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Atomized solar pump for Industrial/Agricultural Purpose using PIC controller

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Abstract - *Many villages in India use fossil fuel based water pumping system for irrigation due to a shortage of electricity. Fossil fuel causes great damage to the environment as they release harmful greenhouse gases. Conventional generation of electricity by thermal and nuclear power plants also harm the environment. In this research work, we propose a solar energy based automated water pumping system which can be used in many villages as an alternative to the fossil fuel based water pumping systems*

Key Words*: *Water pumping, environment protection, Solar energy

1. INTRODUCTION

At present, there is a great interest towards solving the energy problems faced by the world. This has led to research on alternative energy source that would complement the conventional fossil fuel. Solar is a natural energy source. Solar energy is the energy generated by harnessing the power of the solar radiation. It is the cleanest source of energy whose use can contribute to saving exhaustible energy sources. Such systems are based on a solar collector, designed to collect the sun's energy and to convert it into either electrical power or thermal energy.

In India, electrical and diesel-powered water pumping systems are widely utilized for irrigation applications. The continuous exhaustion of conventional energy sources and their environmental impacts have created an interest in choosing RESs such as solar-photovoltaic, solar-thermal, wind energy, to power water pumping systems. The need for the optimum utilization of water and energy resources has become a vital issue during the last decade, and it will become more essential in the future. The availability of RESs such as solar photovoltaic, solar thermal, wind, biomass and various hybrid forms of energy sources provides good solutions for energy related problems in India.

Wherever the rural areas have been brought under power grid the erratic and unreliable power supply has not helped the farmers and the need for an uninterrupted power supply especially during the critical farming period has been has been a major area of concern. India receives a solar energy equivalent of 5,000 trillion kWh/year with a daily average solar energy 3 incidence of 4-7 kWh/m2. This is considerably more than the total energy consumption of the country. Cleaning is one of the necessary activity in daily human being life, it is major cleaning issue in solar panel plate. The water is pushing to the booster pump with sprinkler head connected on top which sprinkler water on the solar panel. These sprinklers cover the solar panel in 180 degree. The sprinkler interval can be automated by using timer.

These system is maintenance free and ensures timely cleaning of solar panel for optimum solar generation. Timely cleaning of solar panel reduce chances of accumulation of dust on solar panel, Also this is one time investment , reduce the labor cost in manual solar panel cleaning.

1.1 Literature survey

Photovoltaic (PV) power for irrigation is cost-competitive in comparison to traditional energy sources for small-scale water pumping requirements. With the continuous increase in fossil fuel cost and reduction in peak watt cost of solar cells due to mass production, the photovoltaic power is to become further economical in future. PV powered water pumping systems have become attractive for livestock and agriculture applications in remote locations with limited access to conventional electricity. A number of studies have been carried out on performance evaluation, optimization, sizing techniques, efficiency improvement, and factors affecting system performance, economical and environmental aspects of PV pumping systems. The highlights of the research investigations are presented in this section [1]

1.2 PIC MICROCONTROLLER (PIC 18F4520):

A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip. PIC microcontrollers are very popular and industrialists; this is only cause of wide availability, low cost, large user base & serial programming capability. In our project we are choosing a PIC18F4520 microcontroller because of its maximum speed, amount of RAM and sufficient number of I/O pins.

Fig 1: PIC Microcontroller

FEATURES: -

- Precision Internal Oscillator:

- Factory calibrated to ±1%

-Software selectable frequency range of 8 MHz to 31 kHz

-Software tunable

- Two-Speed Start-up mode
- Crystal fail detect for critical applications

- Clock mode switching during operation for power savings

- Power-Saving Sleep mode
- Wide Operating Voltage Range (2.0V-5.5V)
- Industrial and Extended Temperature Range
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up

Timer (OST)

- Brown-out Reset (BOR) with Software Control Option
- Enhanced Low-Current Watchdog Timer (WDT) with On-Chip Oscillator (software selectable nominal 268 seconds with full percale) with software enables
- Multiplexed Master Clear with Pull-up/Input Pin
- Programmable Code Protection
- High Endurance Flash/EEPROM Cell:

- 100,000 write Flash endurance

- 1,000,000 write EEPROM endurance

- Flash/Data EEPROM retention: > 40 years

- Program Memory Read/Write during run time
- In-Circuit Debugger (on board)

1.3 System Design and Details

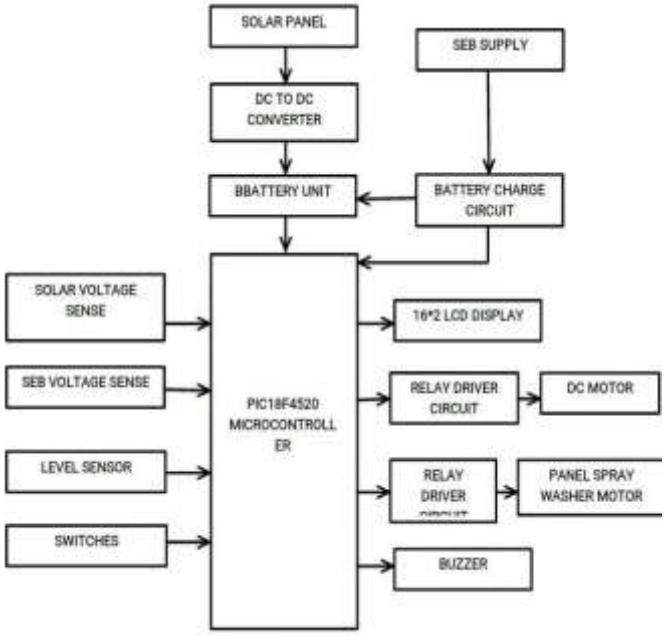

Fig. 1. Block diagram of sensor section of proposed system.

The Systems consist of microcontroller which is PIC18F4520. The unit will consist of microcontroller, LCD, solar panel, DC to DC converter, Battery unit, Battery charge circuit, MSEB supply Switches, Relay driver circuit, Panel spray washer motor, DC motor, Level sensor, Buzzer etc.

Solar panel plate is used to observe the sun light intensity and it convert it into electrical voltage. Solar panel plate voltages apply to DC to DC converter. A DC to DC converter is an electronic circuit or electro-mechanical device that convert direct current from one voltage level to another level. It is type of electrical power convert and then charge the battery unit. Battery unit store the supply which is from solar panel plate or MSEB supply, when the battery voltage level goes on decreasing then buzzer will indicating. The switches will used to control system manually. Voltage sensor is used to sense the voltage of Solar and MSEB. LCD is used to see the voltage and temperature ranges of solar panel and MSEB supply.

A relay driver circuit is a circuit which can drive or operate a relay so that it can function appropriately in circuit. The driver relay can then operate as a switch in a circuit, which can open or close according to the need of the circuit and its operation. The relay circuit is used in system to on or off the DC motor and panel spray washer motor according to the need of operation. The panel washer motor is used to cleaning a solar panel daily by using timer.

Solar Panel

The solar cell operates on the principle of the photovoltaic effect - the creation of charge carrier with in a material by the absorption of energy from the incident solar radiation.

The efficiency of solar cells in converting incident solar energy into electrical energy depends on the illumination spectrum intensity, materials of construction and design of the cell, atmospheric temperature and dustiness of the sky. Solar cell used in running DC electric motors have efficiencies ranging from 10 to 12 percent .Silicon is the most commonly used material for making solar cells. Other materials include cadmium sulfide and gallium arsenate. The fabrication of the solar cell involves a large number of processes. Wafer form, followed by junction formation, contact fabrication and anti-reflection coating on the active surface of the cell. The outer surface of the pan.

Battery

A rechargeable battery is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. In our project we are using 12V-7AH lead acid rechargeable battery. By connecting a battery to the solar panel, we can store the energy generated by the solar cells and this energy can be used when required .System Operation

LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the more about internal structure of a LCD.

Buzzer

A buzzer or beeper is an audio signal device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. If embedded system is misplaced from dashboard, the IR sensor becomes active. The signal is sent to microcontroller to ring the buzzer. It is connected to the pin no.28 of microcontroller.

Relay

A relay is an electrically operated switch. A relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid. state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. Sensor Section Operation.

DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

2. RESULT

At the output solar panel generates an output voltage and water pump is operate on energy generated by the solar panel. The output of solar panel of 3 days is shown in the figure. When the output of solar panel is insufficient to on the pump then supply of pump or motor is automatically switch on the battery voltage battery is charge through solar output. When battery is discharged then motor is automatically operate on the SEB supply.

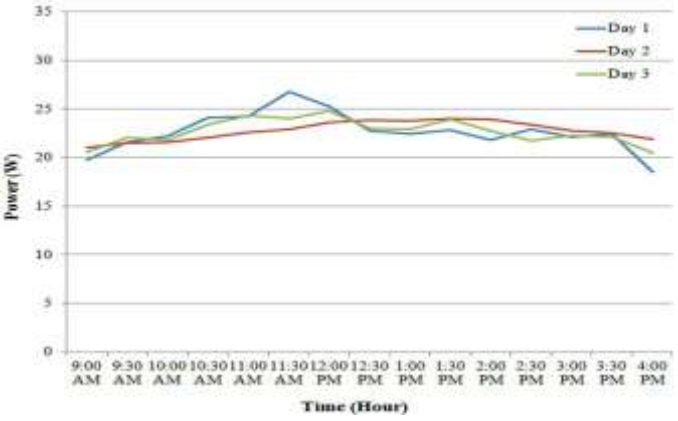

Fig3 Graph of output of solar panel

In the given figure display shows the output voltage of solar panel output voltage of battery and output voltage of SEB supply.

3. ADVANTAGES

- Cost effective: The life cycle and the cost to ultimate beneficiary make the SPV systems cost effective as compared to conventional systems. IN addition the farmer is saved from the capital investment he has to make for drawing lines from the grid to his field/farms. The govt. may save huge resources which otherwise may be uneconomical to network every agriculture field under the state electricity grid.

- Reliable: The SPV is more reliable, consistent and predictable power option as compared to conventional power system in rural areas.

- Free fuel: Sunlight, the fuel source of SPV system is a widely available, inexhaustible, and reliable and free energy source. Hence the SPV system has no monthly fuel bills.

- Low maintenance: The system operates on little servicing and no refueling, making, them popular for remote rural areas, hence the operation and maintenance is very low. The suppliers provide maintenance at a very low annual maintenance contract rates.

- Local generation of power: The SPV system make use of local resource sunlight. This provides greater energy security and control of access to energy.

- Easy transportation: As SPV systems are modular in nature they can easily be transported in pieces/components and are easily expandable to enhance the capacity.

- Energy Conservation: Solar energy is clearly one of the most effective energy conservation programs and provides a means for decentralized PV generated power in rural areas. Solar pump is energy efficient and a decentralized system avoids any unnecessary expenditure on T & D networks.

- Water Conservation: The SPV sets are highly economical when combined with water conservation techniques such as drip irrigation & night time distribution of (day time pumped & stored) water. The SPV system leads to optimum exploitation of scarce ground water.

4. LIMITATIONS

PV pumping system has its various limitations which are as following:

- Low yield: Solar pumping is not suitable where the requirement is very high. The maximum capacity available with solar is very low. However, the output of the solar DC pump is more than a normal pump.

- Variable yield: The water yield of the solar pump changes according to the sunlight. It is highest around noon and least in the early morning and evening.

- Theft: Theft of solar panels can be a problem in some areas. So the farmers need to take necessary precautions. Ideally, the solar system should insured against theft as well as natural hazards like lightning.

5. APPLICATIONS

- In Agriculture.

- The supply is switch automatically solar supply voltage over MSEB supply for water pumping system in agriculture.

- In Colleges.

- In Hospitals.

- In Houses.

The system used in colleges, hospitals and houses to switching power supply automatically i.e. MSEB supply and solar panel supply.

6. FUTURE SCOPE

- In future the need for the optimum utilization of water and energy resources has become a vital issue during the last decade, and it will become more essential in the future.
- With recent developments, auto renewable energy system are easily available for upcoming new industrial and domestic use with the added advantage of minimum maintenance and zero emission

3. CONCLUSIONS

The study focuses on update on solar water pumping technology, performance analysis studies carried out worldwide, optimum sizing techniques, degradation of PV generator supplying power to pump, economic evaluation, environmental aspects and recent advances in materials and efficiency improvement of photovoltaic technology and experience of using solar PV pumps worldwide. Based on the study main conclusions are as follows:

- PV water pumping technology is reliable and economically viable alternative to electric and diesel water pumps for irrigation of agriculture crops.
- PV water pumping for urban, rural and community water supplies and institutions, is another potential feasible sector but is not still widely utilized. The remote inaccessible locations with no grid electricity also need special attention. These sectors still depend on conventional electricity or diesel based pumping system resulting in increased recurring costs to the users.
- Keeping in view the high installation costs of solar water pumps especially for large irrigation and water supplies, more incentives are required to be provided by governments to make the technology further attractive alternative to diesel and electrical water pumping.

Solar pumping is an attractive alternative for irrigation and rural, urban drinking water pumping applications in developing countries especially India, China, other Asian and African countries, keeping in view huge solar potential and the fact that significant rural population lives in the remote areas which requires water for drinking and irrigation of crops.

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