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Applications Of Internet Of Things In Renewable Energy Power Generation System For Efficient Monitoring

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Abstract

The efficient and reliable power supply has become significant with the growing interest in smart cities. The power supply has to ensure the smooth functioning of smart devices. The renewable energy sources can play a vital role in efficiently meeting the demand for smart cities and it can be achieved by integrating IoT and renewable energy production sources. Using IoT for the production of renewable energy is based on using smart sensors for transmission and distribution of energy. Companies can conveniently monitor the equipment in real-time through remote control access. The use of smart sensors and remote control access minimizes operation cost and cuts down the dependence on limited fossil fuel or conventional energy sources. The use of renewable energy is already providing various benefits that are not possible through conventional energy sources. IoT can define the better path to the generation and distribution of clean energy sources. This paper focuses on the use of IoT applications to optimize the generation of renewable energy.
Keywords: *IOT; Renewable energy; Sensors; Transmission and Distribution.*

1. Introduction

From the conventional host-based on images, text, audio, and video, the World Wide Web is now evolving into a physical host. Today, users are capable of controlling physical objects through the World Wide Web. Remote CVV cameras, home appliances, and even factory floors are now easily monitored and even controlled through the Internet of Things (IoT) that serves as a medium of communication. The concept of IoT or the physical web is on the rise these days. For instance, smart energy frameworks backed by IoT have been used to control and automate energy in buildings [1]. The use of IoT communication network is being used to generate as well as consume energy in residential areas. The use of the experimental prototype based on IoT contributed to energy preservation while having a good impact on the sustainability of energy. The communication between utility command centers and consumers is served by smart energy meters. These energy meters ensured the exchange of messages about the consumption of electricity and energy and the current status of home appliances [2]. This study also focused on smart gas and water meters. A set of guidelines was used to conclude the presentation of the use of smart energy monitoring, smart meters, and control systems. Figure 1 demonstrates the broader picture of how power and energy are becoming an integral part of smart cities [3]. Operation data in real-time from various objects including smart gas, electricity, and water meters, smart transportation, surveillance, environment, and waste management systems are collected [3]. The smart cluster head (SCH) then received this operation data which is then transmitted to local smart fusion nodes (SFN). Based on the information, smart decision based on IoT is made. The scalable architecture is monitored and controlled after the collection and exchange of data from the IoT physical network [3]. Renewable energy sources are vital and their importance becomes visible when you have a close look at this conceptual model of a smart city. But there still is the use of coal/fuel and nuclear energy even in smart cities.

There are three major layers in a smart grid. They include communication networks, system of systems, and application layers [4-8]. The utilization of renewable energy resources is through distributed generation units (DG units) and these units are installed closer to where the energy is consumed after conversion. Long transmission lines are not needed in this case which means that power substation and power loss are minimized [4-5]. Solar energy is the most popular source of

renewable energy and other sources include hydroelectric energy and wind energy which should be considered as well [6-8].

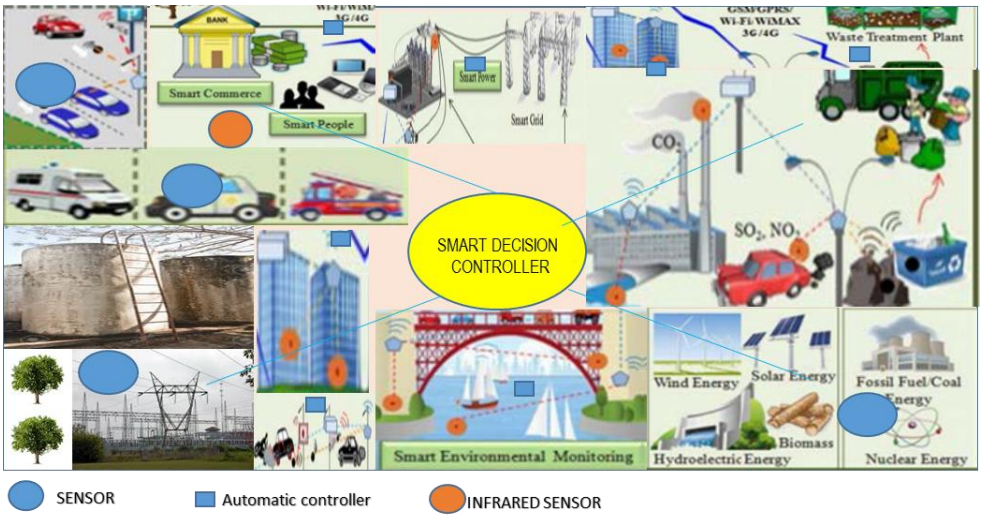

Figure 1. Proposed model of Smart city.

2. Concept of the Internet of Things (IoT)

Convenient interconnectivity and efficient conductivity are dictating the way forward especially in the use of technology. The global community is being integrated through combining multiple technologies serving a variety of applications in different industries. The Internet of Things is the convergence of virtual, digital, and real (physical) things to cities smarter through the use of intelligent devices. The conventional web technology is now backed by IoT in order to establish a connection between real things (physical objects) and smart grid devices by using an exclusively unique address for each physical object [10-11]. IPV6 protocol is the backbone of this concept. It features 2^{128} IP addresses that are different from one another and this number of much bigger than 2^{32} of the IPV4 protocol. The IPV6 protocol allows the developers to use billions of physical devices (objects) while connected them to a monitoring and control system at any given time [12-14].

IoT is completing its journey from virtual concept to reality and these days, academic experts and industrial professionals classify the Internet of Things into a couple of categories, Industrial Internet of Things (IIoT) and Consumer Internet of Things (CIoT) [15-16]. Smart wearable, smart phones, smart home appliances, and smart TVs are some of the most popular CIoT applications being used worldwide. Smart grids, factories, cars, cities, and machines, are popular examples of IIoT [15].

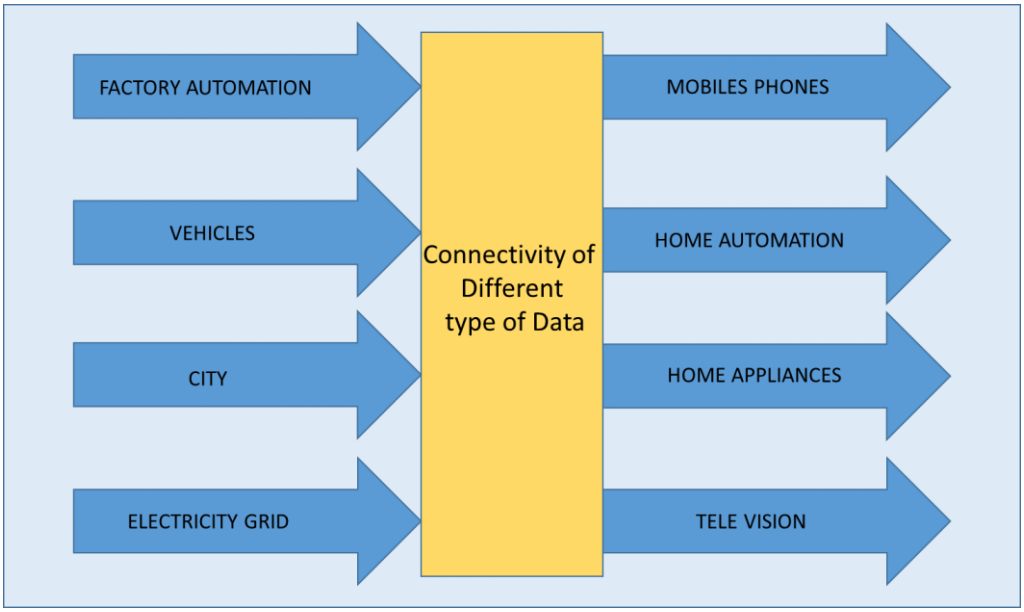

Fig.2 Arrangement of Different things with IOT

3. Proposed IOT based concept for renewable energy resources

There are so many devices in the market which are dedicated to manage the renewable energy based resources. The FX5U which is proposed by the Mitsubishi has 16 Outputs. This device has Inverter Communication through MELSEC Communication protocol (3C/4C Frames), MELSOFT Connection is the example for this purpose which is shown in figure 4. We can use the programmable logic circuit instead of other protocols. All the PLC could be communicate through 4G, wave, Bluetooth or Wi-Fi. In the proposed work all the PLC's can be work as transmitter and receiver. The separate plc can be use with a whole system or the separate PLC's for particular circuit breaker, Isolator, push button, capacitor bank, phase sequence measurement. We can categorized the complete system in three parts which are generation, transmission, consumption. The unique ID to every PLC could be given. The smart PLC can take any decision in any faulty condition. As IoT is more reliable now a days, and they are classify in two parts like Industrial IOT and Consumer IOT. The main IOT application are home appliances, smartphone while the industrial IOT is used in smart industry, electrical grids, machines as shown in figure 2. The other methodology which is proposed by [17] is given in figure 3. In this methodology the industrial IIOT and IOT are used to control or manage the renewable based power generation.

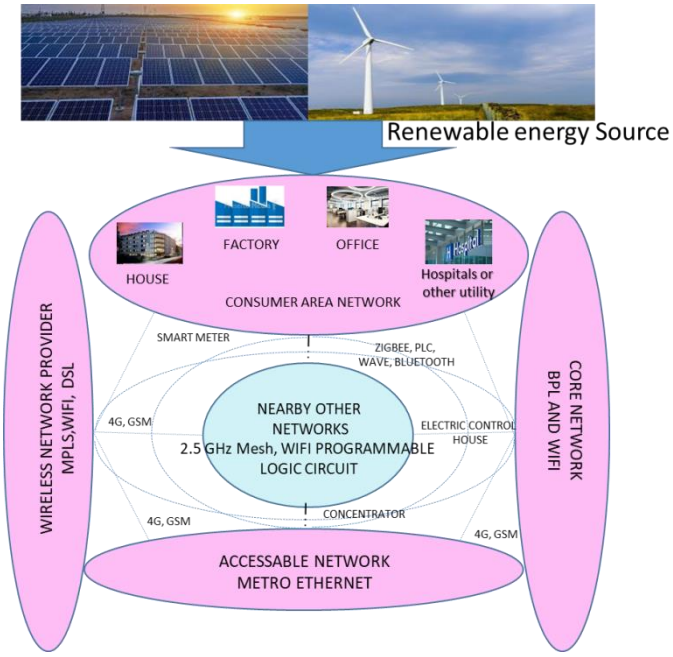

Fig.3 User network area with different methods

In the proposed model all the controlling devices are connect with the PLC and the PLC observe all the component (Switchgear and protection) and communicate by the protocol 3C/4C Frames with the main station. In this way all the component or devices are observable instantaneously by the central unit. If the central unit can only observe the devices then it is called as one way. The other option which is enable in the PLC's is that the central unit can also control the whole system as well as single device like circuit breakers [18-20]. In the modern scenario the circuit breaker are microprocessor based and perform the operation in micro seconds which allow the perfect command over the complete grid.

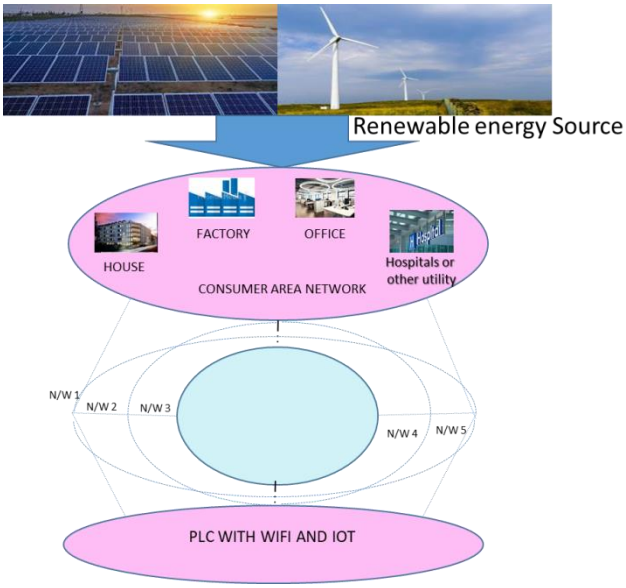

Fig.4. Proposed model with the use of IOT based PLC's

4. Result and discussion

The proposed method find suitable for this purpose. And have a future scope for the researchers. However there are so many other methods which are used for this purpose.

5. Conclusion

This paper present an IOT and IIOT programmable logic controller based single network for renewable energy resources as a replacement for multiple protocols. The proposed system is more advantageous for grid because it control the grid on large scale. This method provide the control on complete system as well as particular component. The proposed work can be extend for metering purpose and theft of electricity can also be control by using this method.

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