AUTOMATED SOLAR PUMP FOR IRRIGATION SYSTEM

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Abstract Solar Pump aims in providing a user friendly, reliable and automated water pumping system. Now a day's technology is running with time, it completely occupied the life style of human beings. Even though there is such an importance for technology in our routine life there are even people whose life styles are very far to this well known term technology. So it is our responsibility to design few reliable systems which can be even efficiently used by them. This basic idea gave birth to the project micro controller based water pump controller. The system is capable of detecting moisture level in the soil and capable of taking the decision of switching ON/ OFF water pump.

The microcontroller forms the heart of the device and there are also soil moisture detecting sensors, which are meant for detecting the moisture in the soil.Whenever soil moisture levels are low, the microcontroller turns ON the relay and the water pump gets ON. If the soil moisture levels are high, then the water pump will not be operated. The moisture levels and the status of the motor can be viewed on the LCD Screen.

I. Introduction:

Imagining a day without electricity in today's world, is equivalent to a nightmare. Since its inception in the early 19th century, electricity's relevance has changed from a mere spark for illumination to a massive driving forcebehind gigantic tasks. Today, Electricity has become an inseparable part of every household. It has gained as much significance as that of food and water for people. From sowing to harvesting and cooking, everything has electricity embedded within it. It is helping reduce the labor involved while doing all sorts of tasks.

II. Automation in Irrigation System:

An automated irrigation system refers to the operation of the system with no or just a minimum of manual intervention beside the surveillance. In order to get the maximum yield, it is essential to supply the optimum quantity of water, and to maintain correct timing of water. This is possible only through a systematic irrigation system- by collecting water during the periods of excess rainfall and releasing it to the crop as and when it is needed almost every system (drip, sprinkler, surface) can be automated with the help of a micro-controller. It makes the irrigation process more efficient and workers can concentrate on other important farming tasks.

➢ Drip Irrigation:

Drip irrigation is one of the simplest and efficient types of irrigation. It is also known as micro irrigation or trickle irrigation. Its working is same as that of a typical system which includes water source, filters, pipes, tubes and control valves.

Water through the dripper (a small opening on the pipe) is either fed directly to the soil or to the roots of the plant. Water at very low pressure of 1-2 kg/m^2 can be generated with the aid of dripper. Thus an estimate of 300-500 litres of water can be delivered per hour. The prime reason for employing this system is its conservation of water upto 80%.

III. Need:

1. Lack of electrification.
2. Lack of basic power supply

3. Excessive dependence on individual expertise regarding irrigation timings.
4. Variation of prices of diesel creates a lack of stability among the farmers regarding their finances.
5. Lack of supply of clean fuels.
6. Farmer suicides have become common across the Indian sub-continent.
7. Lack of modularity among present systems. In a country where 60% of the population still depends on agriculture for a living and most of the crops are grown on small privateplots, the existing large scale power transmission or generation is far too expensive for most of these farmers. (Plots that have remained in the respective families for many generations).
8. The difference between the financial capacity of the ordinary farmer and the capital investment required for basic essentials on a modern farm creates a negative loop of financial doom for those involved.
9. Such problems create an atmosphere where the common farmer of India ends up losing leverage to big corporations that have the financial support and the benefit of the economics of scale on their side.

IV. Goals:

1. Creation of a solar powered, soil sensor controlled, irrigation system using equipment widely available in the Indian markets.
2. To decrease/eliminate the dependence of manual irrigation.
3. To make a modular system, both robust and scalable.
4. Reduction of dependence of farmers on local services which may not be very dependable.
5. Use of Automation to greatly reduce the total amount of attention and man hours required for general irrigation.
6. System must require minimal maintenance and input.

V. Fabrication:

➢ Battery, BCU:

The solar panels are not directly connected to the batteries due to high fluctuations in the watts provided by the panel; it increases the risk of damaging the battery.

To reduce this, a charge controller is connected in-between the solar panel and battery. There are 4 batteries in total, 2 parallel connected sets of 2 batteries connected in series. A single battery is of 12 V and 350 amp hour and the whole set can store 16.8 KWh of power at full capacity. The configuration is made in such a way that the pump only uses 30% of the total power stored in battery and also provides leverage at the time of starting as a pump in an inductive load that will draw 10 times the running current at the time of starting [citation]. This increases the battery life substantially and making solar energy more affordable in the long run. The battery supplies current to a step down transformer, microcontroller, sensor, relay and pump circuit. The step-down transformer decreases the voltage to an amount suitable for the microcontroller. The microcontroller has an internal clock and a soil sensor. The soil sensor provides various input variables including temperature, humidity and alkalinity of soil to the microcontroller, which processes the information and generates output. The output from the microcontroller controls the relay which is in charge of controlling the pump. Relay is used to control the mains as they directly cannot be controlled by the microcontroller. The relay then switches on the pump.

➢ Soil Sensor:

Sensor computing the amount of volumetric water content in the soil is termed as soil moisture sensor. The property utilized in the sensor is capacitance of the soil. The two probes of the sensor calculate the dielectric permittivity and hence the capacitance. An FC-28 soil moisture sensor requires an input voltage and current of 5V and 35mA respectively. The output voltage generated is approximately 4V. There are two possible connections of the sensor: analog and digital mode. It can operate under extreme temperatures of -40°C to 60°C.The output of the sensor is sent to the microcontroller and thus flow rate of water is controlled. When

the percentage of water content falls below a pre-defined value set in the microcontroller, water begins to flow and irrigate the fields as long as the moisture content is not restored to the required value.

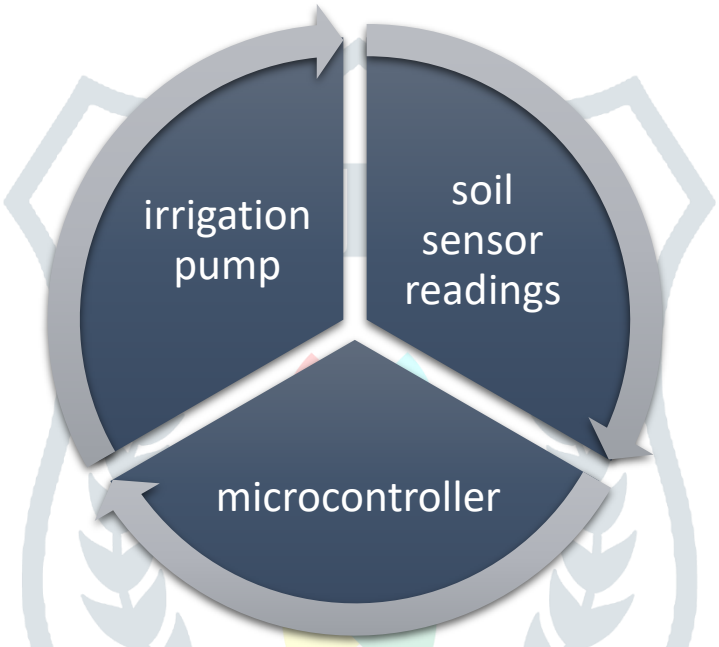
➢ Solar Panels:

A wide variety of solar panels are used in the conversion of solar radiation into electricity. The most efficient and reliable ones are monocrystalline solar panels. These have been preferred in the project as they provide the best performance (high operational efficiency of around 15%) while being reasonably priced.

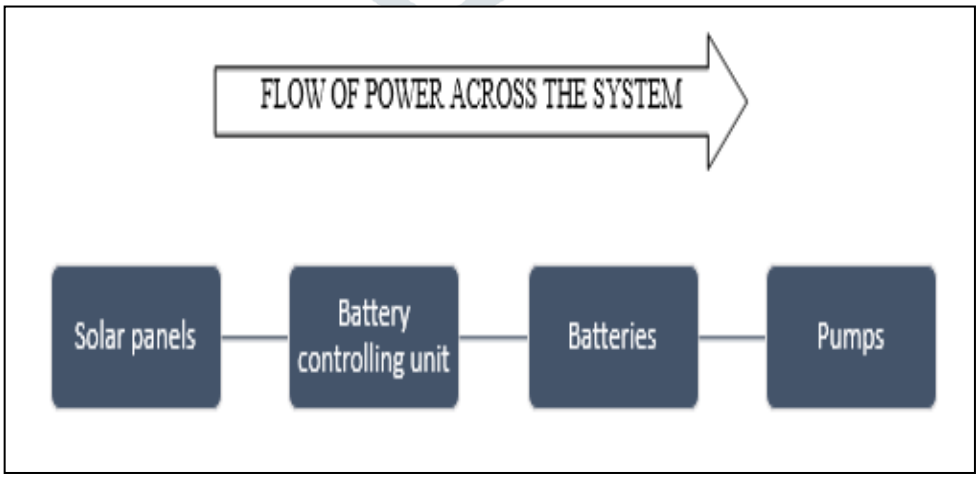
➢ Pump:

Deep well Jet pumps were used in this project to deliver water from a reservoir at a depth of 24 meters (79 feet approx.). With a water level depth of 24 meters, the pump delivers water at a rate of 2000 liters per hour.

VI. Basic Layout:



Feedback loop for Soil Sensor

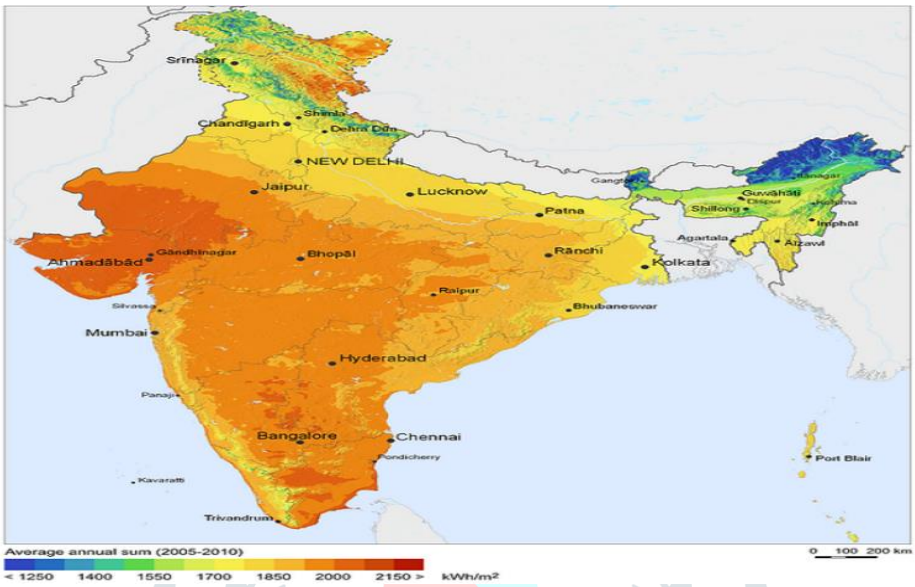


VII. Plantations:

This project was undertaken at plot owned by a local farmer in the Ranga Reddy district of Hyderabad. The plot on a total area of 0.5 acres and had a total of 72 hybrid mango trees. The trees were planted at a radial distance of 3 meters and were 3-6 years of age. The average water requirement for a hybrid mango tree of this age is fifty to sixty liters per day as per the data in the local farmers handbook published by the Telangana government.

Hence, total expected water requirement= = 72* 55=3960 liters.

VIII. Solar Irradiance:



Solar irradiance is the amount of solar energy a surface receives over a given period of time. It depends greatly on a number of factors including inclination, altitude, cloud patterns for that specific region etc. With the widespread growth of solar power, the data regarding solar irradiance in the form of solar irradiance maps or simply, solar maps has become widely accessible.

Average solar irradiance for Telangana= 5.27 KWh/m^2/day.

Average Solar radiance at the site of the project= 5.33 KWh/m^2/day.

(Data provided by Synergy environ engineering solutions Ltd.)

PUMP POWER REQUIREMENT:

Pump name= KJ DEEPWELL jet pumps

Manufacturer= Kirloskar

Technical Specifications

Depth t Low Water Level: 9-55 metres

Capacity: 3600-120 Liters

Power Rating: 1.2 kW (1.5 HP)

Voltage Range: 170-240 volts

Depth of water reservoir= 24 meters

Total water requirement= 3960 liters (Approx.)

Flow rate at a suction depth of 24 meters= 2010 liters

Average daily run time = $\frac{totalwaterrequirement}{LPHatdepth}$=$\frac{3960}{2010}$=1.97≈2 hours

Power rating =1.5 hp or 2.01kw

Total energy required=(power rating x daily run time)

= 2.01*2

=4.02 KWH

NOTE: the total power requirement is less than 30% of the total battery capacity. This is done to increase the battery life in the long run.

PANEL REQUIREMENT:

Solar irradiance at site= 5.33 KW/m^2/day

Efficiency of mono =crystalline solar panel modules= 15%

Gross power harnessed by the panels per m^2= solar irradiance x panel efficiency

=5.33 x 15

=0.7995 KW/m^2/day

Total solar panel area= $\frac{totaldailyenergyrequirement}{paneloutputpersq.m}$=$\frac{4.02}{0.7995}$=5.02 m^2

Results:

Separate tests were conducted in order to assess the amount of power that is being generated through solar panels.The battery is drained completely every alternate hour in order to record power correctly in the following hour.

The project is designed to operate a water pump automatically based on the soil moisture sensor detection of sufficient water to the plant or in fields. The switching mechanism can be done automatically with the help of microcontroller using relays. This project eliminates the manual switching mechanism used by the farmers to ON/OFF the irrigation system.

Conclusion:

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology. Thus the project has been successfully designed, tested and implemented.

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