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SMART ENERGY STORAGE SYSTEM USING ZERO EXPORT INVERTER

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Abstract:

In traditional energy production at large-scale, conventional methods are being used, including fossil fuels. This in turn leads to greenhouse gas emissions (e.g., carbon dioxide or CO2) that cause environmental concerns, but also those traditional methods rely on traditional distribution systems, which are burdened with high transmission losses. This paper focuses on a new concept in the energy sector that undergoes transformation from a traditional centralized system to a decentralized one. The energy industry is integrating renewable energy sources into the energy system in order to achieve sustainability targets like net-zero emissions. This calls for a change that unites numerous large- and small-scale energy providers (such as rooftop solar panels, wind farms, and solar plants) in one. While being a challenging endeavour, this massive transition is doable because to recent developments in information and communication technologies, digitalization, the Industry 4.0 concept, and Internet of Things technology. Although it cannot be regarded as thorough or conclusive, this study offers a review based on keyword bibliometric analysis and gives an overview of current global research.

Introduction:

The world's population is expanding, and there are more electric products on the market than ever before. Moreover, electricity is essential to modern economies and culture. Electricity powers the technological advancements we utilise every day. Particularly in light of sustainability and energy security, it is vital to balance the supply and demand of power. Energy production practises need to change as a result of the worldwide trend towards a net-zero emission aim. Unfortunately, this is not a simple task, and in order to accomplish so, new power sources and RES. The loss of the vehicle's power system can be decreased with the help of flawless control of the primary electrical engine or the battery recharge system. To boost the system's effectiveness, the developers of looked at several control methods.

In order to increase overall productivity, numerous investigations on the internal structure of the battery have been conducted. The energy efficiency of the e-transportation system was also greatly improved]. This is included into the most recent versions of electric vehicles, which have a great autonomic track record. To increase the overall autonomy and efficiency of the vehicle, some experts have focused on the charging equipment. Moreover, photovoltaic systems have been integrated into the vehicle to provide electricity from many sources, or mixed sources. The key concerns with regard to the issues created by the aforementioned models are photo voltaic and hybrid recharging methods, as well as the shading effect and the role of traditional customers has changed to that of prosumers as a result of the rapid advancement and improvement of renewable energy technologies. For instance, a person with PVs can market their excess energy to the grid operator or other such as their neighbours, who are prosumers. A distributed energy system is built on a growing number of privately owned generators that enter the energy market since RESs are quicker and less expensive to build than coal or gas generators. In conclusion, distributed generation is the process of producing electricity from numerous, unimportant sources. Those concept of a microgrid emerged as a result of small-scale RES (MG). Large-scale facilities like solar parks and wind farms are also present. Large-scale traditional energy production employs conventional techniques, including the utilisation of fossil fuels. This results in greenhouse gas emissions (such carbon dioxide or CO2) that have an adverse effect on the environment. Moreover, those conventional technologies rely on conventional distribution systems, which have large gearbox losses. A new paradigm of the Internet of Things (IoT) has evolved as a result of an increase in the number of objects (sensors and actuators) connected to the internet. It is a collection of linked systems. Things and their components that can communicate with one another online and exchange data. To name a few, these include different household appliances, cell phones, smart bands, smart watches, weather stations, and a lot more. Because to the widespread use of devices with integrated sensors, IoT is at the forefront of developing technologies. IoT makes it possible to sense, act, communicate, and process in real-time, often without the need for human interaction. Since it has so many applications, it has already been used in P2P networks, smart homes, smart hospitals, vehicle-to-vehicle (V2V) communication, wearables, and smart energy grids. IoT can be used to automate the grid and provide real-time monitoring of an electrical network like the smart grid (SG), which is necessary in today's world. With

1.17 billion devices in 2019 and 1.37 billion in 2020, the energy industry, which is transitioning from a centralised to a decentralised system, will be the largest consumer of IoT edge devices (26% Greater China, 12% Western Europe, and 7% North America). North America. By 2022, the market for smart homes is predicted to expand to reach USD 53.45 billion. In order to meet the expanding energy demand and regulatory requirements, the energy sector is merging operational and information technologies (a zero emissions target).Global energy demand has fallen by 6% in 2020 compared to 2019 because of the COVID-19 pandemic. By 2040, however, it will rise by up to 30% from 2017. Also, 2537 GW of renewable energy was produced worldwide in 2019. The predicted worldwide energy demand for 2050 will be 8% lower than it is today, but 2 billion more people will have access to it. Moreover, Finland's proportion of RESs has climbed to almost 40% as of 2020.In order to meet both the increasing demand for energy and the legal requirements (a zero emissions target), the energy sector is integrating operational and information technologies. Resulting from the COVID-19 pandemic, the worldwide

A smart grid (SG) is an efficient electric grid with technology-assisted information that improves efficiency through intelligent energy management. The smart grid (SG) also interacts with energy prosumers and consumers and uses RESs, such as solar power, wind power, geothermal energy, hydro energy, tidal energy, and biomass energy. An innovative vehicle-to-grid technology (V2G), this energy exchange between prosumers and consumers helps to balance the supply energy. Decentralized energy systems are thus what smart grids (SGs) are . They differ from traditional grids in that they offer a self-managing feature, making them more dependable.

Michael T. Burr coined the phrase "smart grid" (SG) for the first time in 2003. The national energy networks of France and the UK are connected by the IF 2000 underwater connection, which is positioned beneath the English Channel and produces 2000 MW of high-voltage direct current (HVDC).They have several drawbacks, such as "faults in power generation panels, dust accumulation on electricity-generating panels, conductors galloping, and ice," despite their benefits. They are connected to renewable energy sources that smart grids (SGs) employ to keep up with the rising demand for electricity. The market for smart metres is predicted to reach USD 10.4 billion globally in 2022, with a compound annual growth rate (CAGR) of 12% predicted for the five-year period between 2020 and 2027.

An IoT-based smart grid (SG) typically has three layers: data collecting, data communication, and data processing. These layers are based on the IoT computing architecture.

However, some works introduce additional layers in order to aggregate various services. The data collection layer, as seen in Figure 4, is made up of several sensors and actuators that gather various types of data (such as temperature, moisture, noise, energy use, water use, and location) and transfer them to the data communication layer (such as switches and routers) The data processing layer, which includes big data analytics, artificial intelligence, and cloud computing, is at the top of this design.

To make it possible, power management and measurement system are equally important for getting better outputs from renewable sources. In the present era of the rapid growth of renewable energy based applications, community electricity demand management is a challenging issue while ensuring 24×7 energy security. Thus, a renewable energy source is a must for long-term sustainability and to resist climate change. Energy demand is increasing gradually. To satisfy this energy security demand and to ensure a cleaner environment, a renewable energy source integrated micro grid system claims to be a potential community-scale solution. Considering the intermittency of renewable energy sources, multiple energy sources such as solar photovoltaic (PV), biomass, along battery energy storage systems forming a hybrid micro grid can be a potential solution. The most popular renewable energy source to generate large-scale power is hydropower. But hydropower is not suitable for every geographical area, and an individual person cannot install them. This system Zero export inverter for renewable energy resources implementation on IoT technology. The solar panel accepts the solar rays convert to electrical energy and stored to battery. The battery supplies to inverter which is zero export inverter supplies change the 220V to 12V. The amount of voltage and current values are detected the current sensor and voltage sensor. Voltage value given to ESP-32 controller and relay read the voltage value from controller. The two current sensor detect the current values passed through a controller. The load selects the current value which one either renewable energy resources or grid energy. So, these values are updated in adafruit cloud. Monitoring the values in adafruit app for the graphical user interface.

The power consumption of every country of the world is increasing day by day. Most of the third world countries are going through rapid industrialization, and with rapid industrialization, the electrical power consumption of the world in total is increasing every day. Most of this power comes from non-renewable fossil fuel sources. As of 2020, 66.17% of world electrical power consumption comes from fossil fuels. However, using fossil fuels is unsustainable as these will eventually run out and impact the environment negatively. Today’s primary motive for generating power is to use renewable resources. Every power generating company and research organization is now working on various renewable resources for generating electricity to ensure sustainable development in the power sector.

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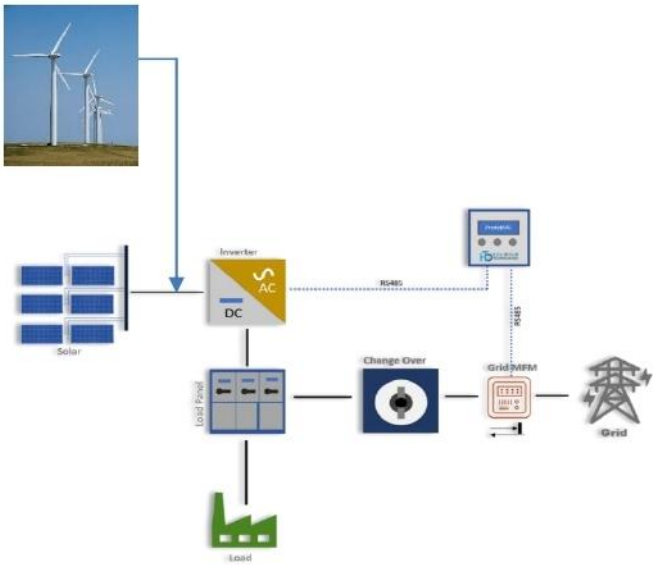

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A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters.

Internet of Things (IOT):

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices for instance, to set them up, give them instructions or access the data.

The internet of things helps people live and work smarter, as well as gain complete control over their lives. In addition to offering smart devices to automate homes, IoT is essential to business. IoT provides businesses with a real-time look into how their systems really work, delivering insights into everything from the performance of machines to supply chain and logistics operations. IoT enables companies to automate processes and reduce lab (or) costs. It also cuts down on waste and improves service delivery, making it less expensive to manufacture and deliver goods, as well as offering transparency into customer transactions.ESP32 is the name of the chip that was developed by Expressive Systems. This provides Wi-Fi (and in some models) dual-mode Bluetooth connectivity to embedded devices. While ESP32 is technically just the chip, modules and development boards that contain this chip are often also referred to as “ESP32” by the manufacturer. The ESP32 chip has a Ten silica Xtensa LX6 microprocessor in both dual-core and single-core variations, with a clock rate of over 240 MHz.

Software Requirements:

Adafruit IO:

Adafruit io is a platform designed by ADAFRUIT IO to display, respond, and interact with your project’s data. Adafruit also keep your data private (data feeds are private by default) and secure (ADAFRUIT will never sell or give this data away to another company).

Usage with Adafruit IO:

The esp32-s2 is an affordable, all-in-one, option for connecting your projects to the internet using our IOT platform, ADAFRUIT IO.For more information and guides about ADAFRUIT IO, check out the ADAFRUIT IO basics series.

Install Libraries:

In the Arduino ide, navigate to sketch -> include library->manage libraries. Enter Adafruit io Arduino into the search box, and click install on the Adafruit io Arduino library option to install version 4.0.0 or higher.

Adafruit IO Setup:

If you do not already have an Adafruit io account, create one now. Next, navigate to the Adafruit io dashboards page. We'll create a dashboard to visualize and interact with the data being sent between your esp32-s2 board and Adafruit io.

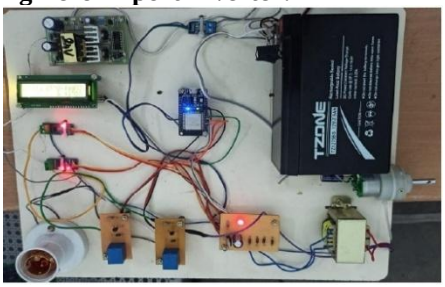
- Click the new dashboard button.
- Name your dashboard my esp32-s2.
- Your new dashboard should appear in the list.
- Click the link to be brought to your new dashboard.

We'll want to turn the board's led on or off from Adafruit io. To do this, we'll need to add a toggle button to our dashboard.

- Click the cog at the top right-hand corner of your dashboard.
- In the dashboard settings dropdown, click create new block.
- Select the toggle block.
- Under my feeds, enter led as a feed name. Click creates.
- Choose the led feed to connect it to the toggle block. Click next step.

Hardware Snap:

Smart Energy Storage System Using Zero Export Inverter:



Conclusion:

The IoT-based real-time monitoring system is done to ensure the capability and remote access of a system. Thus, the proposed IoT based power monitoring scheme and the backup power storage solution presented in this paper are scalable and claim to be very useful for providing real-time power and energy consumption and supply monitoring, and the backup power supply scheme satisfies the uninterrupted power supply to the user under both on-grid and standalone scenarios. To remain relevant in the competitive market, constant improvement of any product is mandatory. For the IoT-based monitoring system, better graphics and a single line diagram can be implemented for the ease of understanding of the client. Currently, the project uses a free cloud server to store and monitor the data. This has a limited customization option and poses a cyber-security risk to the user. Thus, a customized server can be implemented to make the user experience safer and more user-friendly.

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