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Embedded Controller in Farmers Pump by Solar Energy

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Embedded Controller in Farmers Pump by Solar Energy

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Abstract **-** The primary aim of this project is to develop and atomize the solar farmers pump (water pump) considering the power supply, direct current (DC), Alternating current (AC), inverter frequency, a well, water level in the well, submersible monoblock pump. Here we introduce an advanced technique with GSM module. The solar pumps which work by utilizing the energy from the SOLAR ARRAYS and the power from the PV are stored in a battery. The power from the battery is inverted and given to the pump for irrigation. This pump is also controlled by the GSM module. The use of GSM mode is to start and stop working of pumps using mobile phone; the water level monitoring is also done by the GSM mode which this also provides the message for each hour. This is done with the embedded C in PIC16F877A microcontroller. The main advantage of this project is optimizing the power and also saving government's free subsidiary electricity (22% of total power production in India). This proves an efficient and economy way of irrigation and this will automate the agriculture sector.

Keywords **-** *Photovoltaic cells, Microcontroller, GSM Module, Battery, Water Level Indicating sensor, Submersible monoblock pump.*

I. BACKGROUND AND INVENTION

Water recourses are essential for satisfying the human needs, protection and ensuring food production, energy and the restoration of ecosystems, as well as for social and economic development and for sustainable development. Energy is the most basic and essential of all resources. All the energy we use on Earth comes from fission or fusion of atomic nuclei, or from energy stored in the Earth. The problem with both fission and fusion is that they have dangerous radioactivity and side effect [4]. Therefore, most of the generation of energy in our modern industrialized society is strongly depending on very limited non-renewable resources, particularly fossil fuel. As the world's energy demands rise and resources become scarce, the search for alternative energy resources has become an important issue for our time.

The most effective and harmless energy source is probably solar energy. The use of new efficient photovoltaic solar cells (PVSCs) has emerged as an alternative measure of renewable green power, energy conservation and demand side management. Owing to their high initial cost, PVSCs have not yet been fully an attractive alternative for electricity users who are able to buy cheaper electrical power from the utility grid. However, they can be used extensively for water pumping and air conditioning in remote and isolated areas, where utility power is not available or is too expensive to transport [3].

In the current agriculture field there is no proper control in usage of electricity and water. A person is needed to monitor the system. The project optimizes the use of electricity and water and atomizes the operation. As the pump is powered by photovoltaic solar cells there no need for the government to supply electricity to the farmers in case it can be used for some other needs and government can profit more money which can be used for the other development fields. This project will be the permanent solution for this grievance and will be more efficient one.

II. INTRODUCTIONS

The use of photovoltaic solar cells to power water pumps is widespread. It is often more viable than grid extension and avoids the volatility of costs together with uncertainty of supply associated with the provision of diesel fuel to remote diesel-powered pumps [**1**, **2**]. Water pumping for irrigation and water supply for rural communities represents an important area of standalone PV systems. These systems usually consist of a PV generator, source of water, a water storage tank, and a motor pump. However, direct interfacing between PV generator and motor pump introduces significant mismatch problems as the light intensity varies. The

mismatch can be overcome by introducing a battery which stores the energy and provides constant output.

This project is exclusively about the innovation of agriculture based technology. About 22% of electricity from the generation is used for the agricultural sectors. Government spends million and millions of money towards the field of agriculture. This project mainly focuses on overcoming these grievances. The project uses the solar panel to track the solar rays from the sun and the energy is stored in a battery. Then it is converted by using converters to run the motor. This motor is controlled by microcontroller based GSM module. It also includes the water level sensors. The use of GSM mode is to start and stop working of pumps using mobile phone; the water level monitoring is also done by the GSM mode which this provides the message for each hour. The proposed techniques are implemented on a low cost 8-bit RISC microcontroller (PIC16f877A) and it is programmed with the embedded c in PIC controller.

III. CHARACTERISTICS OF PV ARRAY

Solar or PV cells are made of semi conducting materials that can convert sunlight directly into electricity. When sunlight strikes the cells, it dislodges and liberates electrons within the material which then move to produce a DC current.

PV cells are combined to make modules that are encased in glass or clear plastic. Modules can be aggregated together to make an array that is sized to the specific application. The produced power varies with amount of sun shining on the array and temperature. If the latter is held constant, this power variation results in a variable current at a fixed voltage. Increasing (decreasing) temperature reduces (increases) PV array generated power.

Traditional I-V characteristic curves of a PV array are given by the following equation:

$$I = n_P I_L - n_P I_{OS} \{\exp [q (\frac{V + I.Rs}{AkTns})-1\} - \frac{V + I.Rs}{Rsh} \quad (1)$$

Where I_L is the light generated current, I_{OS} is the reverse Saturation current, q is the electronic charge, V is the PV Array output voltage, R_S stands for the series resistance, is the PV array shunt resistance, A is the ideality factor, k denotes The Boltzmann's constant, T is the absolute operating Temperature, n_S is the number of cells connected in series and n_P is the number of modules connected in parallel.

The symbols I, V, R_S and R_{Sh} in (1) can be defined as:

$$I = n_P I_{cell}$$

$$I = n_s V_{cell}$$

$$R_S = R_{SCell} X \frac{ns}{np}$$

$$R_{Sh} = R_{ShCell} X \frac{ns}{np}$$

Since the shunt resistance is much greater than the series resistance; the last term in (1) becomes very small with respect to the other terms (Fig. 1). Therefore, the last term will be neglected as it will not cause a large error in the PV array model [5].

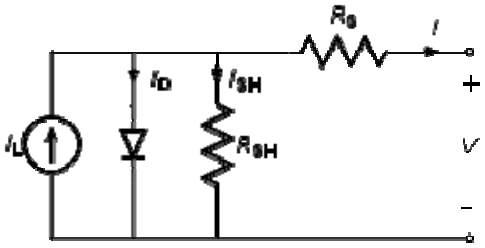

Fig. 1: Solar cell model

IV. FUNCTIONAL BLOCK

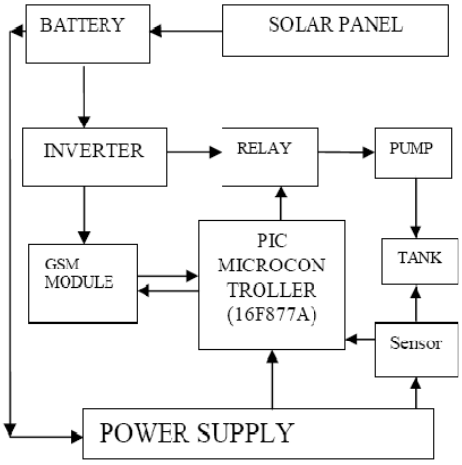

Fig. 2 : Overall functional blocks of Solar pump

This project was divided into nine segments which include:

1. Solar panel comprised of solar or PV cells. Solar or PV cells are made of semi conducting materials that can convert sunlight directly into electricity. When sunlight strikes the cells, it dislodges and liberates electrons within the material which then move to produce a DC current.
2. Battery used in this project is truck (automotive) batteries. Automotive batteries are designed to

deliver very high current for short periods of time. After all, their main purpose is to start the motor, and that doesn't take long and doesn't occur very often. They are not designed to be deeply drained and recharged repeatedly, and doing so shortens the battery life. Typically, not more than 20% of the storage capacity should be drained.

3. H- bridge inverter is used in this project. For the inverter [11]
4. Power supply of 5v which gives supply to the relay, microcontroller and water sensor.
5. Microcontroller used in this project is PIC 16F877A. The system is run from a stationary PC and phone line. In remote side, it is used a microcontroller. PIC microcontrollers have an inbuilt ADC. It consists of all peripherals such as memory, I/O ports, timers, and it is cheaper, more economical, simple, and easy to control compare to microprocessor units. PIC16F877A microcontroller contains 35 instruction sets, with 1024 program memory.[15]
6. Relay here acts as switch when it receives the signal from the controller it gets actuated and operates the motor and vice versa to stop it. The other end of the relay is connected to the pic controller.
7. GSM Module is designed to overcome many operational, monitoring and controlling issues for scattered remote sites and provide efficient and timely management of equipments, services and facilities [14]. Emergency events such as fire, alarm, system failure can be detected at remote sites and notification can be sent out immediately via SMS to particular (owner's) mobile phone for immediate attention and actions. Users can also send SMS to switch on/off different control devices that are connected to the GSM Modem output [16]. Communication with G.S.M. module of the system is based asynchronous data transmission protocols. In each frame of data transmission start bit, control characters and stop bits are added. Start bit is always one single bit but the number of stop bits can be one or more. Control commands are data in length of eight bits. Data transmission starts with start bit, then from D0 (LSB) to D7 (MSB) bits send sequentially. Finally to stop bit is included. Data transmission rate is set by means of software (usually 2400 bps) on a central computer. The communication speed, length of data, the number of stop bits should be same on transmitter and receiver parts. In communication, RS232 serial interface standards are used with UART transmission.[15].
8. Water level indicating sensor It is often necessary to measure the depth to water in a well. The depth to water influences pump selection and placement. It also determines the energy required to lift water to the surface in the pumping process. Water Level Indicator is a microprocessor-based water level measuring device consisting of a tank-mounted sensor system (sensor plus sensor control box) and a remote digital display the entire system is powered by a low-voltage transformer which permits safe and easy installation without an electrician. Depth indication is provided by numbered metal tags securely crimped to the cable at intervals of five feet or every meter on the metric model. The use of the two conductor cable makes a separate ground connection unnecessary so the instrument will function equally well in cased test holes or in uncased wells in rock. Water entering the well from casing leaks or perforations above the water level will not affect the function of the instrument.[17].
9. Submersible monoblock pump sets are particularly suitable for open wells. The farmers can overcome the water level fluctuation problem easily because this pump sets rest at the bottom of the well. In this project we use submersible monoblock pump set. Instead of that an open well monoblock pump set or submersible pumps can also be used. The pump with low current rating will give the maximum output and use the electricity more efficiently. The pump we use is of self priming type.

V. OPERATION OF SOLARISED FARMERS PUMP

In this project the sunrays are received by the solar panels, the solar array converts the light into electricity and the output is given to the battery, the battery stores the electricity and supplies during night times also. The output of the battery is given to the power supply and the inverter. We use 5v power supply which gives supply to the relay, microcontroller and water sensor. The output of the battery is given to the sine wave inverter which converts dc wave into ac wave form and the output is connected to the relay.

The relay here acts as switch when it receives the signal from the controller it gets actuated and operates the motor and vice versa to stop it. The other end of the relay is connected to the pic controller. The pic controller is connected to the gsm module and the sensor. If the user wants to start the motor means he needs to send a sms, the controller will verify the password and sends signal to the relay and activates it. Same process is followed to switch it off. The password for on and off is different. In mean time the sensor

indicates the water level to the controller and in sends the information through sms. The water level sensors also connected to the relay, if water is below the required level it sends the signal to the relay to turn it on and if it is above the maximum level it again sends the signal to turn it off.

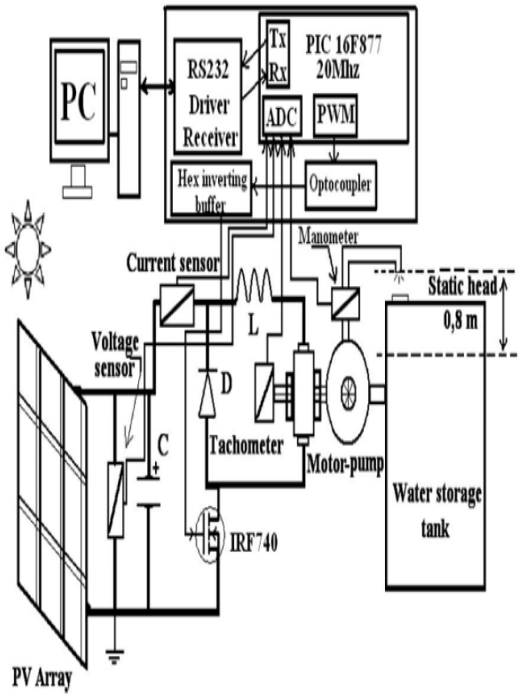

Fig. 3 : Internal structure of solarised farmer pump

VI. INCENTIVES FROM CENTRAL/STATE GOVERNMENT

In India the Ministry of non-conventional energy sources and the state govt. agencies provide a variety of incentives. MNES SPV programme provides subsidy on solar water pumping system @ Rs. 135/- per watt, subject to a maximum of Rs. 250000/-[14].

VII.POWER CONSERVATION

The Total Production of Electricity in India=164,835.80 Mw [6].

Free subsidiary power given to agriculture= 22% of total power production [7].

i.e., power drawn to agriculture =164,835.80 * 22/100

=**36,263.836 MW.**

If this project is implemented 36,263.836 Mw of energy can be saved per hour.

VIII.ADVANTAGES

- There no need for new erection of new power plant
- The cost of operation and maintenance of solar pumps is negligible
- Useful for water pumping in remote areas without grid power.
- we can reduce the environmental impacts
- High subsidy results in early pay back
- It can be operated from any place because it is completely atomized
- Efficient and effective use of electricity and water.
- Highly reliable
- Durable
- Easy to remove, transport and store
- Simple to install

IX. CONCLUSION

Conclusively, this method is the most effective and efficient method as it saves crores and crores of rupees for the government. By implementing the project we can turn the whole agricultural field to use electricity and water very efficiently and we atomize the whole operation as the owner can operate it from any place. This project is going to be the future of the field of agriculture. The moisture sensors, MPPT and others facilities will also be implemented in future depending upon the necessities.

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