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IMPLEMENTATION OF SOLAR INVERTER FOR HOME

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Abstract:

The purpose of this project is to implement tele control of solar home system. Implementation of Internet of Things in this project is used to support the design of monitoring system to control electric power load generated by solar panel. The design of the system begins with a simulation and then it is manufactured and tested system parameters that include current, power and duration of time when the device connected power load control via internet network. The technique used is to collaborate the value of current and voltage measured by the current and voltage sensors as the value of power used.

I. INTRODUCTION

Electricity is the major source of power for country's most of the economic activities. But in Bangladesh, we have been suffering for the electricity crisis for a long time. To reduce this problem, there are some alternative ways which can help in this purpose. But among all of the methods solar system may be an easy and effective one especially in the rural areas where the electricity has not reached yet. Solar energy is a renewable energy which possibly has no harm on the environment. A solar panel can maximum produce 128 watt which can run 11 CFl (compact florescent lamp) of 6 watt power, a fan conducted on DC current. Also 19/20 inches black & white television can run. Presently, Grameen shakti, BRAC solar home system and also many companies have a mission to provide electricity to the remote areas and also reduce the crisis of electricity by using the solar energy. Generally these kinds of projects like solar panels are mostly dependent on the DC appliances. Here, DC sources are converted to the AC source by using an inverter. From several researches, we have found that Grameen and BRAC solar project is dependent on DC applications. Due to lack of proper inverters, the companies provide usage of DC appliances only not AC appliances. The reason is that the existing inverter produces modified sine wave (square sine wave) which causes major power losses and harms to AC appliance. But in comparing to pure sine wave, it has better performance than modified one and the power loss is less. For that reason, our objective is to design a pure sine wave inverter which can be used in the Solar Home System at an affordable cost. In this project, our aim was to design a pure sine wave inverter which is thedigital versioned circuit using micro-controller applications. The world demand for electric energy is constantly increasing, and conventional energy resources are diminishing and are even threatened to be depleted. Moreover; their prices are rising. For these reasons, the need for alternative energy sources has become indispensable, and solar energy in particular has proved to be a very promising alternative because of its availability and pollution-free nature. Due to the increasing efficiencies and decreasing cost of photovoltaic cells and the improvement of the switching technology used for power conversion, we are interested in developing an inverter powered by PV panels and that could supply stand-alone AC loads and also be connected to the grid. Solar panels produce direct currents (DC), and to connect these panels to the electricity grid or use them in other industrial applications, we should have an AC output at a certain required voltage level and frequency. The conversion from DC to AC is essentially

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accomplished by means of a DC-AC inverter, which is the major component in the system. Yet, the output of the solar panels is not continuously constant and is related to the instantaneous sunlight intensity and ambient temperature.

II. POWER SUPPLY

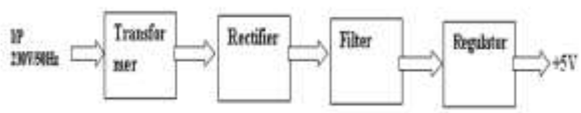


Figure.1.Power Supply

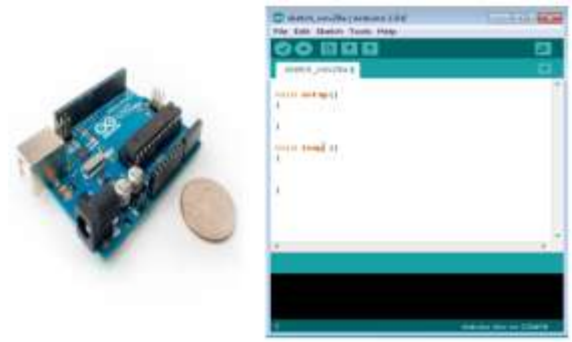
III. HARDWARE

Arduino

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

The key features are −

- Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.
- You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).
- Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.
- Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.
- Finally, Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.



Liquid Cristal Display

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

A program must interact with the outside world using input and output devices that communicate directly with a human being. One of the most common devices attached to an controller is an LCD display. Some of the most common LCDs connected to the contollers are 16X1, 16x2 and 20x2 displays. This means 16 characters per line by 1 line 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

Many microcontroller devices use 'smart LCD' displays to output visual information. LCD displays designed around LCD NT-C1611 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 5X7 dots plus cursor of the display. They have a standard ASCII set of characters and mathematical symbols. For an 8-bit data bus, the display requires a +5V supply plus 10 I/O lines (RS RW D7 D6 D5 D4 D3 D2 D1 D0). For a 4-bit data bus it only requires the supply lines plus 6 extra lines(RS RW D7 D6 D5 D4). When the LCD display is not enabled, data lines are tri-state and they do not interfere with the operation of the microcontroller.

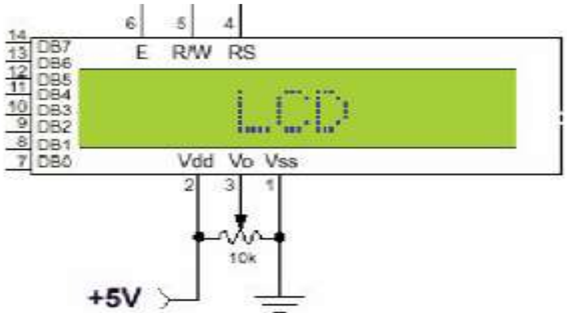
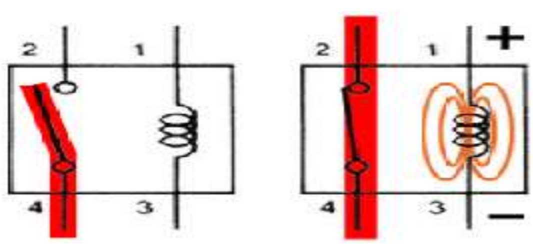


Figure.2.Pin diagram of 1x16 lines LCD

Relays

A relay is an electrically operated switch. These are remote control electrical switches that are controlled by another switch, such as a horn switch or a computer as in a power train control module, devices in industries, home based applications. Relays allow a small current pin, 4-pin, 5-pin, and 6-pin, single switch or dual switches. Relays are used throughout the automobile. Relays which come in assorted sizes, ratings, and applications, are used as remote control switches. A typical vehicle can have 20 relays or more.



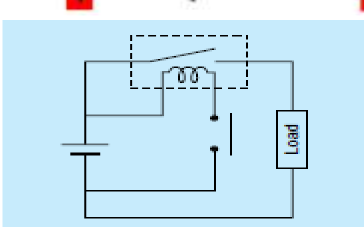


Figure.3. Relay

Voltage Sensor:

A voltage sensor is a sensor is used to calculate and monitor the amount of voltage in an object. Voltage sensors can determine both the AC voltage or DC voltage level. The input of this sensor can be the voltage whereas the output is the switches, analog voltage signal, a current signal, an audible signal, etc.

Sensors are basically a device which can sense or identify and react to certain types of electrical or some optical signals. Implementation of **voltage sensor** and current sensor techniques have become an excellent choice to the conventional current and voltage measurement methods.

Advantages of Voltage Sensors Over Conventional Measuring Techniques

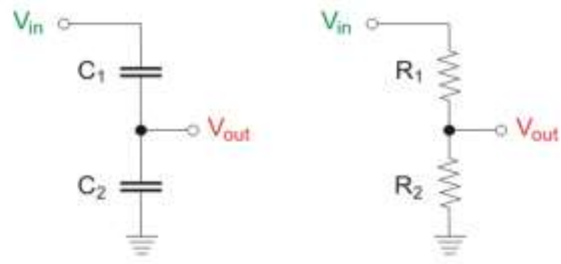
The advantage of voltage sensors include:

- Small in weight and size.
- Personnel safety is high.
- Degree of accuracy is very high.
- It is non-saturable.
- Wide dynamic range.
- Eco-friendly.
- It is possible to combine both the voltage and current measurement into a single physical device with small and compact dimensions.

That is, some **voltage sensors** can provide sine or pulse trains as output and others can produce Amplitude Modulation, Pulse Width Modulation or Frequency Modulation outputs.

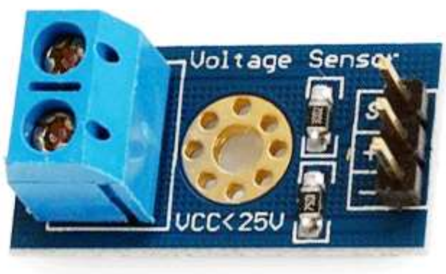
In voltage sensors, the measurement is based on a voltage divider. There are two main types of voltage sensors are available- **Capacitive type**

voltage sensor and **Resistive type voltage sensor**.



$$V_{out} = \frac{C_1}{C_1 + C_2} \times V_{in}$$

$$V_{out} = \frac{R_2}{R_1 + R_2} \times V_{in}$$



WIFI Module:

The ESP8266 is a low-cost WiFi module that can be integrated easily into IoT devices. We've featured several projects using this module, such as **How To Make Smart Home Electronics: A Smart Mailbox** and **How To Read Your Arduino's Mind: Building A Childproof Lock**. This tutorial will walk you through setting up ESP8266 Wifi module which can be used with Arduino. The ESP8266 comes in many models with different functionalities. We'll be focusing on the ESP8266 ESP-01 module, the most common and basic one available.

Figure 4. ESP8266 ESP-01 module / ©Sparkfun

Battery:

Batteries are a collection of one or more cells whose chemical reactions create a flow of electrons in a circuit. All batteries are made up of three basic components: an anode (the '-' side), a cathode (the '+' side), and some kind of electrolyte (a substance that chemically reacts with the anode and cathode).

When the anode and cathode of a battery is connected to a circuit, a chemical reaction takes place between the anode and the electrolyte. This reaction causes electrons to flow through the circuit and back into the cathode where another chemical reaction takes place. When the material in the cathode or anode is consumed or no longer able to be used in the reaction, the battery is unable to produce electricity. At that point, your battery is "dead."

Batteries that must be thrown away after use are known as **primary batteries**. Batteries that can be recharged are called **secondary batteries**.

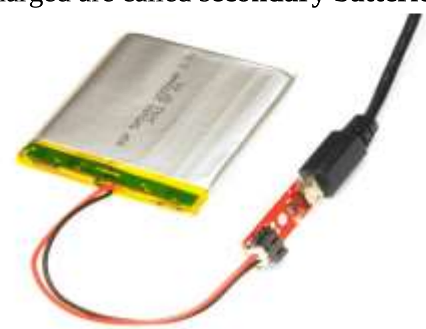


Fig : 5. Lithium Battery

Solar Panel:

The term **solar panel** is used colloquially for a photo-voltaic **(PV) module**.

A PV module is an assembly of photo-voltaic cells mounted in a frame work for installation. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity. A collection of PV modules is called a PV Panel, and a system of Panels is an Array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.

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The most common application of solar energy collection outside agriculture is solar water heating systems.[1]

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can be either the top layer or the back layer. Cells must be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells are connected electrically in series, one to another to a desired voltage, and then in parallel to increase amperage. The wattage of the module is the mathematical product of the voltage and the amperage of the module.

A PV junction box is attached to the back of the solar panel and functions as its output interface. External connections for most photovoltaic modules use MC4 connectors to facilitate easy weatherproof connections to the rest of the system. A USB power interface can also be used.

Module electrical connections are made in series to achieve a desired output voltage or in parallel to provide a desired current capability (amperes) of the solar panel or the PV system. The conducting wires that take the current off the modules are sized according to the ampacity and may contain silver, copper or other non-magnetic conductive transition metals. Bypass diodes may be incorporated or used externally, in case of partial module shading, to maximize the output of module sections still illuminated.

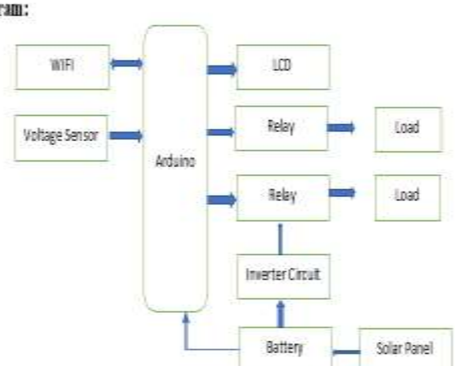
Bulb:

A **light bulb** produces light from electricity.[1] In addition to lighting a dark space, they can be used to show an electronic device is on, to direct traffic, for heat, and for many other purposes. Billions are in use, some even in outer space.

Early people used candles and oil lamps for light. Crude incandescent lights were made in the early and middle 19th century but had little use. Improved vacuum pumps and better materials made them shine longer and brighter late in the century. Electric power stations brought electricity to urban and later rural areas to power them. [2] Later gas discharge lights, including fluorescent lights, use less electricity to make more light.

IV. RESULT

Block Diagram:



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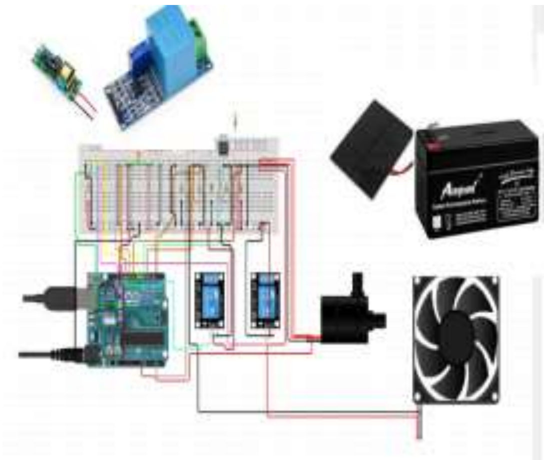
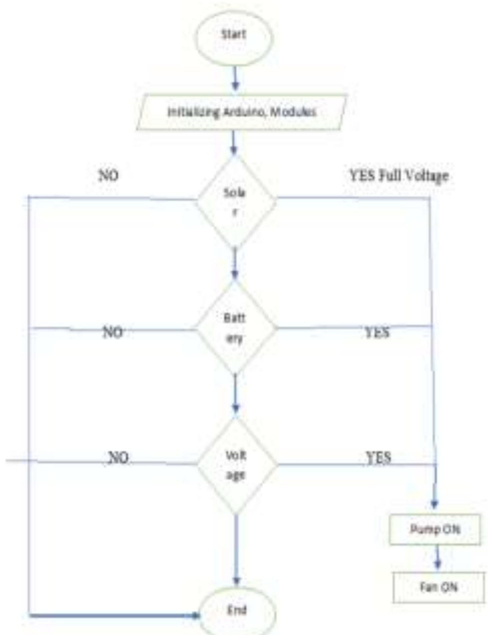
Schematic Diagram:



Flow Chart:



IV. Working:

In this Project we are using solar panel inverter for home applications. For this we are using a controller for maximum efficiency of output. So, this controller will continues monitor the voltage of solar panel, battery if full voltage is available the it will feed to device in home if not the battery will be charged. For loads in homes, we need AC supply but we get DC supply in solar power for that we are implanting inverter circuit which converter DC to AC.

V. CONCLUSION

The project has a lot of component blocks that can be reviewed. The bulky components like the transformer can be replaced by a high frequency transformer with the right ferrite core which is a lot smaller than the one we used. Thus allowing us to test the initial design (H-Bridge DC-DC converter, followed by the high frequency transformer, and the H-Bridge for the DC-AC inverter)
which may lead better efficiency and high power capabilities. The H-Bridge will reduce the magnetizing energy stresses on the transformer. When we go into high frequency, we use a small L to filter the output of the H Bridge. This will give us the opportunity to conduct a comparison between the two designs and decide which one is more efficient.

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