Energy Management System For Smart Grid Using Hybrid Energy Source

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Abstract

Today's alternating current power grid evolved after 1896, based in part on Nikola Tesla's design published in 1888 (see War of Currents). At that time, the grid was conceived as a centralized unidirectional system of electric power transmission, electricity distribution, and demand-driven control. In the 20th century power grids originated as local grids that grew over time, and were eventually interconnected for economic and reliability reasons. By the 1960s, the electric grids of developed countries had become very large, mature and highly interconnected, with thousands of 'central' generation power stations delivering power to major load centres via high capacity power lines which were then branched and divided to provide power to smaller industrial and domestic users over the entire supply area. The topology of the 1960s grid was a result of the strong economies of scale of the current generation technology: large coal-, gas- and oil-fired power stations in the 1 GW (1000 MW) to 3 GW scale are still found to be cost effective, due to efficiency-boosting features that can be cost effectively added only when the stations become very large. A smart grid is a digitally enabled electrical grid that gathers, distributes, and acts on information about the behavior of all participants (suppliers and consumers) in order to improve the efficiency, importance, reliability, economics, and sustainability of electricity services.

Keyword :- unidirectional, efficiency, reliability, sustainability.

1. Introduction

The term smart grid has been in use since at least 2005, when it appeared in the article "Toward A Smart Grid" of Amin and Wallenberg. The term had been used previously and may date as far back as 1998. There are a great many smart grid definitions, some functional, some technological, and 2 some benefits- oriented. A common element to most definitions is the application of digital processing and communications to the power grid, making data flow and information management central to the smart grid. Various capabilities result from the deeply integrated use of digital technology with power grids, and integration of the new grid information flows into utility processes and systems is one of the key issues in the design of smart grids. Electric utilities now find themselves making three classes of transformations: improvement of infrastructure, called the strong grid in China; addition of the digital layer, which is the essence of the smart grid; and business process transformation, necessary to capitalize on the investments in smart technology. Much of the modernization work that has been going on in electric grid modernization, especially substation and distribution automation, is now included in the general concept of the smart grid, but additional capabilities are evolving as well.

2. Methodology

Smart grid does a lot of works. It is not possible to demonstrate each of the tasks in a single project. So an attempt is made to demonstrate some of its functions like automatic scheduling, power shading, distance controls etc.

Description of loads:

1. Two simple houses representing a colony

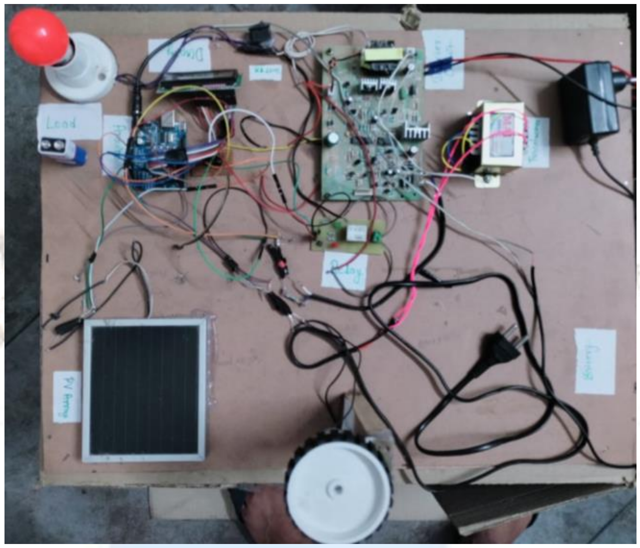
2. A hospital

3. An industry

In case of the colony, the houses are supplied by the main supply. In case of power cut, they are being supplied by the storage which is represented by an UPS. But when the storage discharges fully in case of long power cut, then the colony remains in dark.

In the hospital, since many of the biomedical equipment like breather are running continuously on the electricity, so there is an interruptible need of electric supply. So, for the hospital, an arrangement is made such that if the main supply goes off, then it is being supplied by UPS. When UPS discharges, then it is being supplied by another energy source representing renewable energy source.

In case of Industry, two loads are shown by means of two bulbs. The first load in the industry is its normal load and the second one is extra or overload. During normal operation, it is being supplied by the main supply. During power cut, it is being supplied by the renewable energy source.As can be seen in the figure, in the first circuit, the supply from UPS is also stepped down to approx. 17v ac by means of a transformer and is then rectified to 12v ac to operate the 2C relay



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The rectified output is given to the exciting coil of the 2c relay. Normally the plate is attached to the NC pin of the relay under not excited condition. So we have attached the NO (normally open) pin to the main supply, so that in case of main power on, the supply is provided by the main to the hospital.

In case the mains gets off, the UPS supplies the hospital load. And if UPS too gets discharged in case of long power cut, then the renewable energy source connected to the NC (normally closed) pin comes into action and supplies the hospital load.

In case of industry too, the same concept is used. Ac supply from mains is stepped-down to be rectified to yield 12v dc to run the relay. In case the mains gets off, the renewable energy source supplies the industry load.

Another complication has also been added to the industry to show the load shading. In case the extra or overload is on, a buzzer is made on by the help of microcontroller and then after some time the colony power cut happens.

In addition to all these, all the loads can be controlled individually by using a mobile phone showing the distance operation using DTMF technology. For this purpose, a 1c relay each is connected to individuals loads.

Also, the UPS charging or not charging can be controlled by distance operation using DTMF technology.

3. Literature Review

3.1 Feature of the smart grid

The smart grid represents the full suite of current and proposed responses to the challenges of electricity supply. Because of the diverse range of factors, there are numerous competing taxonomies, and no agreement on a universal definition. Nevertheless, one possible categorisation is given here.

3.1.1 Reliability

The smart grid will make use of technologies that improve fault detection and allow self-healing of the network without the intervention of technicians. This will ensure more reliable supply of electricity, and reduced vulnerability to natural disasters or attack.

3.1.2 Flexibility in network topology

Next-generation transmission and distribution infrastructure will be better able to handle possible bidirection energy flows, allowing for distributed generation such as from photovoltaic panels on building roofs, but also the use of fuel cells, charging to/from the batteries of electric cars, wind turbines, pumped hydroelectric power, and other sources. Classic grids were designed for one-way flow of electricity, but if a local sub- network generates more power than it is consuming, the reverse flow can raise safety and reliability issues. A smart grid aims to manage these Situations .

3.1.3 Efficiency

Numerous contributions to overall improvement of the efficiency of energy infrastructure is anticipated from the deployment of smart grid technology, in particular including demand-side management, for example turning off air conditioners during short-term spikes in electricity price. The overall effect is less redundancy in transmission and distribution lines, and greater utilisation of generators, leading to lower power prices

3.1.4 Sustainability

The improved flexibility of the smart grid permits greater penetration of highly variable renewable energy sources such as solar power and wind power, even without the addition of energy storage. Current network infrastructure is not built to allow for many distributed feed-in points, and typically even if some feed-in is allowed at the local (distribution) level, the transmission-level infrastructure cannot accommodate it. Rapid fluctuations in distributed generation, such as due to cloudy or gusty weather, present significant challenges to power engineers who need to ensure stable power levels through varying the output of the more controllable generators such as gas turbines and hydroelectric generators. Smart grid technology is a necessary condition for very large amounts of renewable electricity on the grid for this reason.

3.1.5 Smart meters

A smart grid replaces analog mechanical meters with digital meters that record usage in real time. Smart meters are similar to Advanced Metering . Infrastructure meters and provide a communication path extending from generation plants to electrical outlets (smart socket) and other smart grid-enabled devices. By customer option, such devices can shut down during times of peak demand.

3.1. Arduino Board

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message- and turn it into output activating a motor, turning on LED, publishing something online. We use the Arduino ogramming language and the Arduino Software (IDE) by sending a set of instructions to the microcontroller on the board to control the Processing. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers such as students, hobbyists, artists, programmers, and professionals has gathered around this open source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to lovices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming

3.2. Arduino UNO

The Arduino UNO is the best board to get started with electronics and coding. The UNO is the most ised and documented board of the whole Arduino family. Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform

4. Relay

Relay is an electromagnetic switch which is used to defer two circuits electrically and connect magnetically. When the arduino transmits the signal then the relay driver receives the signal and starts its work. They are frequently used to interface an electronic circuit (working at low voltage) to an electrical circuit which works at extremely high voltage. For instance, a hand-off can make a SV DC battery circuit to switch 230V AC mains circuits. In this way a little sensor circuit can drive, say, a fan or an electric knob. A transfer witch can be separated into two sections: information and yield. The info arca has a loop which creates an ttractive field when a little voltage from an electronic circuit is connected to it. This voltage is known as the working voltage. Generally utilized transfers are accessible in various arrangements of working voltages like 6V, 9V, 12v, 24V and so on. In a basic hand-off there are three contactors: ordinarily shut (NC), regularly open (NO) and normal (COM). At no info express, the COM is associated with NC. At the point when the working voltage is connected the transfer curl gets charged and the COM changes contact to NO. Diverse ransfer setups are accessible like SPDT and DPDT which have a distinctive number of changeover contacts. by utilizing a legitimate blend of contactors, the electrical circuit can be turned on and off.

Conclusion

In conclusion, hybrid microgrids are emerging as a promising solution to address the challenges of modern energy systems. By combining multiple energy sources, such as renewable energy generation, fossil fuels, and energy storage, hybrid microgrids offer increased reliability, efficiency, and resilience. One of the key advantages of hybrid microgrids is their ability to integrate renewable energy sources, such as solar and wind power, with traditional fossil fuel generators. This combination allows for a more stable and continuous power supply, as renewable energy sources can be intermittent. By intelligently managing the energy flow and storage, hybrid microgrids can optimize the utilization of renewables and reduce reliance on fossil fuels, leading to a greener and more sustainable energy system.

Overall, hybrid microgrids hold great potential in transforming our energy landscape by providing reliable, sustainable, and resilient power solutions. With continued advancements in technology and supportive policies, hybrid microgrids are likely to play a significant role in achieving a clean and decentralized energy future.

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