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Internet of Things based Residential Power Load Forecasting

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Abstract –

Load Forecasting is the major step in determining the future expansions in power generation, transmission and distribution arrangements. To match the demand and supply equilibrium, Load Forecasting weighs heavily on traditional forecasting techniques. With increasing power demand for all types of consumers, it is essential to forecast close to accuracy.

This paper focuses on the potential use of 'Internet of Things' system for collecting prerequisite data for Load Forecasting purpose. Individual residential consumer data of different essential elements can be collected and analyzed with the proposed model. We have considered weather conditions and its effects on load variation for residential electricity consumers.

***Key Words*: Internet of Things, Load Forecasting, Residential Load, Temperature and Humidity**

1. INTRODUCTION

There are three broad types of electricity consumers comprising of different types of loads- Commercial, Industrial, and Residential. Commercial and Industrial consumer loads are almost independent of the weather conditions, While residential loads have large seasonal variations. Household electrical appliances such as Air-conditioning, Fan, Lighting Bulbs, Electrical Blowers .etc. are used for comfort from varying weather conditions. This paper proposes a feasible idea of implementing sensors and current and voltage measurement devices at every residential consumer unit and its interfacing with Internet of Things system. The data collected by the system over the time will be analyzed and effectively used for load forecasting.

1.1 Impact of Weather Conditions on Residential load

Following weather conditions are taken into account for the corresponding reasons for change in load demand-

1. Temperature- Hot or Cold temperature will cause a decrease in efficiency of the system at near maximum capacity. Considerable temperature swings will cause an increase in the system loading. These loads are either heat or cooling system loads.
2. Humidity- High percentage of water content in the air gives rise to discomfort. Heat levels can increase or decrease due to variation in humidity. Loads are usually dryers, fans or air-conditioners. etc.
3. Light Intensity- Cloud cover in rainy days will decrease the light intensity and can increase 'Lighting' based load during the daytime.

Following graphs represents weather dependent load curve plotted by data collected from a house in Ratnagiri region. This data varies significantly from home to home due to different weather conditions.

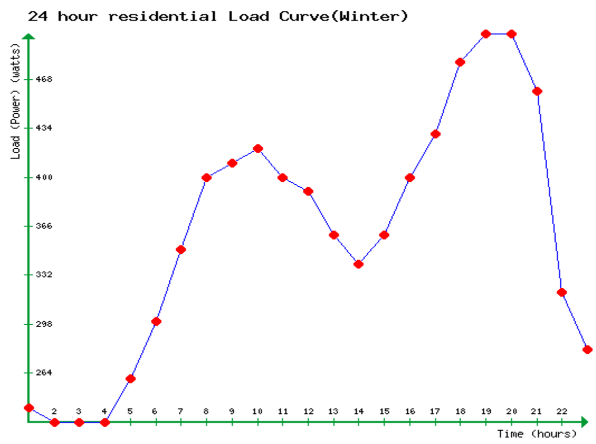

Figure -1: Residential Load in winter in Ratnagiri

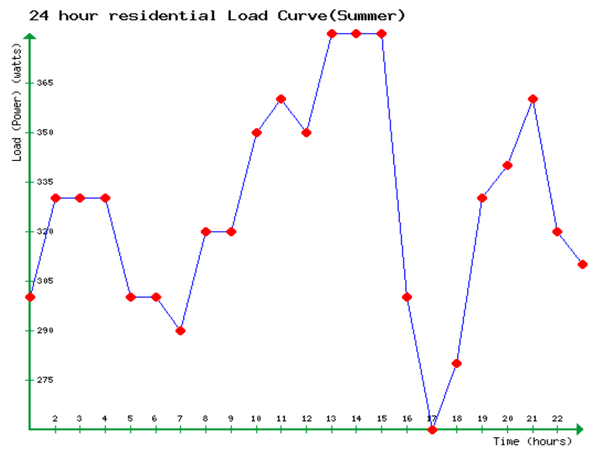

Figure -2: Residential Load in summer in Ratnagiri

2. ADVANTAGES OF IOT BASED LOAD FORECASTING

1. For conventional Load Forecasting data, temperature and humidity measurements are taken at a specific location which is different at every consumer location. Different areas have different weather conditions and hence load demand varies accordingly. IoT based weather data is collected from premises of each consumer which will make the database more precise.

2. Different data for different areas can be used to plan future expansions and estimated power generation capacity for different areas. i.e. Areas with maximum load can be provided with different load forecasting as that of areas with lower power consumption.

3. Load variations and weather conditions are available in real time environment.

4. Collected data is readily available on the internet cloud and can be viewed any time required.

5. Collected data can be plotted over required time period with different physical quantities, such as Load Curve. This data can be used for Short term, Medium term and Long term forecasting.

6. Power Consumption details of the residential unit can be measured and evaluated for tariff purpose. Along with that power factor at the consumer ends can be measured with ease.

3. POTENTIAL SYSTEM SETUP

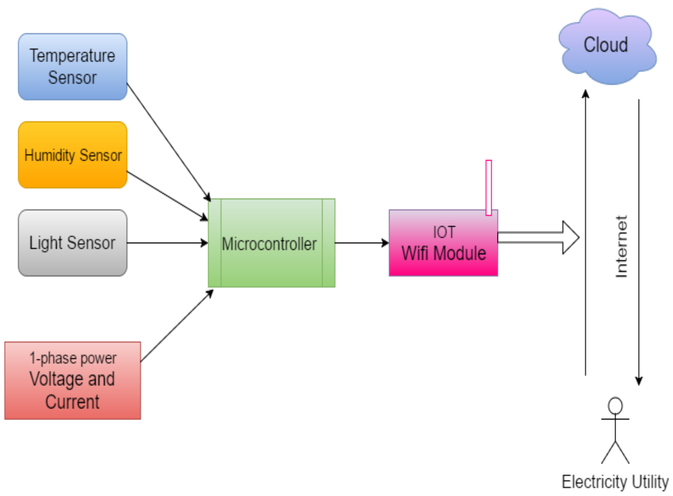

Figure-3: System overview

Fig.3 shows the overview for the Internet of Things based system for residential load forecasting. For the weather condition data, three types of analog sensors are used. 1. Temperature sensor 2. Humidity sensor 3. Light sensor. These sensors can be connected to a miniature web server module such as Flyport Wi-Fi 802.11g.

A] Sensor specification-

1. Temperature and Humidity Sensor Module- This module has a humidity measurement range of 20~90%RH with working voltage of 5V DC. The Accuracy of +/- 5%RH is achieved. Temperature measurement range is 0-60^{0}C. This specification is sufficient and costs effective.
2. Light sensor- LDR Photosensitive Resistance Sensor Module can be used for this system. It has working voltage of 3.3 V to 5 V and the output form is DO digital switch output (0 and 1) and AO analog voltage output.
3. Current sensor- Hall current sensor can be connected to one of the analog input of Flyport module.
4. Voltage sensor- CE-VJ03-32MS2-0.5 AC Voltage Sensor 0-250V (50Hz). This voltage sensor measures line voltage up to 250V. It requires 12V external DC supply. This AC Voltage Sensor provides 0 to 5V DC analog signal that is linearly proportional to the AC voltage measured at the terminal blocks.

B] Flyport Wi-Fi 802.11g specification-

This wireless connection module consists of an internal microcontroller (PIC 24FJ256GA106 processor) with 256 Kbyte memory and 16 Kbyte of RAM. Its 802.11G certified transceiver can connect to the internet easily. This module provides the function of both the microcontroller and Wi-Fi module in a single integrated module. The sensor can be connected with its 4 Analog inputs and can be converted to a digital signal with its 10 bit onboard ADC. Also, in the case of digital sensors, it can accommodate up to 18 Digital inputs. Power supply required is 3.3V or 5V DC.

The module can be programmed in such a way that the required data can be collected by the electricity supplying utility. For more detailed data logging, a GPS module can be integrated with every module for the Geo-tagging purpose. This will generate a data in almost all required elements- time, location and physical quantities.

Each residential consumer can be identified with a unique IP Address and a location address. For the security of data, a dedicated server can be setup for the cloud system or the service can be provided by public servers.

4. DRAWBACKS

1. Lack of internet network in the area can rule out the implementation of this system. Especially in rural areas, where the reach of internet facility is limited.

2. The cost of the system can be a major drawback. System cost can either be fulfilled by government subsidy basis or it can be included in the electricity tariff.

3. In the case of faults on the consumer side, separate protection system needs to be implemented which further escalates the implementation and maintenance cost.

5. CONCLUSIONS

From the Load Forecasting point of view, this system can provide in detail information to the electricity provider. The data acquired from Internet of Things system can be effectively used to find saturation level of appliances used, usage pattern by each consumer with respect to change in weather and energy consumption per consumer. Using extrapolation method above data can be used to load forecast for chosen area. Other possible applications of this system are Tariff monitoring, Weather condition monitoring. Etc. Overall, this concept implies the effective use of information technology in electrical systems. Development of internet network can eventually lead to the experimental implementation of this system. This idea can contribute to Smart Grid system.

REFERENCES

[1] Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things” , Willey Publication, 2013.

[2] S. C. Mukhopadhyay, N. K. Suryadevara (auth.), Subhas Chandra Mukhopadhyay (eds.) “Internet of Things: Challenges and Opportunities”, Springer International Publishing, 2014.

[3] Roy Billinton and Ronald N Allan, 'Reliability Evaluation of Power System', Plenum,Press, 1984

[4] R.L. Sullivan , “Power System Planning”, Tata McGraw Hill Publishing Company

[5] Patrick Day, Michael Fabian, Don Noble, George Ruwisch, Ryan Spencer,Jeff Stevenson, Rajesh Thoppay , “Residential Power Load Forecasting”, Conference on Systems Engineering Research (CSER 2014)

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