two sources will be in series causing a higher voltage to charge the capacitor through the diode D.
Soil moisture sensor is inserted into the soil for level of moisture detection and also it indicates different moisture level for different crops. In this system crops like paddy, wheat, and sugarcane can be irrigated.

III. SYSTEM ARCHITECTURE

The system uses solar power panel to energize the system and soil moisture sensor to sense the water level for crops. Solar power is used only the source of power to control the overall system, supply from the solar panel 12V is given to boost converter circuit. The boost converter circuit has resistance R1, R2 to control the voltage from solar panel. Diode act as voltage controlled device, inductanceare connected series in it. Through MOSFET device PWM pulse is generated to increase the stored voltage in capacitance. Constant voltage from boost converter is stored to 12V Battery. Regulators are used to regulate the 12V DC to 5V. 5V from regulator is used to operate the PIC microcontroller.The microcontroller act as a control circuit to control the overall process. It has 40pin IC each pin is connected for respective operation, soil moisture sensor are dipped in the soil to sense the humidity value. Signal from microcontroller to 12V relay is used to operate the motor pump. Water flow from the pump depends upon the signal from PIC microcontroller. The system is controlled by the PIC microcontroller. The irrigation is automated with soil moisture sensor and the relay unit. When soil moisture level is low then a signal is sent to the relay to switch ON the motor and when the soil is wet then motor will be in OFF condition. Relay gives the ON/OFF condition to the motor. The entire system is powered by solar panel energy. When the system uses solar energy then the electricity energy can be conserved. Regulator is connected to the PIC microcontroller to regulate the power supply from the solar panel. 16x2 LCD display is used to display the status of the humidity in the soil and show the level of the water with the help of sensors. The display is 2 lines with 16 characters in each line.

IV. SIMULATIONAND RESULTS

The working model of our project is done by software called “MATLAB”. The MATLAB is a test software. The version of MATLABis 2013a which is being used to develop our working model. Here the simulation for boost converter is done and the boosted voltage is fed to the dc motor and its properties are studied.

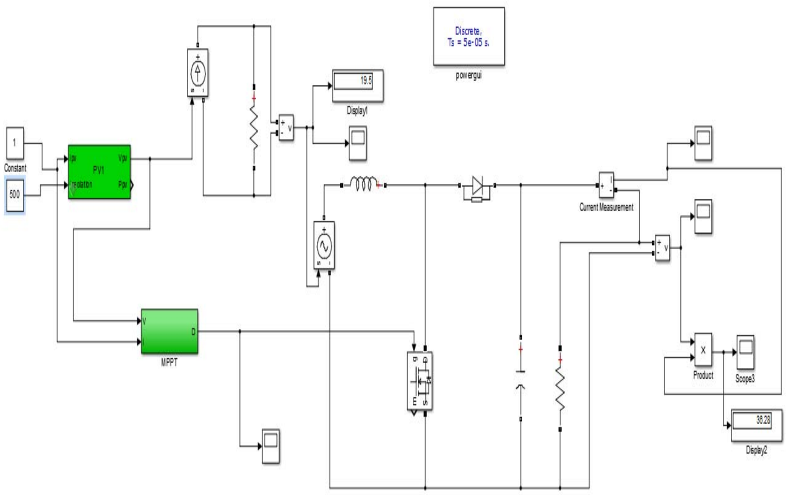

Fig. 4Complete simulation circuit

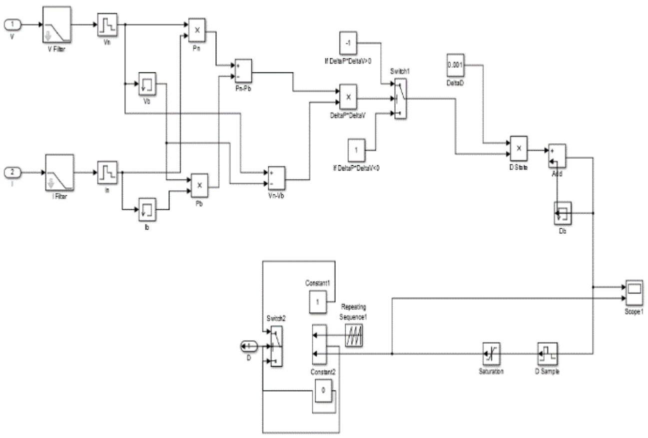

Fig. 5 Simulation Circuit for MPPT Technique

The current and the irradiance level is given as input to the PV panel. The output voltage is measured with the help of the voltmeter and is displayed in the display. The MPPT algorithm used is Incremental Conductance method. The boost converter helps in boosting the voltage up to 40V with the input of 20V.

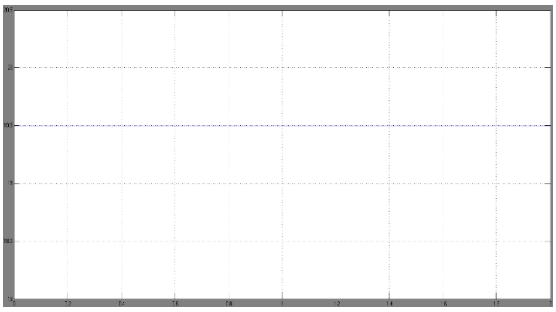

Fig. 6Input voltage is 19.5V when the irradiance level is 500 W/m^2

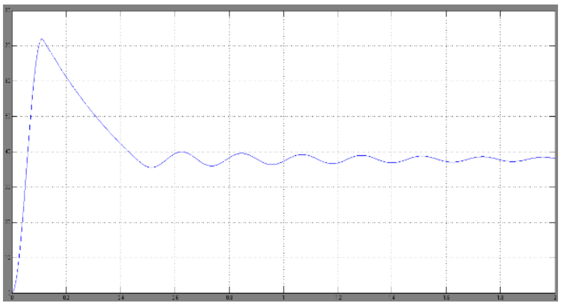

Fig. 7 Observed Output voltage is 38.09V when the irradiance level is 500 W/m^2

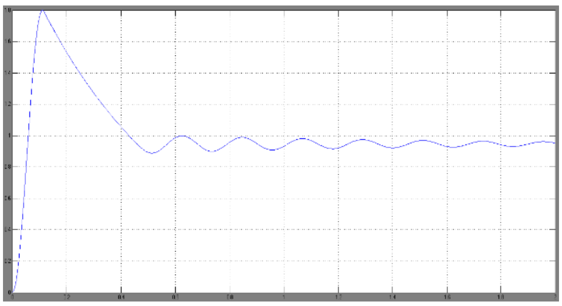

Fig.8 Observed Output current is 0.95A when the irradiance level is 500 W/m^2

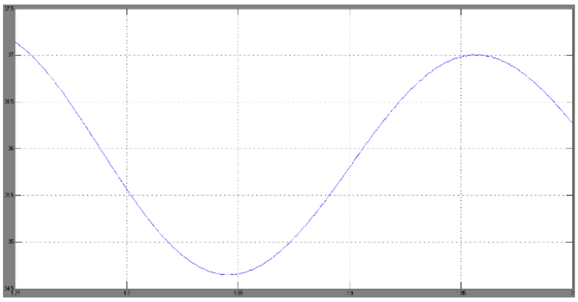

Fig. 9 Observed Output power is 36.28W when the irradiance level is 500 W/m^2

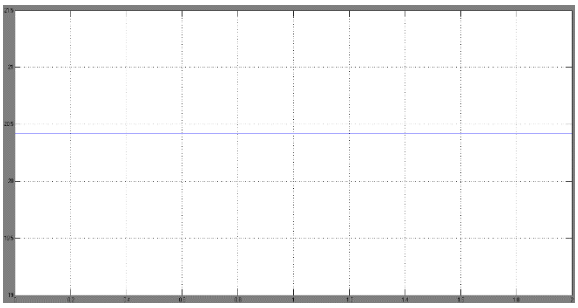

Fig. 10Input voltage is 20.42V when the irradiance level is 1000 W/m^2

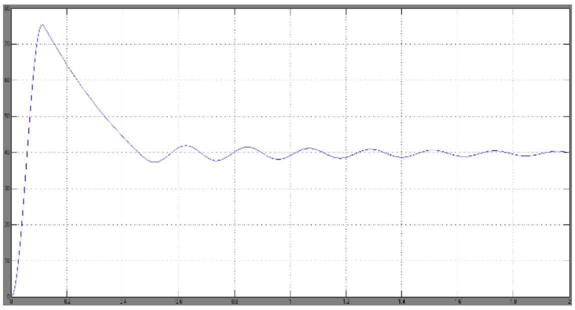

Fig. 11 Observed Output voltage is 39.71V when the irradiance level is 1000 W/m^2

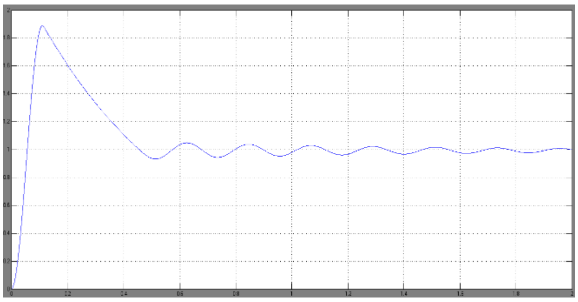

Fig.12 Observed Output current is 0.99A when the irradiance level is 1000 W/m^2

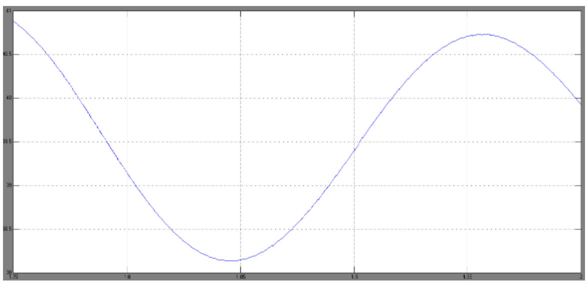

Fig. 13 Observed Output power is 39.42W when the irradiance level is 1000 W/m^2

V. CONCLUSION

This system is beneficial to the farmers and also useful to government. When the soil requires water, it is indicated with the help of sensor. Automatic irrigation system is used to optimize the usage of water by reducing wastage and reduces the human work. The energy needed to the water pump and controlling system is given by solar panel. Solar panels are small grids that can produce excess energy. By using the solar energy we can reduce the energy crisis problem. The system requires minimal maintenance and attention because they are self-starting. To further enhance the daily pumping rates, tracking arrays can be implemented. This system demonstrates the feasibility and application of using solar PV to provide energy for the pumping requirements such asdrip irrigation. This system solves more irrigation problems.

VI. FUTURE SCOPE

In future, the Automated Irrigation System using Linear Programming provides to be a real time feedback control system. Using this system, manpower and water can be saved, as well as with this system the productivity will be improved and ultimately the profit will also be increased. In future with some modification in this system, we can also supply agricultural chemicals like sodium, ammonium, zinc, calcium to the field along with fertilizers by adding new sensors and valves

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