ISSN No:-2456-2165

Development of Automated Grid Monitoring and Control System Using IoT: A Review

[1]Annasab Sheetal Patil, [2]Deeksha N Jain, [3]Bhavana C S, [4]Komala G P, [5]Prof Poornima B
Department of Electronics and Communication Atria Institute of Technology, Bangalore

Abstract:- There is a rapid growth in Smart Grid and Internet of Things (IOT) technologies in the recent days. IOT is a connection of network of physical objects with the internet through sensors and other technologies using any service. Smart Grid is a data communication network which is incorporated with the power grid to assemble and study data that are gathered from transmission lines, distribution substations, and consumers. IOT is widely used in smart energy monitoring and controlling, automation in industries, and a variety of applications. IOT devices are used to monitor and control grid parameters for steady and useful power delivery at various stages of smart grid. These technologies, when used in combination offer energy optimization and user friendliness in terms of monitoring and controlling of electronic devices. Although IOT incorporation in the Smart grid domain contributes lots of service, the threats needs to be solved for the efficient use of the grid. An extensive survey of IOT based Smart Grid environments to provide effective solutions to these threats is done in this paper. The software solutions, challenges such as stability in connection, communication, cost and information privacy and security is also discussed broadly.

Keywords:- *IOT, Smart Grid, Monitoring, GSM Modem, Sensors.*

I. INTRODUCTION

While the era of variation in electricity supply is long blown in many industrialized nations of the world, still many developing countries suffer slowdowns emerging from constant power losses. Without a consequent challenge associated with manual changeover, the plan of alternative power source would haven't bought success.

In many developing countries, there is a need for automation of electrical power generations or alternative power sources to back up the utility supply due to uncertainty in power supply. This automation is needed as there is a high rate of power outages. Smart electrical power distribution grids has become fast developing field. Smart grids when implemented, there will be more efficient energy transmission, fast recovery of power after failure, combination of renewable energy sources, reduction in cost of management and service for utility companies. The existence of developed system for monitoring real time data of the grid helps to attain all those benefits. As the distribution in energy production from renewable sources like solar and wind power generation stations plays a major role in contributing to the network complexities, energy flow monitoring of the grid becomes important. The collecting, storing and processing the detailed information in the operation of the grid are done by the monitoring system. The grid can be controlled and managed using the results of processing in which some of the control tasks can be either automated or manually operated.

Smart grid generally refers to a highly integrated power-based grid having the capability of distinguishing the different types of powers such as wind power, solar power, hydropower etc. It is a combination of remote-control technology of computer, physical grid, and wireless measurement technology. The major problem in smart grid technology is to synchronize the user generated power with electric utility supplier to enable the bidirectional flow of power in the transmission lines.

Power grid is a system which distributes electric power which is generated by several sources through various stations using transmission lines. The failure in power grids due to fluctuating voltages or improper maintenance in one system leads to breakdown in the adjacent systems which would lead to a great economic loss. The process of fixing would require manual repairing or switching operation from the main system to an alternative system. This would require an automated process to avoid causalities and health issues since the workers deal with high voltages and radiations while fixing the issues. The proposed system is designed to perform multiple operations such as monitoring voltage, current, temperature and humidity using various sensors which is recorded in a computerized device. Also, it includes unmanned switching of load between two different sources when one system fails.

Due to various reasons the Primary Transformer breaks down so, Switching Operation has to be done between Primary and Secondary Transformers (Back-up) for the transmission of electric power to continue. The Switching Operations are done manually which are having various Health Hazards to people working there due to High Radiations, Voltage and Frequency. Automation is necessary in order to prevent dangers and also to predict the problems and the possibility of Break down in advance.

II. LITERATURE SURVEY ON SMART GRID

Obasi , Chijioke Chukwuemeka , Olufemi Babajide Odeyinde John Junior Agidani ,Victor Onyedikachi Ibiam1 Ubadike , Chiedu Osichinaka[1] have proposed a work on design , construction and implementation of power changeover system. The purpose of this paper is to reduce maintenance cost and to limit the utilization of the generator's utilities like fuel where the power outage lasts for a long time. In the design and construction of the system, Modular division and push button methodology was adopted. AT89S52 microcontroller was used in this implementation in which the control program running in its memory. For choosing the different modes and functions, the four push button switches was used. This automated technology will also increase some intelligence to power changeover automatically by allowing user to choose the mode that they want their automatic systems to operate on. The proposed system has upgraded the existing automation and human operated power changeover.

D Gavrilov , M Gouzman , S Luryi[2] have proposed a work on simultaneous function of estimating the power grid operation. This paper focuses on the smart power grid monitoring in real time in which complete information regarding the power flow in the network is required. In this, dense sensor network was implemented to collect and process the real time data in large scale which helps to frame the map of the grid. This proposed grid monitoring utilizes a dense network of low cost sensors installed at each branching point of the power line. The measurement of RMS current periodically and phase shift between the current and voltage is obtained in the conductor using sensors. In order to attain global time synchronization for estimation of all the required parameter by monitoring abnormalities of the electromagnetic field around conductors, every sensor is fitted with GPS receivers.

Ali Azizi , Saeed Peyghami , Hossein Mokhtari , Frede Blaabjerg[3] proposed a work on autonomous and distributed power sharing and energy management method for DC microgrids without utilizing communication systems. This paper proposes a steady operation and a cost effective solution for DC microgrids. Therefore, both generations and loads should be operated appropriately. Here, an Energy Supporting and Consumption (ESC) priority is introduced to upgrade systems performance. Moreover, following the intended control action, the power flow to an empty battery from a full battery can be avoided and the SOC (State of Charge) level of batteries can properly be adjusted. Therefore, the batteries life cycle and the performance of the entire system can be increased. This system proposes a plug and play capability to the microgrid by utilizing each battery unit based on its control system and voltage information.

Amit Sachan[4] proposed a work on monitoring and controlling of smart grid using automated embedded system. The purpose of this paper is to acquire the remote electrical parameters like voltage, current and frequency from smart grid and send these real time data along with temperature at power station with the help of GSM modem/phone over GSM network. A relay is operated as a circuit breaker to switch off the main electrical supply. SMS messages can be sent using commands to read the remote electrical parameters and also the real time electrical parameters are sent automatically in the form of SMS. Whenever the predefined values of the voltage or current exceeds, this system sends the SMS alerts. This system was designed in such a way that the devices can be observed and also be managed using mobile phone connected to GSM model. This claims that the system design have some power quality problems which makes the voltage, current or temperature to peak against the distribution transformer which makes it more robust. Hence the proposed system have made the distribution more stable, dependable and effective by mains.

Trupti Sudhakar Somkuwar , Mahesh. G Panjwani[5] have proposed a work using wireless sensor network (WSN) for controlling and monitoring of the electrical distribution line which is capable of cost efficient monitoring[5]. The aim of this paper is to control and monitor the power transmission line and also to detect the failure node in the power supply. The system consist of RF transreceiver module in which the information can be transmitted and received between the central server and poles, Atmega16 microcontroller module, electrically operated relays, power supply. In this system, message of power failure is sent to the monitoring station through RF transreceiver which conveys the detailed information of the node to the concern lineman using GSM model via SMS with the faulty line pole location from central server which in turn provides better support to the customers and also reduce time.

Sholeh Hadi Praman,Sapriesty Nainy Sari,Eka Maulana[6] have proposed a work on PV based smart grid system for protection and monitoring the electric power usage.

This system also emphasize on power protection to the load by disconnecting the load from the power supply when the power supplied exceeds the conditions of the power using relay module. The current and voltage data can be monitored on load using sensors. In this study of method, ATmega328p Microcontroller is used as data (current, voltage, power) processor which stores the data in its memory card. ESP8266 wifi module is used which can be access to monitor sensor via internet through thingspeak.com web service and Thingview application.

Mr.Rohit Prakash ,Mr Aniket Jambukar[7] have proposed a work on Smart Grid Technology for Intelligent Power Use. This paper focuses on implementation of smart grid which have advanced capabilities of sensing, controlling and communication into the present power grids at both transmission and distribution levels. This proposed system gives design view of smart grid implementation that helps to resolve all the problems faced by the current power grids. This work conveys that the real time monitoring and control of power station is enabled by the smart grid. Power outages due to bad weather or sudden changes in the electricity demand can be monitored using smart grid distribution intelligence by identifying problems, rerouting and restoring power delivery

ISSN No:-2456-2165

automatically.

This system includes installation of smart meters at consumer side which would control and monitor the data and energy consumption and also it sends the data wirelessly through the internet, and data centres which will monitor the energy consumption makes decision about increasing or decreasing electricity generation. Therefore this real time information helps operators to locate power failure or avoid overheating power lines.

Goran H.Ismail ,Bilal A.Mubdir,Asso R.Majeed and Asaad M.Jassim Al-Hindawi[8] have proposed a work on Monitoring and Controlling Electric Power Stations (power generation station, substation) and control center by utilizing a current GSM infrastructure .

This proposed system includes electrical station unit which was aimed to be induct in the power station. This unit collects and process the sensor values are sent for monitoring. To monitor the fields a selected programmable logic controller (PLC) is connected, reads the changes in the electrical parameter measurements and monitors it based on which the PLC is programmed and sends the text message to the control centre. It also includes control centre unit which is responsible for monitoring, consists of Human machine interface (HMI) which was designed using GSM modem and an application built based on visual basic open source platform that helps to monitor the readings that are obtained from the power station. In this work, a simple communication link is used as SMS service for monitoring and control. This system can be easily operated, very flexible and also ready for any expansion.

Ali Asgar Memon,Aneel Kumar,Ghansham,Urooj Yasir[9] have proposed a work on green energy source connected to distribution grid to automate the protection of power transformer. This paper talks about the environment friendly sources like wind and sunlight based energy which are the smart grid fundamental contributors. Power attribute, accuracy and accessibility of electrical energy of customer's end has been a main concern for many electrical power supply organizations. A safe and an effective distribution can be achieved by smart grid and also the preference here isn't about the combination of smart sensors or the monitoring but the better performance of the electrical system. This paper proposes for protection, remote monitoring and the control of transformer through arduino with GSM modem. If the transformer parameters like voltage, current, temperature and humidity if not maintained can leads to damage of distribution transformer with special limits. So this paper takes corresponding protective action when the parameters exceed the pre-set values

III. LITERATURE SURVEY ON INTERNET OF THINGS (IOT)

SS Nagendra Kumar ,S Koteswara Rao, M Suresh Raju, S Trimurthulu , K Shivaji, T Ram Manohar Reddy[10] have proposed a work on smart grid monitoring and control , detection of power theft using IOT technology .Smart grid which is advance compared to the electric grid will be digitally monitored and spot the changes occurring in it. The data transfer between sending and receiving end and controlling is achieved with the help of Raspberry Pi through cloud. Raspberry Pi has a wireless connection with every smart meters which consists of Arduino Uno and Zigbee. This system also monitor the daily usage of electricity through internet which in turn helps the consumers to manage the energy use. It includes two way communication where the information are exchanged by the utility and consumers to achieve maximum efficiency. This proved system also focuses on the power theft by detecting the area. Through VAR acquisition, the location of the power theft can be identified and monitored with the help of the smart meters and smart transformers.

Fatima Alhebsi,Heba Alnabilsi ,Jauhra Alzebaidi,Ahmed Bensenouci,Tayeb Brahimi, Mohamed-Amine Bensenouci[11] have proposed a work on monitoring the functioning of transmission lines in a smart grid using IoT technology. The monitoring of transmission lines system is explored which helps for better efficiency and performance in large scale by implementing IOT technology. The advancement in the utilization of conventional Supervisory Control and Data Acquisition (SCADA)is made using IoT through wireless technology in which a real time data can be obtained. Their approach is about electrical monitoring the transmission lines outages, which are affected by harsh environment of nature like thundering, lightning phenomena, flashover and also overheating. This work includes a design of an ESP8266 Microcontroller(Arduino) which are connected to different sensors(like Motion sensor, Flame sensor, Temperature and Humidity sensor)for monitoring and controlling the technical failures of the transmission line and a mobile application which specify the failure type that helps the user to take suitable action to resolve the problem.

Anay Majee,Madhav Bhatia and Dr.O.V.Gnana Swathika[12] have proposed a work on Microgrid Automation for Optimizing Energy Usage and Controlling using IOT. In this paper IoT concepts are used to solve the Microgrid reconfiguration issues which are occurring due to faults, inclusion and removal of distributed energy resource (DERs) and it also aims to automate, bring down the cost of energy by using suitable processor. Relay is utilized in this system which comprises of one sensing unit and one shifting unit. Over current, over voltage, under voltage conditions can be monitored in the sensor unit and sends for further processing to the microcontroller unit. The abnormal behaviour of the system can be notified and rectified by taking an immediate action.

In this paper, a relay co-ordination with voltage and current sensors that helps for fault detection can be achieved. The monitoring and controlling time can be reduced by processing the data which can be done using cloud. This system is made economic and environmental friendly without any wires and physical connections.

Wu Shu-wen[13] have proposed a work on the application of key technologies of IOT on Smart Grid . In this paper, the application necessities of IOT in smart grid continued with essential element of IOT can be analyzed. IOT technologies for smart grid is creating a immense smart network between mankind and information sensing equipment which combines with the existing network technology database and communication technology. It also helps to get the electrical equipment status in power system. The observation, controllability, self improvement of power system can be determined from the interconnection between equipment and personal management. So this paper improves power system's stability and security, just as to ensures the environment and meet the continuous advancement requirements.

Waluyo, Febrian Hadiatna, Andre Widura, Rangga Maulana[14] have proposed a work on designing a monitoring system based on IOT for smart grid . This paper exhibits the necessity growth of smart grids as the electric energy consumption. The intension of this paper is to monitor and control smart grid to match energy expectations, accuracy, standard, productivity and coordinate sustainable energy sources towards energy ability and industrial development. In this smart grid, electric sources are interconnected in between a solar panel and the 220V PLN network. The system comprises of inverters, relays, charge controller and estimating device. This research presents the integration and recovering of electricity consumption using renewable energy sources.

IV. CONCLUSION

This paper has been marked an outline of IOT technology and its applications in smart grid technology. This paper made a review on the existing systems that integrate smart grids and IOT. The combination of smart grid and IOT are discussed thoroughly with its components and software solutions. The application of the system includes maintenance of power supply equipment, detection of failure and faults. Using IOT technology, various services can be provided and most forms of smart grid can be developed. Due to increase in many driving factors, it is necessary to shift from conventional power grid system to smart grid system as it provides effective power delivery to various consumers.

REFERENCES

[1]. Obasi,Chijioke Chukwuemeka,Olufemi Babajide Odeyinde,John Junior Agidani,Victor Onyedikachi Ibiam1 Ubadike,Chiedu Osichinaka, “Design and Implementation of Microcontroller Based Programmable Power Changeover”, ISSN 2222-1719,Vol.6,No.12,2015.
[2]. D Gavrilov,M Gouzman,S Luryi , “Monitoring Large-scale Power Distribution Grids”, DOI:10.1016/j.sse.2019.03.012.
[3]. Ali Azizi,Saeed Peyghami,Hossein Mokhtari,Frede Blaabjerg , “Autonomous and Decentralised Load Sharing and Energy Management Approach for DC Microgrids”, DOI:10.1016/j.epsr.2019.106009.
[4]. Amit Sachan , “GSM Based Automated Embedded System for Monitoring and Controlling of Smart Grid”, scholar.waset.org/1307-6892/9997170,Vol.7,No.12,2013.
[5]. Trupti Sudhakar Somkuwar,Mahesh G.Panjwani, “Design and Implementation of Electrical Distribution Line Monitoring and Controlling Using Wireless Network”,DOI- 978-1-4673-6524-6/15 - 2015 IEEE.
[6]. Sholeh Hadi Pramono,Sapriesty Nainy Sari,Eka Maulana, “Internet-Based Monitoring and Protection on PV Smart Grid System”,DOI:978-1-5386-2182-0/17,2017 IEEE.
[7]. Mr.Rohith Prakash,Mr.Aniket Jambukar, “Smart Grid Technology for Intelligent Power Use”, ISSN:2454-132X,Vol.3,Issue:1, 2017.
[8]. Goran H.Ismail, Bilal A.Mubdir,Asso R.Majeed,Asaad M.Jassim Al-Hindawi, “Monitoring and Controlling Electric Power Stations Using GSM Network”, DOI:10.24017/science.2019.2.7
[9]. Ali Asgar Memon,Aneel Kumar,Ghansham,Urooj Yasir, “Automated Protection of Power Transformers at Distribution Grid connected to Green Energy Sources”, DOI:978-1-5386-2410-4/18-2018 IEEE.
[10]. S S Nagendra Kumar,S Koteswara Rao,M Suresh Raju,S Trimurthulu,K Sivaji,T Ram Manohar Reddy, “IoT Based Control and Monitoring of Smart Grid and Power.
[11]. Theft Detection by Locating Area”, ISSN 2395-0072,Vol.4,Issue:7, 2017.
[12]. Fatima Alhebshi,Heba Alnabilsi,Jauhra Alzebaidi, Ahmed Bensenouci,SIEEE, Tayeb Brahimi, Mohamed - Amine Bensenouci, “Monitoring the Operation of Transmission Line in a Smart Grid System through IoT”,DOI- 978-1-5386-4817-9/18-2018 IEEE.
[13]. Anay Majee,Madhav Bhatia,Dr.O.V.Gnana Swathika, “IoT Based Microgrid Automation for Optimizing Energy Usage and Controllability”, DOI:978-1-5386-0965-1/18- 2018 IEEE.
[14]. Wu Shu-wen, “Research on the key technologies of IOT applied on Smart Grid”, DOI:978-1-4577-0321-8/11-2011 IEEE.
[15]. Waluyo,Febrian Hadiatna,Andre Widura,Rangga Maulana, “Design of IOT Based Monitoring System for Miniature Smart Grid”, DOI:978-1-7281-2669-2/19-2019 IEEE.