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## Investigation of Automatic Solar Irrigation Model

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# Investigation of Automatic Solar Irrigation Model

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## Abstract

India is an agriculture prominent country. Scientist and researchers are continuously working for betterment of agriculture processes. From the research, it was found that there is a loss of power and resources in irrigation process. Present manuscript consist of proposed model which utilizes renewable energy (solar energy) to operate irrigation process which results in better handling within limited resources. Proposed system consist of moisture sensing device in the field that provide convenience to farmer by supporting them in automation at very minute energy. This proposed design uses polycrystalline photovoltaic solar panel to charge the battery and this battery provide power supply to operate the model.

**Keywords:** *Solar irrigation, Moisture Sensor, Photovoltaic cell, Microcontroller*

## 1. Introduction

In India, agriculture has been playing a major role. Agriculture is the source of living for the population through the production of food, important crops and raw materials. Also, agriculture plays an important role in providing large scale employment to the people [1]. In general, most of the farmer uses manual system to water their crops, this is insufficient. There are many advantages in developing microcontroller based circuits and incorporating new sensing technology into it [2-4]. At present, labour-saving and water-saving technology is a key issue in irrigation [5]. It senses humidity, water level and keep updated farmers with SMS.

The automaticity means that it turn itself and put on and off depending upon the soil moisture requirement. A timely and consistent irrigation is need of the hour in any country where lack of water is not tolerated by soil during irrigation, the excess of water provision is also not recommended for any crop fulfilment. Hence, a feasible irrigation for any land requires suitable amount of water with least delays. Today's world demands is to improve irrigation methods as compared to old ones [6]. The block diagram of electrical supply unit with the help of microcontroller is shown in fig.2. In this paper, AT89S52 microcontroller has been used. This microcontroller uses very less energy and cost efficient in nature [7-8]. SIM900 GSM module is used. This GSM module has very high frequency and operates on quad band frequencies [9]. The software used to compile the microcontroller is code block. Direct current (DC) operated pump has been used to carry water in the field. The main idea behind this is to eliminate the use of inverter.



## 2. System design

The system is divided into two subsystems-

### 2.1 Solar tracker

Solar tracker is a device that tracks solar panel in the direction of sunlight. This device changes their orientation throughout the day to maximise the trapping of solar energy. The use of solar tracker can increase electricity production by 40% [8].

Selecting a solar tracker depends on size, electric requirement, purpose for its use, latitude and weather.

#### 2.1.1 Types of solar tracker

There are basically two types of solar tracker based on their axis i.e.,

##### 2.1.1.1 Single axis solar tracker

Single axis solar tracker is bound to move in only one direction that is wherever the sun goes. The face of the system is tilted towards the direction of the sun as where the sunlight intensity is higher at twelve in the noon. According to latitude of Delhi NCR the angle is set to 28 degree approximately. These tracker is customizable tilt at 28 degree and get programmed with the help of microcontroller to move from east to west.

##### 2.1.1.2 Dual axis solar tracker

Dual axis solar tracker has both latitudinal and longitudinal axes and can track down the sun anywhere in day time. Dual axis solar tracker tracks the sun in all directions with utmost 40% gain in the output energy.

In this paper, single axis solar tracker to keep our module simple and efficient.

##### 2.1.1.3 solar panel angle calculation

The angle of solar panel is different for different regions. Firstly we have to define the topography of that location that is its latitude position.

In general the optimum angle for solar panel can be calculated as

For winter,

$$TILT\ ANGLE = (LATITUDE \times 0.9) + 34 \quad (1)$$

For summer,

$$TILT\ ANGLE = (LATITUDE \times 0.9) + 29 \quad (2)$$

### 2.2 Efficiency of solar tracker

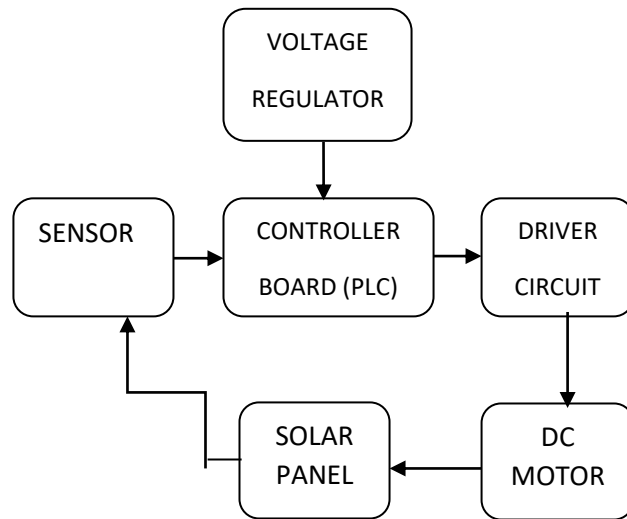
Efficiency of solar tracker can be calculated with the help of some certain condition known as standard test condition (STC). Figure 2 shows the block diagram of single axis tracker system. Solar panel efficiency is the factor that affects how much energy particular panel will produce. The efficiency of panel refers to how much solar energy is converted into usable energy.

$$\eta = \frac{\text{output}(\text{electrical energy})}{\text{input}(\text{solar energy})} \quad (3)$$

### 2.3 Electronic circuits and sensing module

#### 2.3.1 Electronic circuit

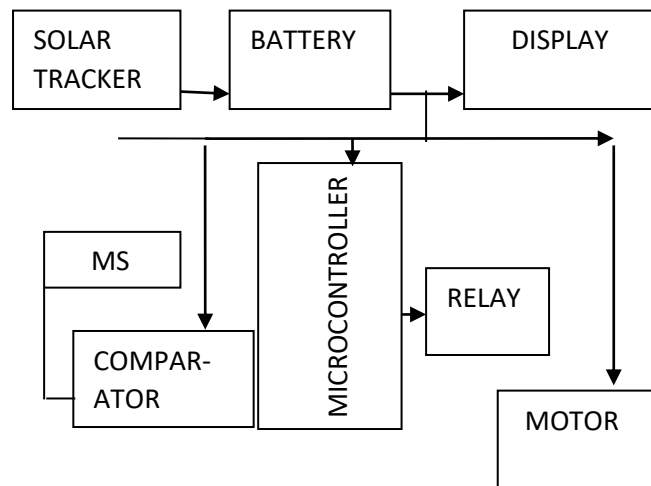
Microcontroller with GSM module and soil moisture sensor helps in sensing the level of moisture on farm and supply water accordingly to irrigate the farm (Fig. 1). A GSM module helps to keep farmer alert with SMSs. Microcontroller is programmed with latest programming software IDE (C Language). It is designed in such a way that it governs on and off of DC pump in the system. It is also programmed in such a way that it receives input signals from the sensing material which consists of comparator to know the moisture level of soil [8].



**Fig. 1** Block diagram of single axis tracker system

**2.3.2 Sensing module**

In this proposed system, three different sensing devices are used in order to gain more information about condition of soil and its surrounding. These sensing devices are moisture sensor, temperature sensor and humidity sensor. All these sensors are programmed in such a way that farmer will receive a SMS regarding water level, temperature of soil and amount of humidity present in soil.



**Fig. 2** Block diagram for sensing devices which gives their input signals to microcontroller

All these sensing devices gives their input signals to microcontroller and programmed data send to the GSM compatible device (as shown in Fig. 2).

### 3. Construction

The accessories taken with their rating in this model as follows

Table 1 Accessories taken in experimentation

S. N O.	ITEM	QUANTIT Y	RATING VOLT
1	SOLAR PANEL	1	12
2	BATTERY	1	12
3	GSM MODULE	1	5
4	ARDUINO UNO	1	3
5	MOISTURE SENSOR	1	0.5
6	TEMPERATURE SENSOR	1	0.5
7	HUMIDITY SENSOR	1	0.5
8	STEPPER MOTOR	1	3
9	CONTROLLER	2	nil
10	RELAY CIRCUIT	2	nil
11	LCD DISPLAY	1	2
12	JUMPER WIRES	3 set	nil
13	PLC BOARD	1	nil
14	LDR	2	1

NOTE- Solar panel dimension is 16\*16\*2.5 cm

### 4. Working

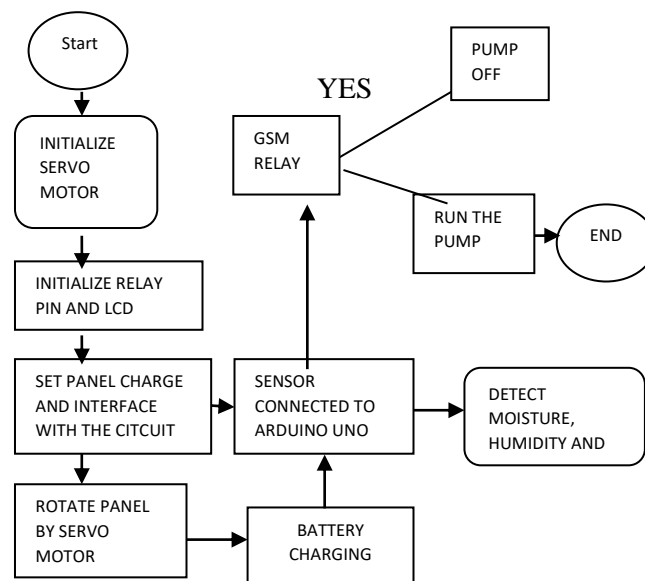
When we complete the circuit then solar tracker start working. The LDR circuit which is placed at solar panel detect light and send signal to microcontroller. The already fed program send signal to motor controller and this motor controller further actuate the gear motor to rotate as per given program. In this way tracker start moving in the direction of sun.

This tracker trap solar energy and convert it into electrical energy. This electrical energy is stored in the rechargeable battery provided. Once battery gets charged it supplies electricity to the microcontroller. Once the microcontroller gets signal from sensing device it compares the data as programmed in a way, which generates output signals and supply current to relay circuit in order to operate pump. This automatic solar irrigation system can be further improve by using a GSM module that consumes solar energy from the solar panels [8].

With the help of crystal oscillator and burner we supply basic programming require to operate this model. The microcontroller AT89S52 has better efficiency and can be burn at once only. This microcontroller is further used in arduino uno circuit to programme our microcontroller easily. All programming is done on keil software which provide total embedded development tools.

A quad band frequency GSM module has an antenna with a very strong signal intensifier that catches very weak signal. This type of GSM module do not delay in sending SMS to the registered mobile number. The entire model is benefitted by using solar panel. The main feature of this model is to fight the effect of power failure on the field.

### 5. Initiative by Indian government for solar irrigation



**Fig. 3** Working flow chart for proposed model

Under the government scheme that is, Kishan Urja Suraksha Evam Utthan Mahaabhiyaan (KUSUM) is the step taken for solar powered irrigation. The KUSUM scheme make mandatory deployment of 2.75 million solar pumps in initial phase of its implementation. Considering the decrement of solar panel's price. IEEFA avail low subsidies model to the farmers. This programme also give boost to make in India programme. Also, India is one of the country that do not charge for installation of solar panel on the agricultural land. The working flow chart for this model given below

### 6. Conclusions

In this paper, we have discussed about the implementation of auto solar irrigation system. This system is combination of solar panel, moisture sensor, microcontroller, battery and GSM module. This project may provide the solution of water wastage as the system will work on the signal of soil moisture so there will be no wastage of water. And the energy is produced by the solar panel which is renewable and environment friendly can be utilised in various purposes. With the help of GSM module the farmer can track the whole system from their mobile phone. This system is very easy to install and to operate.

In future study, experimentation is required for the above system with thermal modelling for PV panel with tracker.

## 7. Acknowledgement

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