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Hybrid Energy Storage with IOT System

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ABSTRACT

In this paper, authors have focused on controlling of hybrid energy system using IOT. There is various combination of energy and all of them are alternative to each other like solar energy, wind energy, bio fuel, fuel cell, etc. The lithium battery-supercapacitor hybrid energy storage system has a high energy density and a long working time, which can well undertake the flattening work of the main low-frequency components in wind power fluctuations. But the need of controlling of hybrid energy system arises when it is installed for domestic or commercial purpose. At this point IOT plays an important role in controlling system. The main criteria being switching between the two sources of energy i.e. solar and wind energy without any inconvenience through a website using ESP8266 Wi-Fi module. The data is transmitted wirelessly through website to ESP8266 module which controls the sources of energy. The transmitted data is controlled remotely using IOT. This enables user to have flexible control mechanism remotely hrough a secured internet web connection. This system helps the user to control the sources of energy, manually and remotely using smart phone or personal computer. This system is very efficient, cheaper and flexible in operation.

Keywords: IOT, Controlling of Hybrid System, Home Automation.

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I. INTRODUCTION

Nowadays solar energy is becoming popular and consumed commercially in huge proportion. As it is natural source of energy the production cost of power using solar is very much less compared to other conventional sources. The concept of TEG is being used in panel whose temperature difference can be converted as electrical energy which is used in miniscule range for various loads. Mainly, in the existing system, the solar panel and the thermal power plants are separately handled. This results in a large amount of losses due to energy conversion from solar energy to electrical energy. The cost for power generation by this method is huge. The load imbalance which occur in this system cannot be managed very easily. Figure.1 shows the existing system of energy conversion using solar energy where each energy conversion system works independently and not economical. Energy is the basic need for development and the requirement of energy is more due to the rapid increase in world population, technology and other political and economic condition. Now a day's electrical energy is generated by the conventional energy resources like coal, diesel, and nuclear etc. and these are depleting day by day. So, there is an urgent need to switch on to non-conventional energy resources.

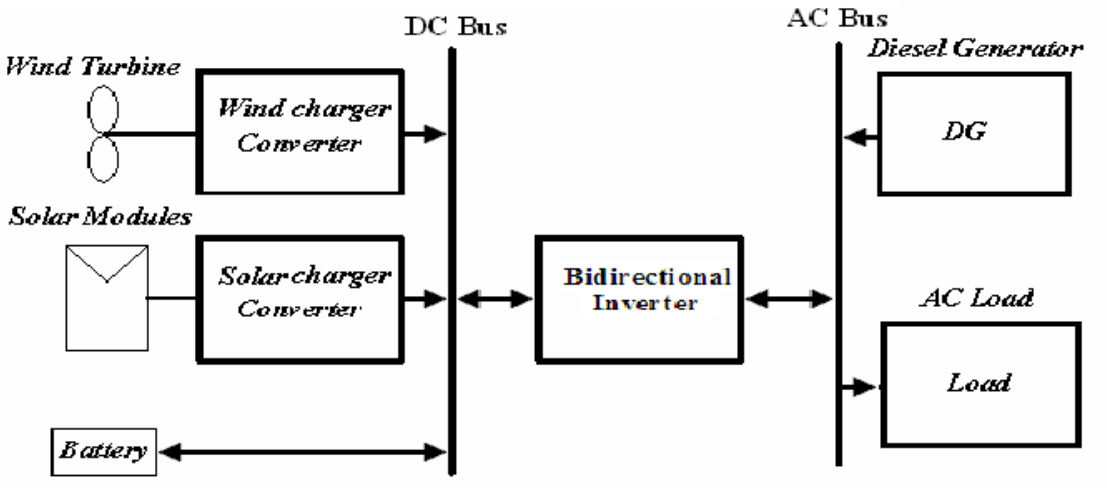

Figure. 1 shows the existing system of energy conversion System.

Solar and wind are easily available in all condition can be good alternative source. With the rise in the demand of renewable energy resources the need of better utilization of these systems has aroused [1]. This in turn has given rise to the hybrid energy system. Hybrid Energy System is the combination of the two or more energy systems. Here, two sources are used solar and wind energy [2]. In order to control the hybrid system IOT can be used. IOT (Internet of Things) is the inter-networking of physical devices embedded with electronics, software, sensors and network connectivity that enable objects to collect and exchange data [3]. IOT is used to switch the power supply i.e., wind energy and solar energy of a house through secure website when the grid supply is off. A prototype is designed to control the switching between these two sources of energy. With the advancement in technology provide sensors, metering, transmission, Distribution, and flexibility to consumers of electricity, it can be possible to control the sources of energy of a house by this prototype.

Recently the energy consumption is in the range of 10 terawatts per year , and in 2050 it may reach about 40 terawatts. This energy requirement using conventional source like fossil fuel, nuclear etc., will produce CO2 emission and pollutes the environment [4]. In order to overcome this problem renewable energy sources are being used widely for the production of non CO2 electrical energy. The simplest approach to control CO2 by mid-century is one in which photovoltaics (PV) and other renewables are used for electricity generation, for transportation usage of hydrogen fuel, and fossil fuels can be used for residential and industrial heating [5]. Thus, solar energy conversion will play a vital role in satisfying the world energy demand in future [6]. Due to wide research happened in solar cells, extraction of maximum energy from PV panel using multi junction cells are used nowadays. Even while using advanced technology in PV cells, a huge amount of the solar irradiance is not converted into electricity and is dissipated as heat. Hence to increase the system efficiency in a better manner harvesting of this heat produced in PV panel can be used which is considere as complementary “green” technology, namely, thermoelectricity [7]. According to this methodology, a thermoelectric (TE) generator (TEG) can be attached to the back side of the PV panel to harvest the e heat for generation of additional electricity, resulting from the Seebeck effect (the thermoelectric effect [8-16]). The Internet of Things is a constantly-evolving area of research, with many new applications and ideas being generated almost daily. From intelligent farming to smart devices in our homes, the IoT has affected almost every industry in our modern world.

Energy resources are classified into two ways:

• **Non-renewable Energy**: Resources which are limited in quantity and can be depleted after few years. Example: Petroleum, Natural gas, Coal etc.

• **Renewable Energy**: Resources which are abundantly available in nature. Example: Solar energy, Wind energy,Tidal energy etc.

OBJECTIVE

- The objective function was to increase the reliability of the microgrid. It designed a hybrid RES consisting of solar PV, battery energy storage system, and pumped hydro energy storage system for an academic institution building.
- Storage systems can level out the imbalances between supply and demand that this causes. Electricity must be used as it is generated or converted immediately into storable forms.
- an objective is “Reduce energy consumption by 10% over the next five years”. An energy target, on

the other hand, is a quantified energy performance goal or goals that must be met in order to achieve the broader energy objective.

II. PROPOSED SYSTEM BLOCK DIAGRAM

In the proposed methodology the continues monitoring of power consumption of the vehicle battery is handled by using Internet of Things concepts.A Hybrid Energy Storage System (HESS) consists of two or more types of energy storage technologies, the complementary features make it outperform any single component energy storage devices, such as batteries, flywheels, supercapacitors, and fuel cell. By this method the battery wear and tear is prevented and the battery life cycle is increased. Historical data of battery performance is also made possible with the help of internet of things. Also, the battery parameters can be monitored remotely with the help of TCP/IP protocol which periodically pumps the battery parameter to the remote server and hence the live data tracking is made possible which increases the scalability.

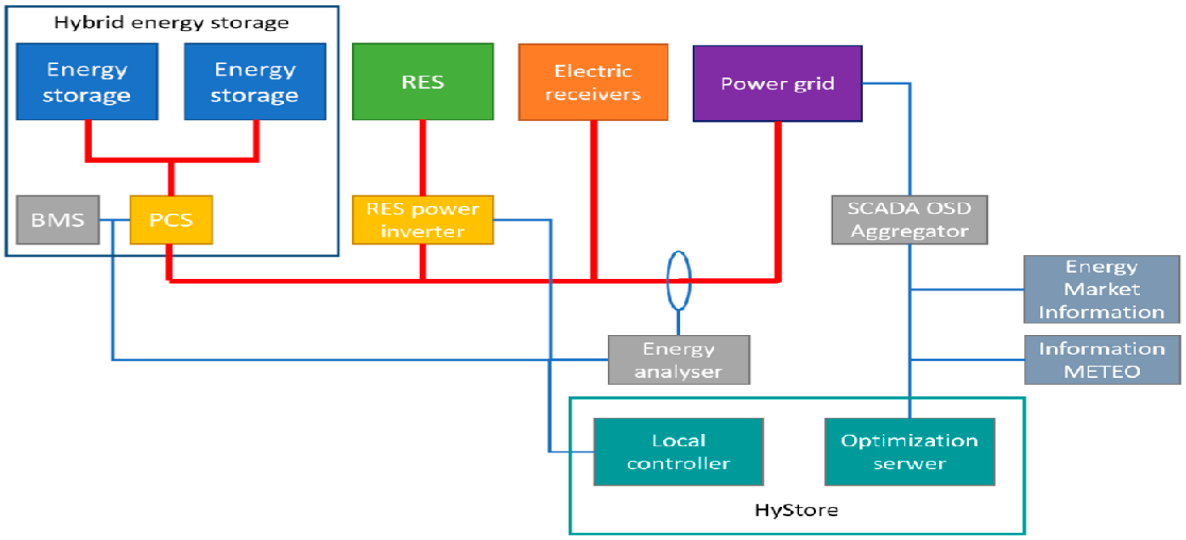

Figure.2 Block diagram for Hybrid energy Storage System.

In proposed system as per figure 2, the energy is harvested using solar and TEG which similar to the existing system, but the harvested energy is hybridized which can be properly regulated and managed through microcontroller and IoT mechanism. The produced energy by hybrid technique are used for DC load through battery and Buck boost converter. The same energy is converted to ac through inverter and it is used for AC load. These two operations are exactly same as existing system, but in proposed system the output of PV and TEG is hybridized. Therefore, the solar panel output and thermoelectric generator output is given to the buck-boost converter which provides a regulated output voltage to match the battery charging voltage. Power supply for the DC grid will be taken from the battery terminals directly. The power supply for AC grid will be taken from the battery terminals via inverter. Apart from hybrid technique, microcontroller and Arduino nano is used to measure the power generation by solar and thermoelectric generator for proper management through IoT. The same will be monitored on the LCD.

III. WORKING

In the proposed system, the load balancing problem due to individual source supply has been overcome due to hybrid technology i.e., the integration of heat and light concept is introduced.The major advantage of the proposed system is that the system consist of various protections like reverse current protection. The bypass switch helps to decide whether the battery or the load is to be connected.

The structure of the design and development of the proposed system is provided in the following sections. Fig.2 and Fig.3 describes the working description of developed system. ESP8266 module is used to transmit and receive the e lectrical data wirelessly, which is collected from internet through designed website and the control system. The ESP8266 transmitter is interfaced with various sensing devices and reliable data reception at a receiver side of ESP8266 module. The ESP8266 receiver has been interfaced through router which is connected to the internet. The Load can be monitored and controlled remotely. The controlling operation is performed in two ways. Those are manual controlling and remote controlling.

Manual control: An on/off and source change switch is provided directly to the system. In this mode user can manually operates the load without following remote control. Manual control is very adaptive.

Remote Control: In remote control user can interact with the load remotely with smart phone or personal computer using secured internet web connection. User can control and operates the system when he is away from the home. This feature also reduces manual efforts and time by controlling the system from one place.

IV. Flowchart of the proposed system

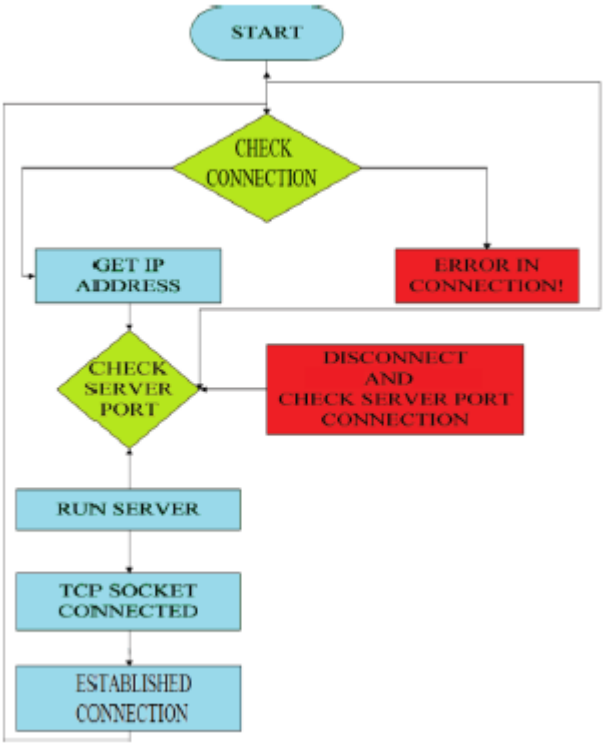

Figure.3 Flow Chart of the System

V. RESULTS AND DISCUSSIONS

a) Web Server for controlling Hybrid energy system.

When module is interfaced with internet, it generates a unique IP address. The webpage is designed so that when IP address is provided in the URL to the control page as shown in Fig.4 opens and user can control power supply by selecting buttons solar on, wind on or off. Internally when user selects the these button internally, Remote procedure call (RPC) commands are initiated for controlling op-amp. When power supply is cutoff, person can switch power to another power supply(either solar or wind, which is more feasiable). With just a single click the whole system could be controlled. Operating time from Virtual button to output is minimum 3 seconds. By changing the module to ESP-12 module and increasing the number of Op-amp AP 358 IC, more energy sources could be added. By using relay, system can be used in houses for the controlling of power supply.We can operate it from a website from anywhere in the world. When website is open then there are three options,

1.) Solar ON
2.) Wind ON
3.) OFF

Figure.4. Switching Options webpage

b) Using Arduino IDE C++ program is uploaded and a variable is created to store data, which is getting by clicking the button in the website, it send data directly to ESP8266 module through internet. The data received from the internet is stored in the ESP8266 module. For each signal to be analyse module gives a domain id and API key. Domain id and API key are uploaded in the module and then code is executed in order to update the values in Esp8266. The outputs in serial monitor can be seen in Figure.5.

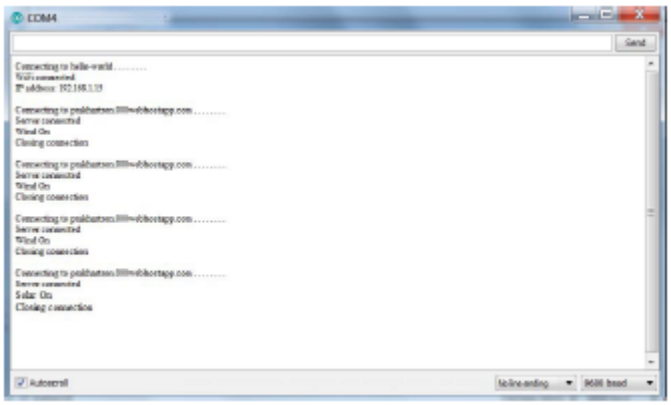

Figure.5. Output of the Esp8266

VI. CONCLUSION

With the fast growing demand of smart devices like IoT systems, the energy management and sustainable power supply research is being conducted widely. This paper proposes integration of IoT with the hybrid energy technology namely solar energy and TEG. Even though, TEG are able to harvest enough energy, the voltage produced is not enough to operate various loads. Hence Integration of renewal energy source along with TEG is proposed, especially in commercial areas where need of electricity is more. It causes no effect on nature i.e. pollution free, at the same time not proneness any kind of accident due to lightning. It is also useful to minimize power supply load i.e. cut short power charge. By using this system, electricity charge is very less and requires less maintenance charge for the equipment. This combination of solar-wind energy source will be highly effective in commercial areas. It is eco-friendly at the same time prevents accidents due to lightening. It is used to cut short power charge. By this system electricity charge could be saved as very less maintenance charge is required for equipment. Moreover there is no power cut or load shedding at any times. In addition to this, the system is controlled by INTERNET OF THINGS as site manager is able to receive detailed information of facility at site, efficient maintenance for regular checkup and failure could be performed conveniently. It is the most reliable and cost efficient. This research is at an underdeveloped stage and may take years to bring it into market. We encourage the scientific community to consider this technology along with others when contemplating efforts and resources for renewable energy.

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