Internet of thing based Smart Power Grid for Smart City

Mrigank Rishav, Rittika Maity, Dipraj Ghosh, V.N. Ganesh, Sivakumar

Abstract--- Smart Grid and Internet of things (IOT) are the two technologies that has become highly developed in the perspective of energy saving & as well as monitoring. Smart Grid is an excellent solution to optimize the energy consumption & to provide continuous supply of energy throughout the city without any Blackouts while the IOT can be a solution that offers consumers the convenience of having a real-time method to control & monitor the consumption of energy. In this paper the authors propose the design of Smart Grid System based on IOT for smart city. In the present time, the conventional electrical network system is outdated due to rapid growth of demand for the electrical energy. The smart Grid can provide better efficiency for electricity consumption as well as its distribution. The smart meters present inside the home of the consumers can monitor the loads individually. The data obtained from the smart meters can be stored in the cloud of the consumer. Consumers of the electricity can continuously monitor the data of their respective loads inside the house. We have also proposed Smart distribution of power to the load by turning the appliances in the power saving mode with help of IOT if it is unnecessarily used for e.g Fridges are most of the time in the ON condition & during winters their need is less but people tend to use so it can be turned to power saving mode & its surplus energy can be stored. The surplus energy can be stored in devices such as supercapacitors to store for further use. In this paper we have proposed a plan in which, the consumer of the house will get a limited plan of electricity just like we have in our sim cards presently in India. The consumer of the house can utilize their energy upon their plans & if they exceed their plans, they can either use energy from renewable sources such as solar or they can again recharge it. This will increase the uses of more renewable resources & saving of electricity. In the city, Each Smart meter will be given a unique identification key which will be registered with the Electricity boards. This ID will be used by the consumer & it will be connected to IOT on the cloud. This ID on the cloud will store all the data of the respective consumers. The data can be viewed by the consumers as well as the electricity boards so it can reduce a chance of current theft & hence less chances of loss for the government. IOT will also help in detection of fault in the transmission line with help of current sensors & voltage sensors installed in the line. Therefore, if any fault occurs in any phase out of the 3 phases at a far distance, Then the exact location of the fault & the fault itself will be predetermined so it will be easy to clear the fault. The sensor data will be continuously going to the cloud with the help of wifi - module & IOT. The data is continuously monitored on the IOT Platforms such as Cayenne's IOT. The loads can be also triggered through IOT Platforms.

Keywords--- Smart Grid, Internet of Things, Smart City, Smart Meter, Fault Monitoring, Cayenne's IOT, Smart Load Management.

I. INTRODUCTION

In India, the conventional Electric Grid is insufficient to meet the demands of growing population. The smart Grids can fulfil the demands of millions of people by providing the continuous supply of electricity. [1] According to Power Grid corporation of India, The smart Grid can provide the solution of Global Warming by introducing the Renewable resources such as solar, Wind, Biogas etc. The smart Grid will be establishing a two-way communication between the Grid & the consumer which will reduce the inconvenience to the consumer. [2] According to World Health Organization report, Kanpur is the most polluted city in the world in terms of Air Pollution so there is big need of Energy which is Produced by Renewable sources instead of non-renewable resources. In order to reduce the Air Pollution, The Electric vehicles are the need of the country but the conventional grid will be insufficient to power the electric vehicles hence smart Grid will be very essential for the country as it can balance the shortfalls of electricity. Internet of things (IOT) will be a major solution for the long-distance communication as the data from the sensors can be stored in the cloud & can be accessed from anywhere.

II. LITERATURE SURVEY

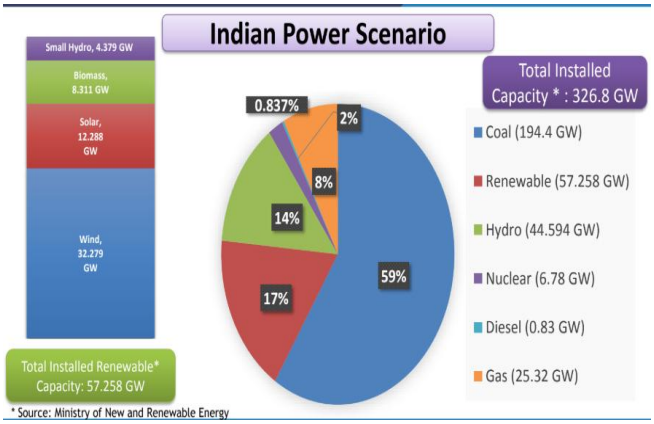

Fig. 1: Indian Power Scenario

According to [4] Ministry of Power, The generation of power from coal is high as compared to renewable resources.[5] According to World Health organization, India is the no.

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One polluted country in the world & therefore the need of smart Grid is very essential to cope up with the pollution.[6] In smart Grid, The electricity can sent back to the grid if the consumer consumption is low & Energy generated by Renewable resources are more. The smart Grid can enable the use of electric vehicles. It will also increase the use of renewable renewable resources by introducing net metering system.

III. SMART METER

In this system, the smart meter consists of a controller such as raspberry pi which collects data from the different sensor connected to the load. This data is uploaded to the cloud by using different communication Networks such as Wide Area Network. This Meter will be connected to the grid through IOT. The consumer as well as the Data monitoring centre can have a Data Analytics of a home. This data will be made available on the App developed By the Electricity Boards. This meter will be assigned a unique ID such as IP Address through which each Meter can be located. This meter can Also establish communication with the individual loads in homes & it can collect data from the sensors connected to them. This Meter will have fixed Plan of Electricity for e.g If a user has chosen a Plan of 5kw per day then he will receive 5kw per day only for 24hrs & the consumer has to adjust his usage. If it exceeds then the consumer will have to switch to its Renewable sources for the Surplus Energy or The consumer will have to choose bonus plans for the day from the App. The consumer will have to Login in the smart Phone App.The app will provide a unique Authentication key to the customer.

The customer has to enter the key in the Smart meter through which it can login & sends the request to provide the electricity. This will reduce the current theft in the System since the customer is continuously Analysing & Monitoring its data. The home with smart meter will be completely registered with the electricity boards so there is no probability of theft of electricity.

IV. SMART TARIFF DESIGN

In this system, the smart meter consists of a controller such as raspberry pi which collects data from the different sensor connected to the load. This data is uploaded to the cloud by using different communication Networks such as Wide Area Network. This Meter will be connected to the grid through IOT. The consumer as well as the Data monitoring centre can have a Data Analytics of a home. This data will be made available on the App developed By the Electricity Boards. This meter will be assigned a unique ID such as IP Address through which each Meter can be located. This meter can Also establish communication with the individual loads in homes & it can collect data from the sensors connected to them. This Meter will have fixed Plan of Electricity for e.g. If a user has chosen a Plan of 5kw per day then he will receive 5kw per day only for 24hrs & the consumer has to adjust his usage. If it exceeds then the consumer will have to switch to its Renewable sources for the Surplus Energy or The consumer will have to choose bonus plans for the day from the App. The consumer will have to Login in the smart Phone App.The app will provide a unique Authentication key to the customer. The customer has to enter the key in the Smart meter through which it can login & sends the request to provide the electricity. This will reduce the current theft in the System since the customer is continuously Analysing & Monitoring its data. The home with smart meter will be completely registered with the electricity boards so there is no probability of theft of electricity.

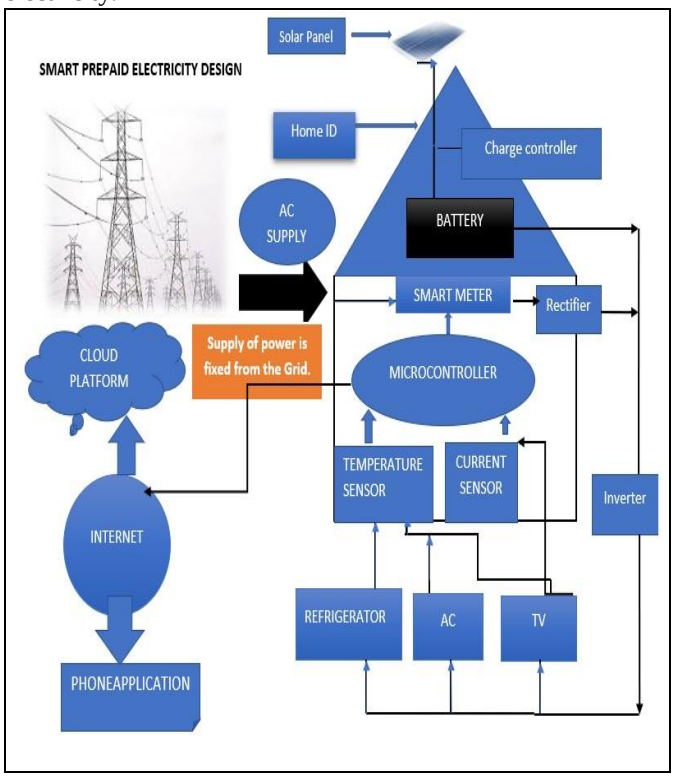

Fig. 2: Smart Tariff Design

V. SMART LOAD MANAGEMENT SYSTEM

In Smart Load Management system, the load is connected to smart controllers which consist of sensors which provides the feedback to the controllers. In this system, the controllers of 2 appliances or Loads communicate to each other by a common controller through M2M communication. This communication is done during the time of peak Load so that one appliance can enter into the power saving mode if it is not necessary to be used. The data from the sensor of the Appliances is taken into cloud for various Data Analysis. This Data can be viewed by Data monitoring station & as well by the consumer through an App.The Data will consist of Power saved by the appliance & also individual power consumed by an Appliance. The data obtained can make the customer aware about its individual appliance consumption & hence The consumer can compare the savings of wattage mentioned on the appliances which will make them aware about the actual working of the product purchased.

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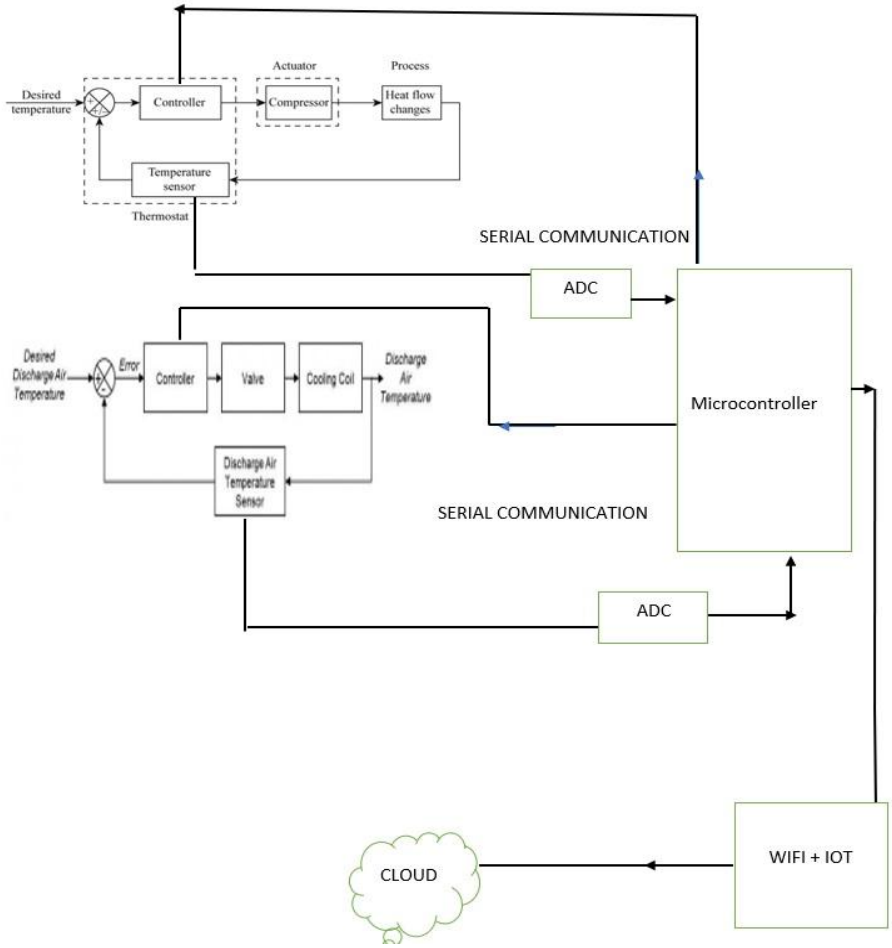

Fig. 3: Smart Load management design

VI. FAULT MONITORING IN TRANSMISSION LINES

This design consists of monitoring & Analysing of Faults in the Transmission Lines through IOT.This design works on the basis of change in current values or change in temperature. The Flame sensor detects the fire caused in the transmission line & transmit the data immediately through IOT. This will reduce the reaction time between the transmission line & the Grid. The exact location of the Fault will be determined by GPS.The damage caused the Fault will be also determined by the Image Processing. Image Processing can also determine the lose connection in the transmission line. It can also determine condition of equipment's such as insulators, inductors etc. This design is basically useful for Short-Circuit Fault, Line-Line Fault & Line to Ground Fault. The lightning Strike can be also determined in this design. The data can be stored in SD card & then it can be transmitted to the cloud through WIFI. Each controller will be assigned an IP through which it will be identified. The data Analytics compares the data with the previous data & then predetermine the causes of faults which will make the new system more reliable than it was. The controller will be pre-programmed Through Python since it will help in establishing machine to Machine communication. The Fault can be monitored on Cayenne's IOT Platform. The Fault will cause the loads to turn off. Similarly, when Fault will get cleared, The Load will get turn on. The sensors such as current sensor, Temperature sensor is installed in the Transmission line to monitor the state of current & Temperature.

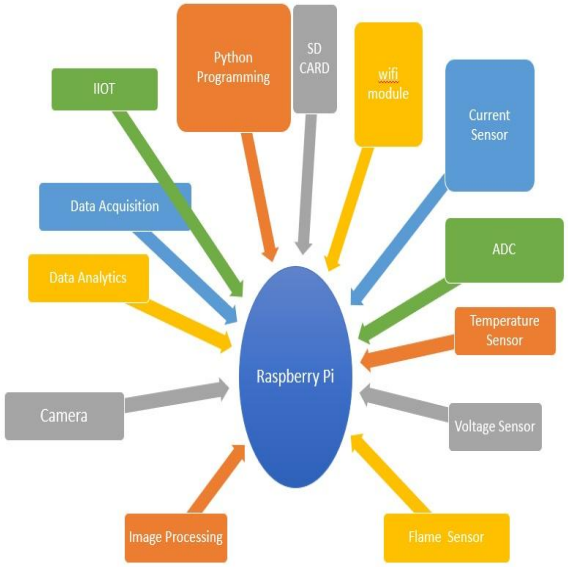

Fig. 4: Block Diagram of Fault Monitoring System

VII. RESULTS

The results from the sensor such as current sensor & Temperature sensors are obtained on IOT Platform such as Cayenne.

The Loads can be triggered also from the IOT Platform with use of Mobile Phones & Laptops. The Faults can be Triggered online through IOT Platform. If any Fault occurs, The IOT Platform Gives The indication of the fault present in the system. The Data is monitored on different Platforms such as Thing speak & Cayenne's IOT.

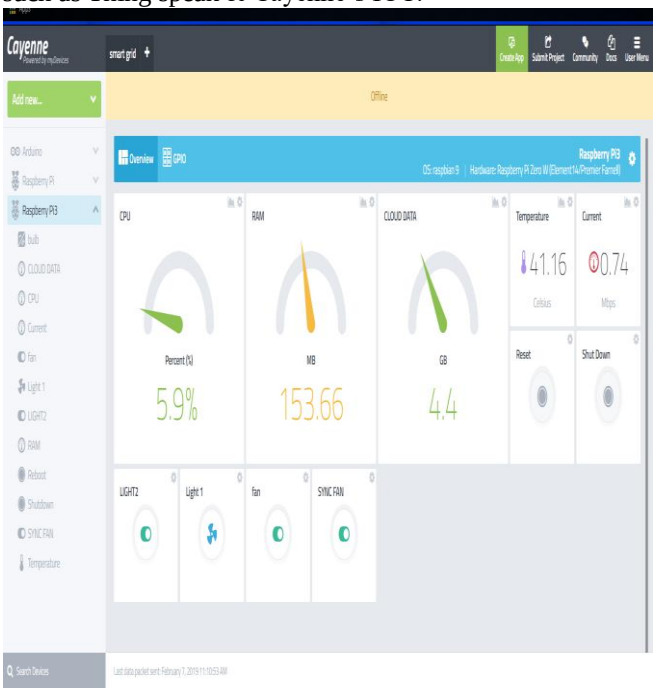

Fig. 5: Energy Monitoring Through IOT

The Loads are being monitored on cayennes IOT Platform. The data such as cloud storage, current value, switching on/off of loads can be done through IOT Platform.

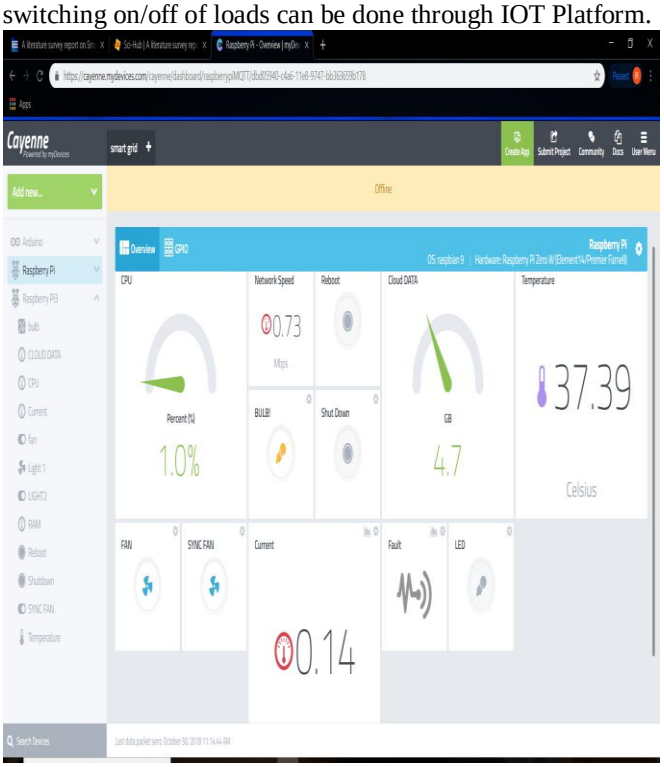

Fig. 6: Fault Monitoring and Controlling of Appliances

The Faults can be observed in the IOT Platform & if any Fault occurs, The Loads can be switched off.Similarly,If the Fault is Cleared The Loads will be Switched on. The Loads connected through Raspberry Pi can be triggered through IOT & their parameters can be monitored.

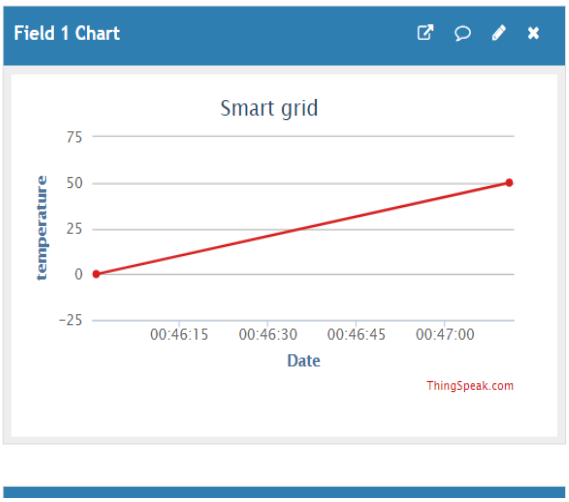

Fig. 7: Temperature vs Time of a Temperature sensor through IOT

The change in Temperature with respect to time can be monitored on IOT Platform. For e.g The cooling of Air-Conditioner can be monitored & controlled through IOT.

REFERENCES

1. Power Grid corporation of India "Smart Grid Green Energy Corridor report".
2. World Health Organization Report of Air Pollution released in Geneva.
3. A course in "Introduction to Smart Grid" by NPTEL.
4. Mohsenian-Rad. Hamed, "Introduction to Smart grid", Department of Electrical & Computer Engineering Texas Tech University 2012.
5. Adi Candra Swastika," IOT-Based Smart Grid System Based design for Smart Home" The 3rd International Conference on Wireless & Telematics 2017.
6. M.Yun.B.Yuxin, "Research on The Architecture and Key Technology of Internet of Things (IOT applied on smart grid),international conferences on advances in energy engineering .
7. X.Wang, S.D.J. MCArthur, S.M.Strachan, J.D Kirkwod and B.Paisley "A Data Analytic approach to automatic fault diagnosis and prognosis for distribution automation " IEEE Transactions of Smart Grid ,Volume-9,November 2018.
8. B.Celik, R. Roche, D. Bouquain, and A. Miraoui, Decentralized Neighborhood Energy Management With Co-ordinated Smart Home Energy Sharing, IEEE Transactions of Smart Grid ,Volume-9,November 2018.
9. Shady S. Refaat Texas A&M University at Qatar, Doha, Qatar Residential load management system for future smart energy environment in GCC countries, 2015 First Workshop on Smart Grid and Renewable Energy (SGRE).
14. Qinghai Ou,Yan Zhen,Xiangzhen Li,Yiying Zhang,Lingkang Zeng, Application of Internet of Things in Smart Grid Power Transmission, 2012 Third FTRA International Conference on Mobile, Ubiquitous, and Intelligent Computing.

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