International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS)
1st Special Issue on Engineering and Technology | Volume VI, Issue VS, May 2017 | ISSN 2278-2540

IOT Based Smart Inverter Using Raspberry PI

Megha A Joshi, Kavyashree S

Department of Electrical and Electronics Engineering, Dr.Sri Sri Sri Shivakumara Mahaswamy College of Engineering, Visvesvaraya Technological University, Karnataka, India

***Abstract* -In this paper we are proposing for smart inverter integrating with raspberry pi which makes smart home .In this work a bi-level (Supervisory-Local) PV based micro grid configuration is proposed for low power residential applications. In the supervisory level a long-term control scheme is assigned to define the set points for local controllers. The local level is mainly formed from a set of controllers which are basically responsible to control the power electronic interfaces and converters. Within the supervisory level a dynamic price scheduling framework with load and solar energy forecasting is implemented using time series-based regression technique. In the local level, adaptive double mode controllers are developed to realize intelligent inverters with smart grid-tied (GT) capabilities and smooth transition between GT and stand-alone modes.**

I. INTRODUCTION

With the rapid increment in industrialisation and urbanisation, the demand of energy has increased. The greater demand of energy requires more fossil fuels.Increment in demand for fossil fuel has lead to depletion of natural resources and also leads to increment of pollution. Time has come to switch over to renewable sources of energy. They are clean and abundance in nature. The major problem is increasing the efficiency of renewable sources of energy. In this project we aim at increasing the efficiency of harvesting solar energy and monitoring the battery of charging.Nowadays integration of renewable energy sources (RES) has gained outstanding interest in order to reduce the fossil fuels emission, address the load-demand congestion, and to moderate the electricity price in power generation market. The most common types of RESs are wind and solar energies. Due to ease of use and installation, PV arrays have been widely used for residential applications. Although the mother nature provides this source of energy for free, variety of technical-economical challenges are still remained to be addressed for acceptable efficiency from both industrial (grid side) and residential-user viewpoints. In this work we focus on aggregation of PV-based micro grids for the low power residential applications, and try to address the following major technical-economical issues: RESs output power uncertainty and fluctuation that cause variation on the grid voltage and frequency. The low output voltage of PV modules and their low reliabilities to feed the input terminal of the 3-phase GT inverters (GTI). Load forecasting and solar irradiation pattern. Optimizing the lifetime of the energy storage modules.

Energy transaction based on real time pricing. Although a rich body of literature is available for RES aggregation, most of these works are considering solely technical or solely economical challenges. As a result, we may split them into two following classes: articles on designing power electronic interfaces (PEl), and articles on designing energy management systems (EMS). Within PEl, energy back-up systems also known as battery energy storage systems (BESS) have been widely used to reduce the power fluctuation of RES and improve the reliability of the micro grid. However, an intelligent bidirectional configuration should be defined to optimize the battery life-time in parallel with the overall performance of the system. In order to address the low output power issue, some works implement a series combination of the PV cells. However, using series combinations of PV modules (or batteries) reduces the reliability of the total system, since failure in one module will result in failure of the whole string. Another approach is the utilization of high gain PE converters, such as floating interleaved converters.

On the other hand, some articles consider standalone micro grid configurations while others try to develop grid-tied PV-based schemes. To convert DC voltage of the PV arrays to a compatible AC grid voltage, an appropriate inverter is required. Depends on the modality of the system (GT or standalone), the control strategy differs. In grid-tied PV-based systems, the main objective of the inverters' controller is controlling the behaviour of the injected current to the grid. However, in standalone PV -based systems the main objective is controlling voltage in the point of common coupling (PCC). In case of double-mode micro grids, designing a reliable controller which is able to work in both standalone and GT modes is an important issue.

Fig 1. Raspberry pi board

Fig 3. Drawing representing IoT

Source :Internet

II. BLOCK DIAGRAM

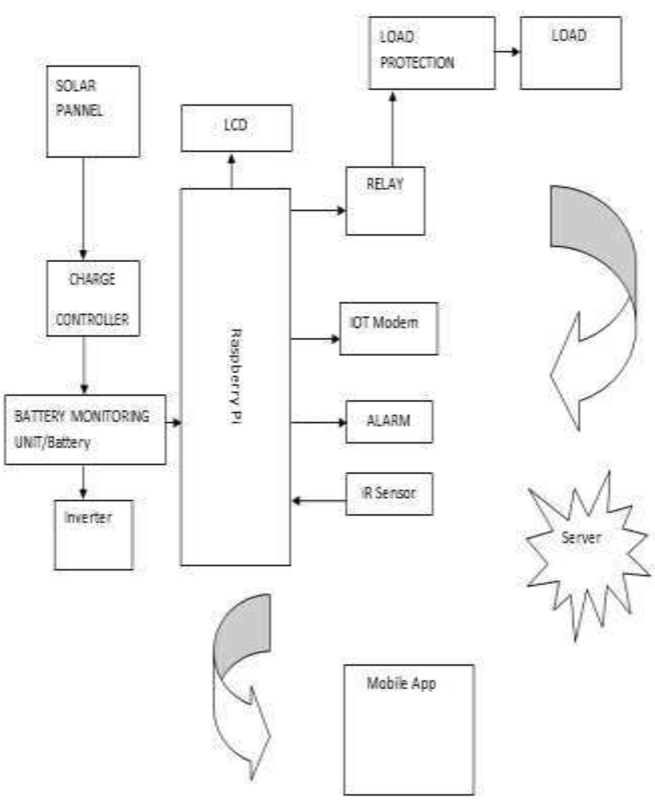

Fig 2. Block diagram of IoT based smart inverter using Raspberry pi

III. FUNCTIONAL DESCRIPTION

The functions of the various working components are given below:

A. *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.

B. *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 flyback converter using a single inductor instead of a transformer.

C. *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.

D. *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.

E. 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 color 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 preset words, digits, and 7-segment 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.

F. 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.

G. 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 .

H. LOAD :

Usually load means which consumes energy. For residential purpose the loads means the fans,bulbs,tubelights, and many more which consumes energy.

IV. IMPLEMENTATION

A. 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.

B. EXISTING SYSTEM:

In the present system everything is monitored and controlled manually. Only analog systems are there for power verification and cross checking. The security provided at the grids and homes is not up-to the mark. The controllers used are very primitive with lesser operating frequency and durability.

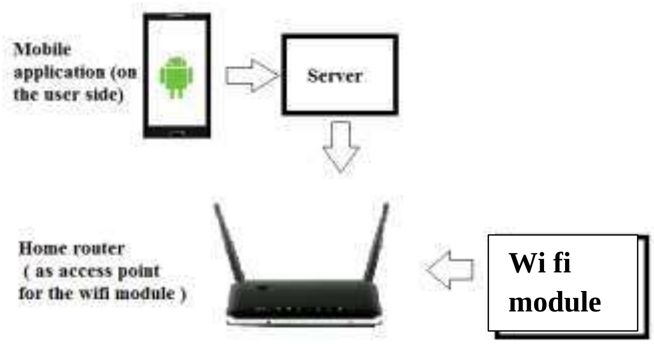

Fig 3. Actual set up of switching unit

V. ALGORITHM

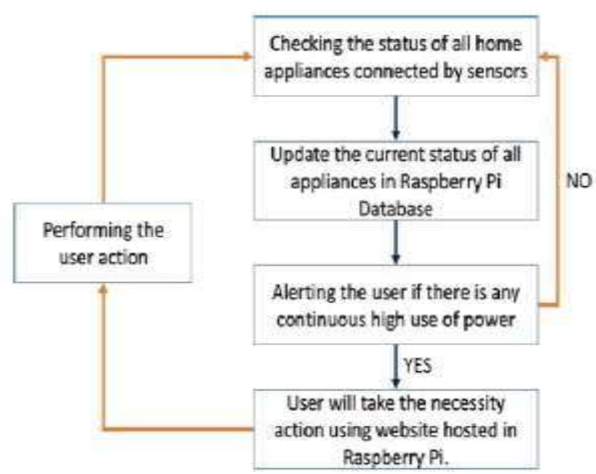

Fig 4. Algorithm showing raspberry pi working system

The proposed system can be demonstrated with the help of following steps:

- Import all the required modules.
- Check the status (ON/OFF) of all home appliances connected to Raspberry Pi.

- Update the website database of appliances with the current status.
- The IR sensor which senses that wheather any of the load is left turned on ,if yes then it alerts by sending a message to the authorised person by web app servor.
- Whenever there is change in status of appliances then the changes are updated in website database.

VI. RESULT

The system allows the user to control the appliances from anywhere in the world using an internet connection. The proposed home automation system is practically implemented and thus the results are obtained.

VII. CONCLUSION AND FUTURE SCOPE

In the present system everything is monitored and controlled manually. Only analog systems are there for power verification and cross checking. The security provided at the grids and homes is not up-to the mark. Hence the low cost device,credit card sized computer i.e., Raspberry pi makes the less space consumption which guards sending a message to the authorised person by web app server. All the devices connected to system can be controlled using web app from anywhere in the world.

REFERENCES

[1]. Charles Severence, "Eben Upton: Raspberry Pi", vol.46, NO.10, pp. 14-16, 2013.
[2]. " An IOT based Smart Inverter" IEEE International Conference On Recent Trends In Electronics Information Communication Technology
[3]. Raspberry pi , https://en.wikipedia.org/wiki/Raspberry_Pi
[4]. "http://www.solarpowerworldonline.com/2014/01/smart-solar-inverter/", for solar smart inverter.
[5]. Vamsikrishna Patchava, Hari Babu Kandala,, P Ravi Babu, " A Smart Home Automation Technique with Rasp-berry Pi using IoT". 2015 International Conference on Smart Sensors and Systems.
[6]. "https://en.wikipedia.org/wiki/Buck%E2%80%93Boost_converter " Buck Boost conveter .
[7]. Inverter ,"Power Electronics" from the text book of Mohammed Rashid