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IoT based Solar Water Purification and Quality Assessment

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***Abstract*: In the modern era where the scarcity of freshwater is increasing daily, the strain we place on our resources due to the over use is causing irreversible damage. Adding on, the purity and quality of the water is to be of great concern for water used in households. The total quality management of the water available is nowadays as important as water itself. Here we are envisioning a device that is sustainable and also portable in order to be used in remote places and during extreme conditions. The use of solar panels to power the device makes it a cleaner technology and more environmentally friendly. The water is filtered using the process of Reverse osmosis making use of RO candle filters that are available commercially. It is used so as to desalinate-detoxify-destroy pathogens and other microbes. The purified water is measured for its pH and turbidity using sensors which are IOT based and will notify the user about the values. This device is a necessity as it finds its application in military areas during emergencies like a ship wreck or an attack also for those remote locations where freshwater availability is still a mirage. This portable module can be further modified to add a garbage collector unit if needed. In conclusion this device is a cleaner cost-effective sustainable approach towards freshwater harvesting.**

***Keywords*: Assessment, Dirty water, Filters, Internet of Things, Ph, Quality assessment, Solar, Turbidity, Water purification.**

1. Introduction

Water is an essential thing that's needed for the survival of all living things. This is because it plays a vital part in sustaining life also it constitutes a large percent of the body of a living thing. However, despite water being very important, it has not been spared the wrath of pollution especially in these times when industrialization is at its best. Polluted water possesses a great threat to life especially because it causes very deadly diseases.

In this modern world where the scarcity of fresh water is decreasing daily. We need to use the available technology in an efficient manner. The strain we place on our resources due to over usage of our planets natural sources of energy is causing irreversible damage. In this project we have envisioned a plant which can purify and produce fresh usable water from commonly available water which is working on solar energy and is IoT based.

Solar power is the conversion of energy from sunlight into electricity either directly using photovoltaics (PV) or indirectly using concentrated solar power or a combination of both. Photovoltaic cells convert light into an electric current using the photovoltaic effect. Desalination is the process of purifying and filtering sea water through various methods (Electro Dialysis, Solar still, Reverse Osmosis). Reverse Osmosis is a water purification technology that uses a semi permeable membrane to remove ions molecules and larger particles from sea water. In Reverse osmosis an applied pressure is used to overcome osmotic pressure that is driven by chemical potential difference of the solvent. The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side. Microcontrollers and the concept of IOT is put into action to produce pure and clean water. Quality assurance is also made possible by the use of different sensing devices.

2. Methodology

A. Working of purification and monitoring system

As a pre-setting process the Wi-Fi module is set as a Wi-Fi client rather than a Wi-Fi host. At first in order to connect to a specific user network we feed the ssid and password. The node MCU then checks for the availability of the host server to be connected with. The submersible pumps are controlled using switches assigned to it on the web-page using IoT. When pump 1 is turned ON the inlet contaminated water is pumped into the filter module. The filter module processes the water in the following manner: Pre filtration process-Sedimentation-Carbon filter-RO membrane. The processed water is then moved to a storage tank with the aid of the second pump. The quality monitoring of the processed water is then done using the pH and turbidity sensor which are immersed in the processed water. The pH and turbidity values are then displayed on the host server.

B. Working of boost converter

The boost converter is used to step up the voltage from a lower to much higher value. The boost converter used here is consisting of-voltage source 5V diode bridge kbpc35005, inductor, MOSFET IRF840, capacitor 63v 1000uf.The need of a boost converter in this setup is to step up 5 v input power supply to 15V, in order to run motor.

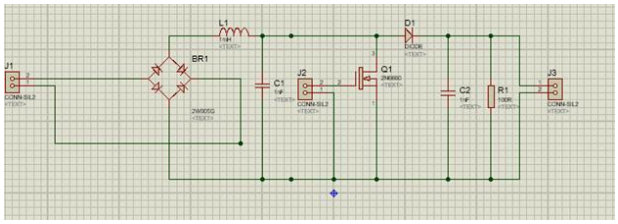

Fig. 1. Boost Converter

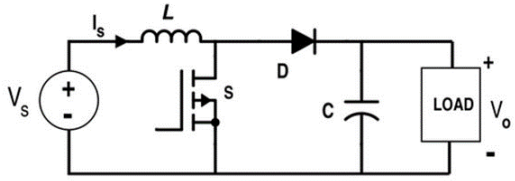

Fig. 2. Boost circuit

When the switch is open the input supply 5V flows through the inductance L and flows through diode and the capacitor get charged. Fig 3 shows the switch off mode of boost converter. Now when the switch is turned on the supply flows through the inductor and inductor get charged. The switches turned off again charging the capacitor and we get a boosted output across capacitor.

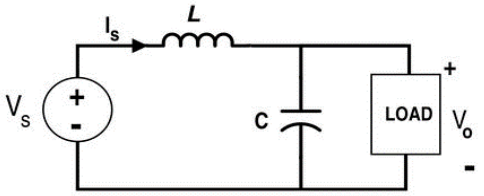

Fig. 3. Switch off mode

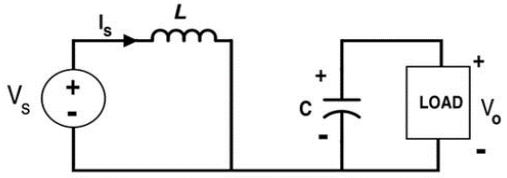

Fig. 4. Switch on mode

C. *Driver circuit using TLP250*

The function of the driver circuit is to convert the 5 volt pulses to 15 volt ones in order to control and operate the switching device which is a MOSFET IRF840. A half-wave rectifier is also situated at the back of the circuit. The input signal to the half-wave rectifier is 12 volt AC and the output is 15.836 volt (12V- 0.8v (drop across diode)*1.414(capacitor filter boost) = 15.836vDC). For 1 mA of current 15 volt pulses are required, hence rectifier output current must be more than 1 mA (say 2mA) As we know that, Ic = C Dv/Dt (Where Dt=10milliSecond one half cycle of input voltage)(And Dv =20 milli volt. I.e. Ripple free voltage across capacitor) From the above two values the capacitance C is found out as 1000 micro Farad. Also it is to be noted that the voltage across the LED should not exceed 5 volts, but the voltage across the LED is now 15.7380 V DC. In order to reduce the voltage a 1000-ohm resistor is used. One transistor is NPN and the other is PNP. When a 5-volt pulse is transmitted from the PIC controller the PNP transistor turns off and the NPN transistor lets the signal pass to the Gate -Source terminal and no voltage drop occurs. When there is no pulse from the PIC, PNP will be on, short circuiting the gate source terminal and no voltage drop across it. It is used for providing matching impedance between PIC and driver circuit. Impedance matching helps to reduce the attenuation of pulses.

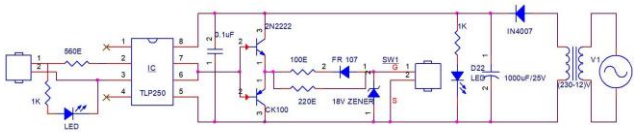

Fig. 5. Drive circuit using TLP250

D. *Relay Circuit*

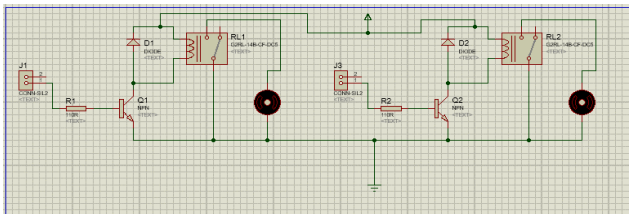

Fig. 6. Relay circuit

A relay is an electrically operated switch. Current owing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example, a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical. Relays are very simple devices. There are four major parts in every relay.

They are: Electromagnet, Armature that can be attracted by the electromagnet, Spring, set of electrical contacts. When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force approximately half as strong as the magnetic force to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing. The relay's switch connections are usually labeled COM, NC and NO.

NOTE: Connect to COM and NO if you want the switched circuit to be on when the relay coil is on. Connect to COM and

NC if you want the switched circuit to be on when the relay coil is off. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Hence a CB amplifier is used to achieve the current rating of the relay. Transistors and ICs must be protected from the brief high voltage produced when a relay coil is switched off. The diagram shows how a signal diode (e.g. 1N4148) is connected 'backwards' across the relay coil to provide this protection. Current owing through a relay coil creates a magnetic field which collapses suddenly when the current is switched o. The sudden collapse of the magnetic field induces a brief high voltage across the relay coil which is very likely to damage transistors and ICs. The protection diode allows the induced voltage to drive a brief current through the coil (and diode) so the magnetic field dies away quickly rather than instantly. This prevents the induced voltage becoming high enough to cause damage to transistors and ICs.

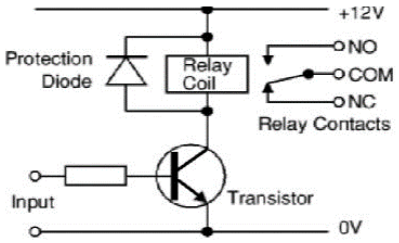

Fig. 7. Drive circuit and protection diodes for relay

3. Results

The project consists of two parts-hardware and software parts. The hardware part consists of construction of frame for our model and also assembling of all the components and also providing dual power supply by introducing a solar panel and its associated components. Software part includes the program used for creating the webpage using HTML. With the help of this model we are able to collect contaminated and dirty water from various places using a mobile purification unit and make them undergo various filtering process using different filters like carbon filter, RO filter, etc. which give us clean and drinkable water. As it can support dual supply source it can be powered with the help of solar panel and also taking direct supply from utility. Thus making it very popular to use in places where continuous electricity supply is a major concern and also having supply from utility it can be used during night time and also during cloudy conditions.

4. Conclusion

This device is a necessity as it finds its application in military areas during emergencies like a ship wreck or an attack also for those remote locations where freshwater availability is still a mirage. This portable module can be further modified to add a garbage collector unit if needed. In conclusion this device is a cleaner cost-effective sustainable approach towards freshwater harvesting.

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