International Journal of Research in Advent Technology, Vol.4, No.4, April 2016
E-ISSN: 2321-9637
Available online at www.ijrat.org

Cleaning of Swimming Pools Using Solar Energy

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Abstract-In recent years people are showing a great interest in the construction of Swimming pools. People construct swimming pools for personal use or for the commercial propose like Water Parks. To keep pool water clear and healthy, and in addition to avoid the algae and dirt inside the pool, we require a control room consists of generator, motor, pumps etc. and an operator, which requires extra amount of money. This whole system consumes electricity either from fossil fuels or domestic power grids. Use of fossil fuels will produce Carbon Dioxide and affects our environment. But by the use of Solar Energy we can avoid the use of fossil fuel and also domestic power supply. Here we propose the use of solar electricity to operate the pumps used for circulating the water and cleaning swimming pools.

Index Terms-Solar cell, Battery, Water level detector, over temp detector, Light detector, OR gate. Mother board, Motor driver

1 INTRODUCTION

Electricity generated from renewable does not result in any CO_2 emissions. In contrast, gas, oil, and coal-fired power generation produces between 0.2 and 0.9 tons of CO_2 per MWh, depending on the energy source and the efficiency of the plant.

The sole purpose of this project is to develop a system that allows the owner of any swimming to be clean the swimming pool automatically using solar energy. A number of other sensors that could help the user in better management of the pool were also considered and investigated in the process. The primary objective of the project is to create a system that saves water and 3cleans the pool automatically using solar energy. For these purposes diff. sensor based hardware will be implemented and the measurement will be sent to a microcontroller.

Here we are using a water sensor for water saving, a temp sensor water cycling and a dirty detection sensor to clean the water. The entire sensor connected to a mother board. And for water storage and cycling we are using 3 DC pumps, which powered from solar energy.

2 Why we use Solar Electricity to Power Swimming Pool Pumps

The efficiency and reliability of solar cells are increasing as we are using the new thin-film solar cells instead of old crystalline silicon cells. The new cells are capable of producing electricity more than twenty years without a significant decrease in efficiency.

Although the efficiency of solar cells is currently around 10% to 16%, this figure is expected to double within the next decade. The cost of solar cells is currently around Rs. 43 per watt in India.

In this paper we are interested in using solar electricity to power the pool pumps. The pools that have already been installed and are working can be converted to use solar electricity by one of the following options:

- Using the existing AC pumps and purchasing PV panels and an inverter.
- Replacing the existing AC pumps with their DC equivalents and purchasing PV panels and a pump controller.
- Purchasing a solar energy pool kit.

Option 3 may be attractive for home owners and in option 1 we are using AC pumps but they have lesser efficiency then DC pumps. Implementation of option 2 may cause extra cost but the use of DC pumps would provide high efficiency.

Here in this paper we are interested to describe about the option 2. Here we discuss about 3points i.e. water level, temp. of water and pollute water

3 Block Diagram

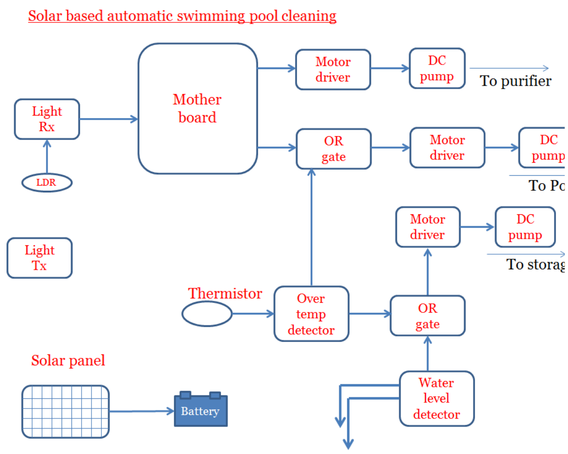

Fig. 1 Block layout of circuit

3.1 *Solar Cell*

A solar cell (also called a photovoltaic cell) is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect.The operation of a photovoltaic (PV) cell requires 3 basic attributes:

- The absorption of light, generating either electron-hole pairs or exactions.
- The separation of charge carriers of opposite types.
- The separate extraction of those carriers to an external circuit.

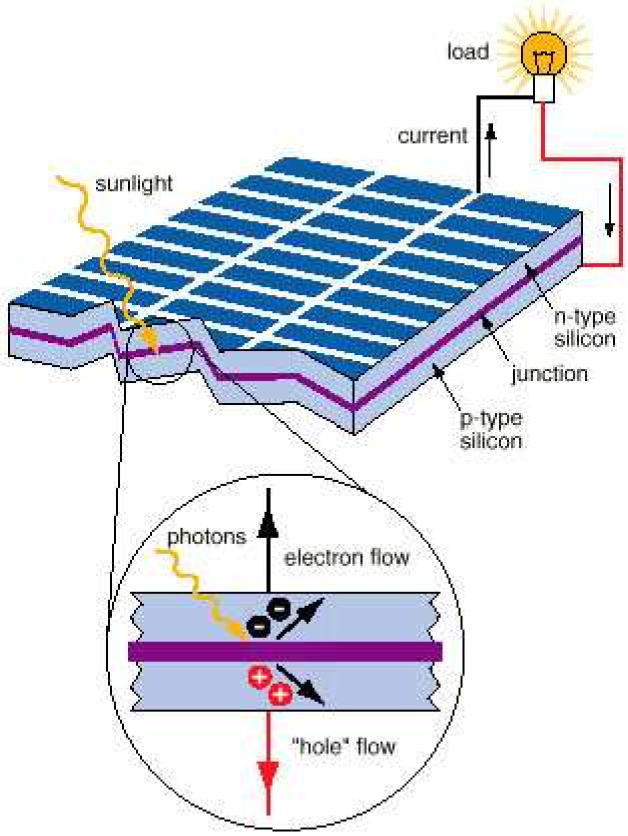

Fig. 2 The Photovoltaic Effect in a Solar Cell

The amount of power available from a PV device is determined by;

- the type and area of the material;
- the intensity of the sunlight; and
- The wavelength of the sunlight.

Fig. 3 Solar Panel

3.2 *Battery*

Here we use Rechargeable Battery because solar cell provides DC supply and the supply is not uniform always but here the equipment need constant supply. So we use such battery which can be recharge at morning times and can give supply when the sun light is not available

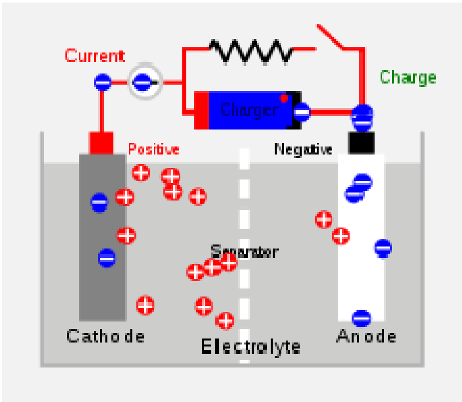

Fig. 4 Charging of Battery

3.3 *Water Level Detector*

In our project we use a water level detector, it will indicate the level of the water but at the same time it will ON/OFF the motor with the help of a relay.

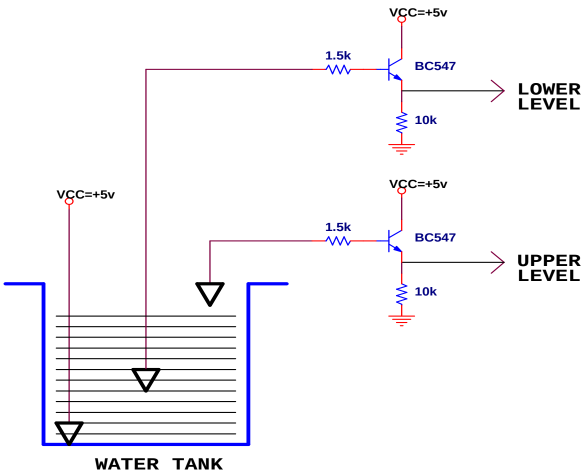

Fig. 5 circuit connection of Water level detector

Whenever the water level goes above the upper level sensor, the transistor is in ON state and the output is high. Similarly whenever the water level touches the upper level sensor, the transistor gets a high voltage the conduction of the water because we have inserted two sensors, one sensor is connected to a 5v which touches the lower ground plane and another upper level sensor to the above the ground plane that sensor is connected to the base of the transistor (BC547) through a base limiting resistance (1.5k) according to the resistance of the water, collector end to the Vcc (5v) and the output is taken across the emitter junction of the transistor through a resistance which is connected to the GND.

Whenever the upper level sensor touches the water, the transistor gets a high voltage at the base i.e. the transistor comes to saturation condition i.e. ON condition, the current will flow from collector to the emitter junction and the output is taken from the emitter junction. That output is given to the µ-controller; according to the programming the extra amount of water will be taken out by the DC pump to the storage.

3.4 *Over Temperature Detector*

In this section our aim is to detect over temperature, for that we needs a temperature sensor as a (THERMISTOR) which is a N.T.C type for sensing the temperature and for comparing the temperature we needs a OP-AMP which is configured as an voltage comparator (LM393) which compares the two input voltage and gives the corresponding outputs according to the temperature. In the temperature sensor is a circuit that converts temperature to the corresponding voltage.

3.4.1 Connection

The temperature sensor (THERMISTOR) one end of the terminal of the thermister is connected to a Vcc and the other end terminal is connected to the GND through a series connected resistances, which forms a voltage divider network. At constant room temperature, the corresponding voltage will be available at the output. If the temperature increases the corresponding voltage will increase according to the increase in temperature. That output signal is given to the comparator for comparing the voltage. If the comparator input is connected to the inverting terminal (+) reference value is greater than the non-inverting terminal (-), the comparator output is high i.e. ON condition. Similarly, if the comparator input is connected to the non-inverting terminal (-) reference value is greater than the inverting terminal (+), the comparator output is low i.e. OFF condition. But, here both of the comparator input of inverting and non-inverting of both of the comparator is connected to the temperature sensor and the set value input inverting and non-inverting of both of the comparator through a variable resistance (10k). That output signal is given to the LED indicator section for indication purpose for the availability of the signal at the output of the comparator.

3.4.2 Operation

At constant room temperature suppose in 30°C, the output at the of the sensor circuit that forms a voltage divider network gives a corresponding voltage suppose 3V. That voltage goes to the input of the comparator. The output of the signal sampling voltage (3v) goes to the input of both of the comparator. If the temperature increases, the corresponding voltage will increase due to the increase in temperature say 6V. That voltage goes to the input of the non-inverting terminal(which is a reference voltage) of the OP-amp which is configured as a voltage comparator. In this comparator we have set the voltage say 3V to the inverting terminal. In this case non- inverting terminal is greater than the inverting terminal. That means output of the comparator goes to +Vsat is HIGH this means that over temperature has occurred.

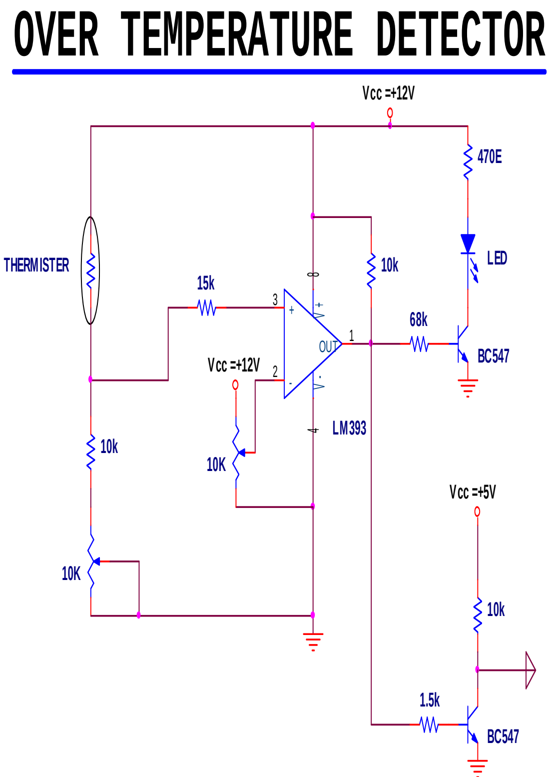

Fig. 6Connection of Over Temperature Detector

3.5. Light Detector

The LDR sensing circuit is configured as a voltage divider circuit. At normal condition, the source light filling on the LDR its resistance increases, so the voltage decreases which is given to the non-inverting terminal of the op-amp which is nothing but the reference voltage and the inverting terminal is connected to a variable resistor (10k) through a Vcc. Here the op-amp is configured as comparator; comparator is nothing but compares the two voltages i.e. non-inverting to the inverting terminal. If the non-inverting (-) terminal is greater than the inverting (+) terminal, the output of the comparator goes to the –Vsat=0. Similarly, if the inverting terminal is greater than the non-inverting terminal, the output of the comparator goes to the +Vsat=1.

In this section, at normal condition the light source is falling on the LDR sensing ckt and that LDR sensing ckt is configured as voltage divider network, at the voltage divider network the resistance of the LDR decreases and the output increases, that output is feed to the inverting terminal of the comparator say the output voltage is 5v goes to the inverting terminal which is nothing but reference voltage for the comparator and the non-inverting terminal is connected to a variable resistor which is one of the terminal is connected to a Vcc and another terminal is connected to ground and the tapping terminal is feed to the non-inverting terminal of the comparator which is a set voltage for the comparator is set at say 7v.

In this condition the inverting (+) terminal is smaller than the non-inverting terminal, so the output of the comparator goes to LOW (-Vsat). If somebody tries to interrupt the light source, the LDR resistance increases in which the voltage decreases, which is given to the non-inverting terminal of the comparator. In this case the output of the comparator is goes to HIGH (+Vsat). That output is given to the monoshot as input through an inverter and to the led indicator for indication purpose.

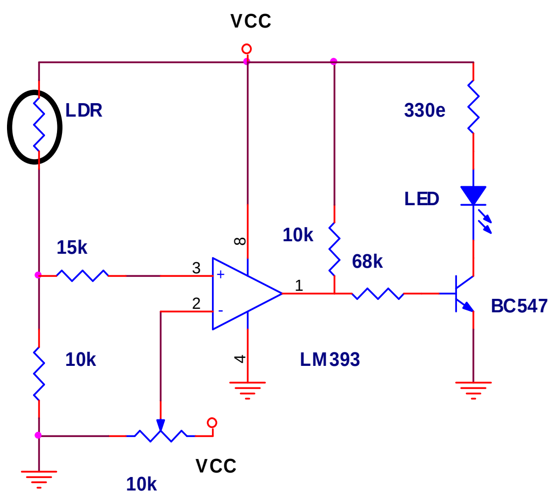

Fig. 7 Connection of Light Detector

3.6. Mother Board

The motherboard of this project is designed with a MSC–51 core AT89C51 micro controller. This board is consisting of a socket for micro controller, input /output pull-up registers; oscillator section and auto reset circuit.

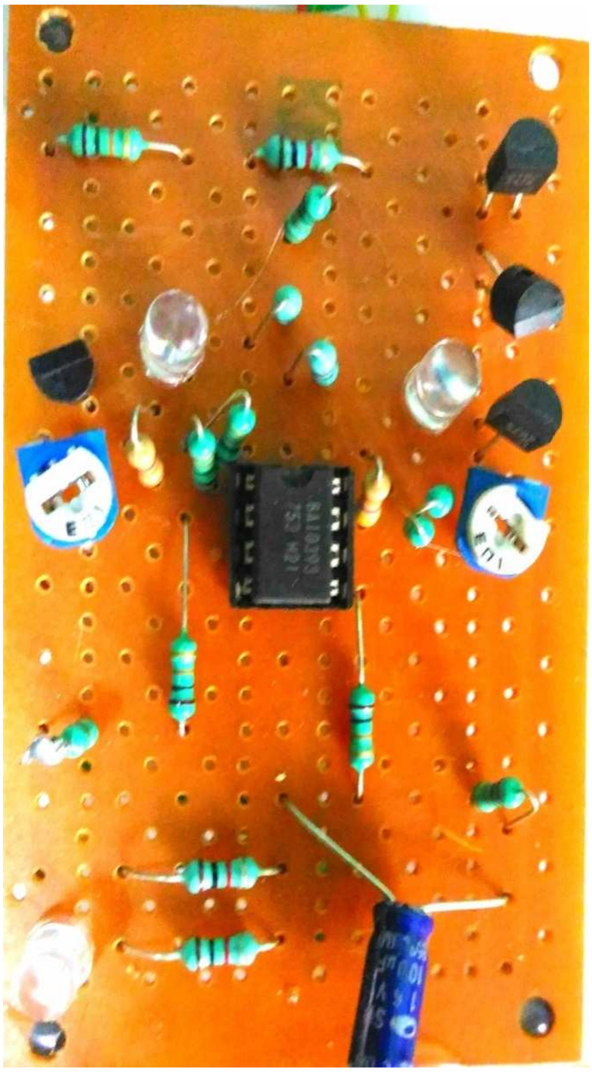

Fig. 8 Mother Board

3.6.1 Micro Controller AT89C51

Here we are using AT89C51 micro controller which is from 8051 family and widely famous in robotics field.

Fig. 9 AT89C51

3.6.2. Pull UP Resister

It is use at the interface between two different types of logic devices, possibly operating at different logic levels and power supply voltages.

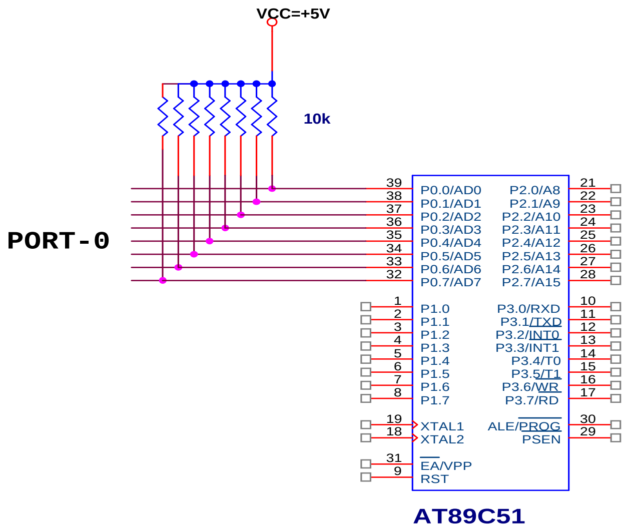

Fig.10 Connection of Pull up restister with AT89C51

3.6.3 Crystal Oscillator

The 8051 family microcontroller contains an inbuilt crystal oscillator, but the crystal has to be connected externally. This family of microcontroller can support 0 to 24MHz crystal and two numbers of decoupling capacitors are connected as shown in the figure. These capacitors are decouples the charges developed on the crystal surface due to piezoelectric effect. These decoupling capacitors are normally between 20pf to 30pf.

3.6.4 OR Gate

The OR gate is also called as "any or all" gate. The OR gate is the combinational logic circuit which has only one output and may have any number of inputs. The output is 1 when any one or more than one of the input is 1 and the output is 0 only when all the input is 0.

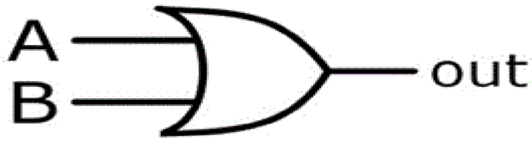

Fig. 11 OR Gate

3.7. Motor Driver

Here in this project model we using 12V DC motor that is typically find applications in robotics and control systems also used for techno-generator in the industries.

Here this motor is working as a DC pump. After getting signal it circulates the water.

Fig. 12 DC Pumps

4.Practical Aspects and Cost

If we implement this project on a high standard way then we require

- 750W DC pool pumps
- 6 × 180W PV panels
- Pump controller
- Cables

6 PV panels would be cost around Rs. 3laks, one 750W DC Pool pumps is of Rs. 42k, Pump Controller is in between Rs 2k to 4k. So approximately the cost of equipment is around Rs 4laks. After including installation charges the total cost may be around Rs 5laks.

In normal case where we are using AC pumps to circulate the water in swimming pools; operate with 240V AC and have a power rating of 2KW. Assuming 12hour of operation, the required energy is 24kWh per day. In a month it will consume around 720kWh. The cost of one kWh in India is very according to the states. Let take an average of Rs 4.50. Then monthly bill will be Rs. 3,250 and annual cost around Rs. 39,000. We also need a person at service who will operate the system and we also have to pay him. Let Rs. 60,000 per annum; i.e. nearly Rs. 1laks per year.

If we use this project commercially then the initial cost which is around Rs. 5-6laks will be recover with in 5-6years. Then after is the profit as the sun and his light is always present there, so this will work for many years.

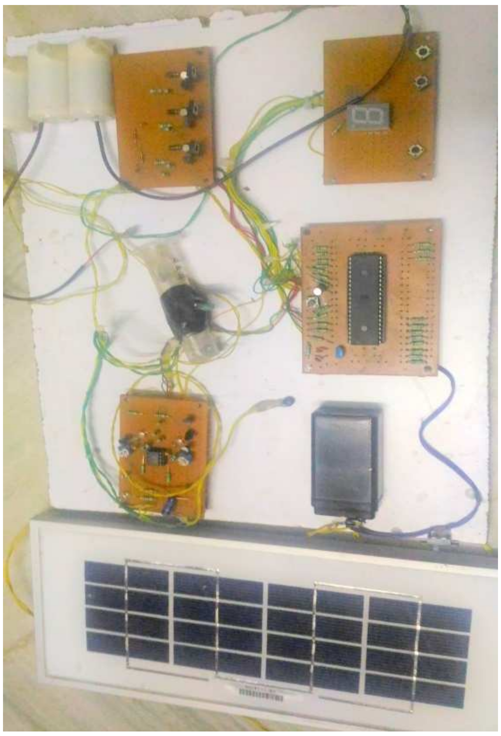

Fig. 13 Total circuit connection of Model

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