MONITORING OF IOT BASED SMART INVERTER USING RASPBERRY PI

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ABSTRACT

Inverters are commonly found in most household's applications in today's life. However this work we discuss the implementation of a IOT enabled smart inverter i.e. a solar charged inverter that uses Wi-Fi technology to engage a two way communication with the user. This work uses the Raspberry Pi board based on the ATmega328P along with Node MCU which runs on theESP8266 Wi-Fi module to implement the objectives.

INTRODUCTION

The industrial revolution in power has become the most fundamental element required to fuel an economy. Every section of society like industries, homes and the government itself is heavily dependent on power for its smooth functioning. However, the population expansion has resulted in an increased demand for power. Pollution due to conventional energy sources is already at an all-time high. Hence, it is time we use renewable energy sources in order to reduce pressure on power grids. Therefore, it is extremely important to focus on the concept of energy generation using renewable sources and energy storage in an efficient manner to reduce the pressure on power grids. Energy storage comes in handy during emergencies like floods, storms, equipment failure etc which result in long power cuts. The population explosion has also resulted in a power shortage and consequential power cuts. But with the ever-rising technological advances the inverter is expected to be much smarter than it is now. One way of doing it is to let the consumer monitor its status remotely. In this paper we mainly focus on monitoring of inverter's battery, displaying the run-time utilization of the loads and controlling of loads wirelessly. Inverters found in most households and industries are powered by non-renewable energy resources and are primitive in their architecture and usage. Most consumers are caught off-guard when the inverter's battery dies out as the existing inverters lack the ability to alert the users about the power consumption and battery life remaining. A smart inverter must use renewable energy to charge its battery, it should be adaptive and able to send and receive messages quickly, as well as Share data with the owner. Hence there is scope for retrofitting the existing inverters to make them more user-friendly by displaying the battery voltage and also providing information on the run-time of his loads while using the battery, which will also promote judicious use of available energy by the consumer.

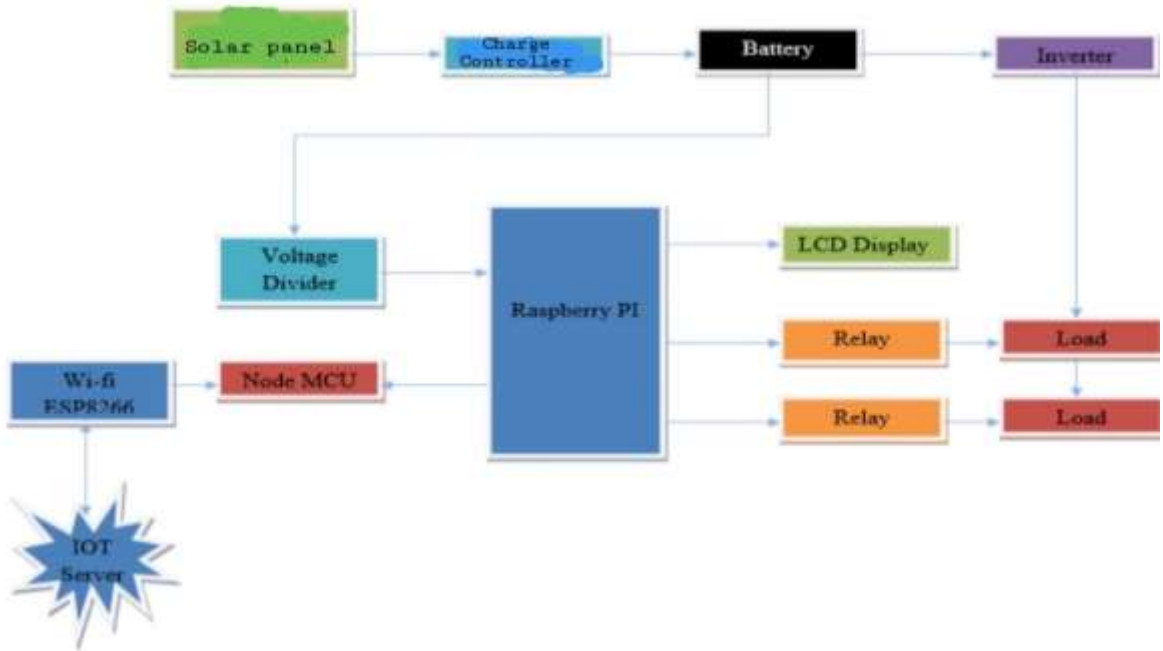
OBJECTIVES

- To create an interactive lOT-enabled Smart Inverter which is charged by a sol:ir PV panel and can display the existing battery voltage at any point intime.
- To allow the user to then decide which crucial loads to run in the event of a power failure and key in his preferences onto the provided GUI such as a Mobile Application.

PROPOSED SYSTEM:

The main aim of the system design is that the user can control the home appliances through mobile. The system basically is a IOT based Smart Inverter where energy is harvested using solar panel and boosted using buck boost converter and stored in a battery. Later using it will be converted to AC using inverter. The load will be connected at the end. The main part of the project is IOT using which all the data will be sent mobile app using server. The system is having an automatic power cut-off and high range of security for identifying unauthorized person using IOT. All the devices connected to system can be controlled using web app from anywhere in the world.

BLOCK DIAGRAM:



Solar panel: Solar panels absorb the sunlight as a source of energy to generate electricity or heat. Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. The majority of modules use wafer based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture. Modules electrical connections are made in series to achieve a desired output voltage and/or in parallel to provide a desired current capability. The conducting wires that take the current off the modules 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.

Charge controller: Here in this work used as a charge controller. The fluctuating voltage from the panel is controlled and brought to some standard voltage value. The buck–boost converter is a type of DC-to-DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. It is equivalent to a fly back converter using a single inductor instead of a transformer.

Smart inverter: For an inverter to be considered smart, it must have a digital architecture, bidirectional communications capability and robust software infrastructure. The system begins with reliable, rugged and efficient silicon-centric hardware, which can be controlled by a scalable software platform incorporating a sophisticated performance monitoring capability. A smart inverter must be adaptive and able to send and receive messages quickly, as well as share granular data with the owner, utility and other stakeholders. Such systems allow installers and service technicians to diagnose operational and maintenance issues including predicting possible inverter or module problems and remotely upgrade certain parameters in moments.

Raspberry pi: The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. These boards are approximately credit-card sized and represent the standard mainline form-factor. This board is available in three models named A, B, B+. The B+ Raspberry Pi board is the latest version among them, and it runs on ARM11 processor with 512MB RAM operating at 700 MHz frequency

LCD: A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as pre-set words, digits, and 7segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements

Relay: A relay is an electrical switch that uses an electromagnet to move the switch from the off to on position instead of a person moving the switch. It takes a relatively small amount of power to turn on a relay but the relay can control something that draws much more power.

IOT: The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

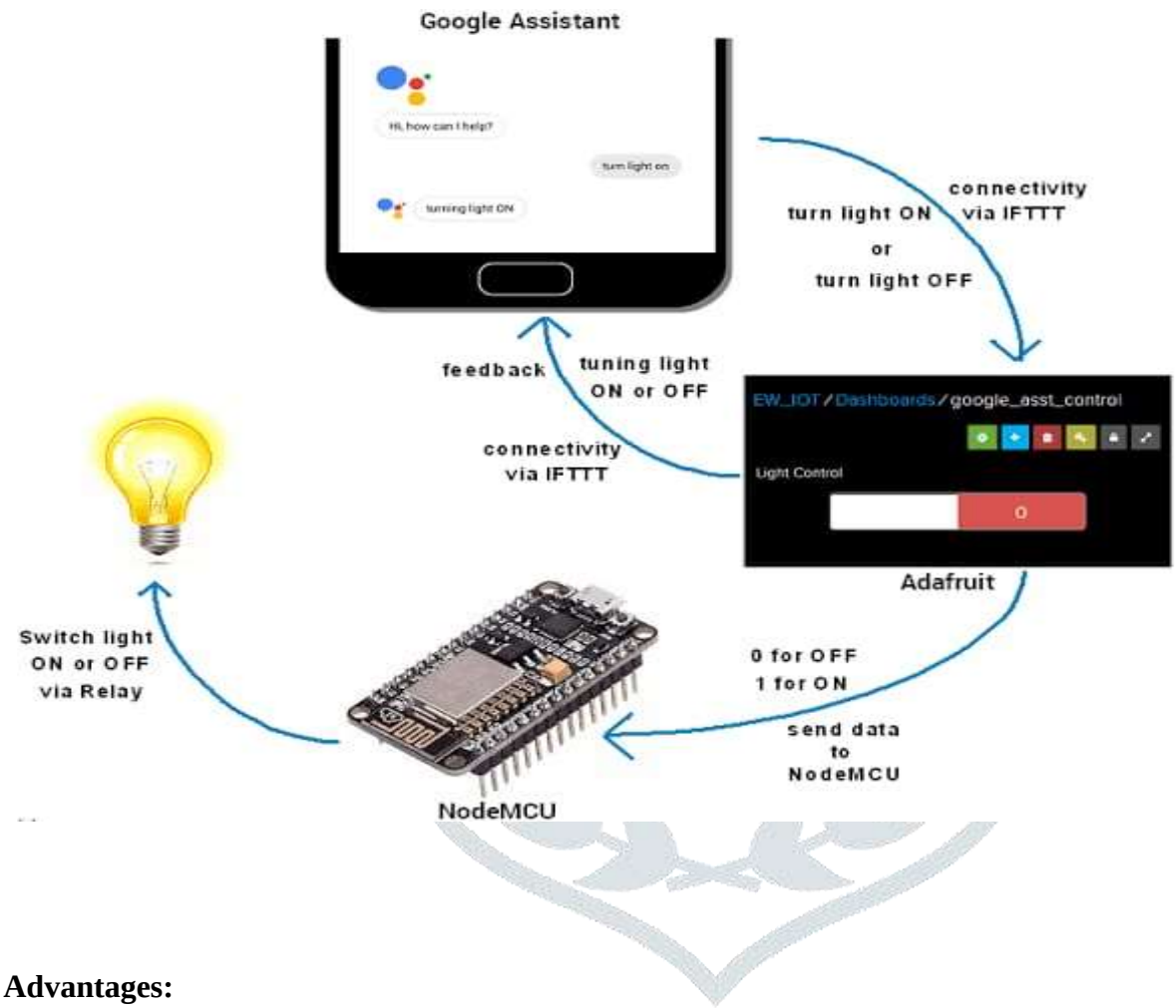
LOAD: Usually load means which consumes energy. For residential purpose the loads mean the fans, bulbs, tube lights, and many more which consumes energy.

SOFEWARE IMPLIMANTATION

The software portion of the system mainly consists of two parts:

- Code to program the Rasperry pi and to configure the ESP8266 Wi-Fi module to send data to server.
- Finally, the IOT adafruit IO server is accessed through user name and password.
- A MQTT protocol is used to publish the data and subscribing the data.

Wireless Controlling Of Load Through Google Assistant



Advantages:

- Renewable energy source.
- Reduces electricity bills.
- Low maintenance cost.
- Technology development.
- Easy to control.
- Eco-friendly.

Applications:

- Single axis sun tracker can be used for large and medium scale power generation.
- It can also be used for power generation at remote places.
- It may be used as domestic backup power system.
- It can be used in solar street lighting system.

- It may be used in water treatment technologies and solar heating.
- It can be commercialized

CONCLUSION AND FUTURE SCOPE:

This method, we can successfully implement an IoT based Smart inverter by retrofitting an existing inverter with new functionalities such as bidirectional communication with the user. At the time of a power cut the user can wirelessly control loads based on his/her priorities. we can also check the battery voltage in order to avoid being caught off guard when the battery completely drains out with no indication. This prototype gives insight into working of a self-sufficient and reliable system for home automation and monitoring power consumption of household appliances. This system requires only initial stage investment in solar panel and the smart inverter system is developed at low cost. A consumer generates enough energy for oneself and uses it accordingly with an environment friendly system. If extended to a community, this paper can be connected to grid, where users can "sell" or "buy" the power generated from others, making it even more diverse. This can be implemented using the concept of net metering. Also, since this work is confined to a LAN, port forwarding can be implemented to control the loads even when connected to a different network.

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