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SMART CITY BASED DEMAND RESPONSE SYSTEM USING IOT

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***Abstract*—The technologically growing world is nothing without electricity and electricity consumption has increased substantially over the last decade. It is caused due to increased usage of home appliances. Therefore in order to overcome this hurdle, we have proposed an online module to monitor and control the power consumption through IOT (Internet of Things) for optimization of energy, balancing power supply, reducing peak demand and the electricity bill. Our proposed system maintains the power supply through categorized loads namely essential and non-essential loads and the appliances based on its utility is brought under these respective loads. Such that electricity consumption, bill limitations and load priorities can be done online. During the peak demand and excess usage, the non-essential loads will be disconnected. This proposed IOT algorithm can be controlled by both the distributor and the end consumer**

***Keywords*—IOT, Essential and Non Essential loads**

I INTRODUCTION

Demand response (DR) is a mechanism which allows electricity customers manage the time of use of their appliances in order to response price changes..Nowadays, the world is nothing without electricity. World over the economic growth is driven by electricity. In India, the demand for electricity has always been more than the supply. India, is an agricultural country and thus sometimes, a lot of electricity is needed in fields to pull water from canals and to water the crop. Now, since we have a really huge population, and sufficient electricity cant be produced to meet the demands of the city as well as the villages, power cuts are introduced. Shut down of power happens due to less generation of electricity than the demand rate. So, when a particular area demands high power, power will be shut down for the surrounding areas. Elders and babies may suffer without electricity. By this project, during high power demand, the power will be supplied only to the essential loads like light and fan and cuts down the power for non-essential loads like washing machine, AC,etc., When the usage of electricity exceeds the particular unit, we can save power and money by shutting down the non-essential loads. This project uses IOT for monitoring and controlling the loads.

II SYSTEM ARCHITECTURE

We have used a system that comprises of LPC812 microcontroller which is used to connect the input modules such as current sensor[ACS712] and output modules such as wifi module, loads namely essential and non- essential, relay driver and server called ubidots. IOT is the new technology that make embedded objects belong to the internet in an interactive way. Through IOT, digital and physical entities can be linked using appropriate information and communication technologies

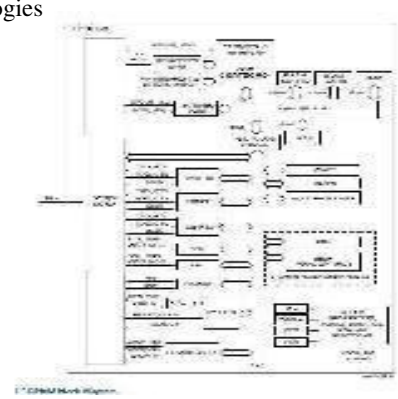

Fig. 1 LPC812 Architecture

The system we use here needs 5V power supply, current senor, WIFI module and relay driver.

1. The LPC812 is an ARM Cortex-M0+ based, low-cost 32-bit MCU family operating at CPU frequencies of up to 30 MHz and support up to 16 kB of flash memory. The registers incorporated into the ARM Cortex-M0+ core, such as NVIC, SysTick, and sleep mode control, are located on the private peripheral bus.
2. The peripheral complement of the LPC812 includes a CRC engine, one I 2 C-bus interface, up to three USARTs, up to two SPI interfaces, one multi-rate timer, self wake-up time state-configurable timer, one comparator, function-configurable I/O ports through a switch matrix, an input pattern match engine, and up to 18 general-purpose I/O pins.
3. ACS712 current sensor operates from 5V and outputs analog voltage proportional to current measured on the sensing terminals. It features 100 mV/A output sensitivity, 5.0 V, single supply operation, Output voltage proportional to AC or DC currents, 80 kHz bandwidth, Low-noise analog signal path.
4. ESP8266 is an impressive, low cost WiFi module suitable for adding WiFi functionality to an existing microcontroller project via a UART serial connection. The ESP8266 requires 3.3V power–do not power it with 5 volts. The ESP8266 needs to communicate via serial at 3.3V and does not have 5V tolerant inputs, so you need level conversion to communicate with a 5V microcontroller like most Arduinos use.
5. Relay driver IC is an electro-magnetic switch that will be used whenever we want to use a low voltage circuit to switch a light bulb ON and OFF which is connected to 220V mains supply. The required current to run the relay coil is more than can be supplied by various integrated circuits like Op-Amp, etc.

III WORKING

This system can be implemented on the electricity distribution of specific area. During the time of peak demand of electricity, the entire available power of the city can be distributed equally with the help of our proposed system. The consumed current can be measured by the measured by the means of ACS712 current sensor and the data in the unit if ampere will be fed into the microcontroller LPC812 which will convert the ampere value into power value ie. In watts by using the formula

$$P=V*I$$

this power value will be uploaded to the ubidots server periodically. So that the distributor can monitor the current usage and he can control two loads essential and non essential through the server using IOT technology. The home appliances based on its utility it will brought under those two loads. During peak demand on the essential load electricity will be distributed and the non essential load will be turned off. So that we can uniformly distribute the available power to everyone without any power shutdown.

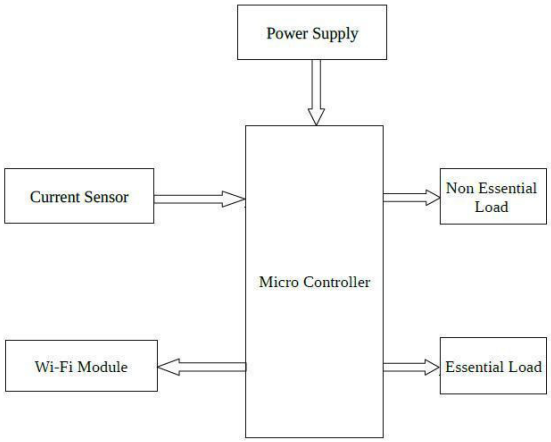

Fig. 2 Block diagram

1. By using Current Transformer, we read the output current of the connected load.
2. Then the output is given to microcontroller which stores the current value in its buffer.
3. A wifi is connected to the microcontroller which acts as a gateway for the cloud.
4. Two AC loads like Essential and Non Essential loads are connected to the Microcontroller through relays driver circuits.
5. Then create an account in the web server (Ubidots).
6. In Ubidots, create some variable for controlling both essential and non essential loads.
7. Then, flash the program into your controller
8. By clicking respective buttons in the web server (Ubidots), you can controls the respective load of the end users through wifi.

IV RESULT ANALYSIS

There are no firm conclusions in this document on the best market model to be used for Smart Demand Response. This is intended to be a discussion paper to raise awareness of the options and the associated pros and cons with each option. What it has highlighted is the opportunity to approach the implementation of Smart Demand Response in a number of incremental steps, each of which can be analysed for cost benefit to GB. Evolution of potential Smart Demand Response models is essential to match the developing market scenarios.

There will be a need to adopt and maintain common

definitions as to what services are included, which parties can and must do what: common definitions will be needed, and developments need to be cognisant of operations including those in development – such as the work being carried out by European Network of Transmission System Operators for Electricity (ENTSO-E)7 so that the new arrangements are understood and work with, rather than disrupt, existing arrangements. There must be a positive cost benefits case to implementing any new Demand Response model and we need the right incentives in place at the right time to facilitate Smart Demand Response. Timing of implementation will be key to any cost benefit analysis as the case for action on Smart Demand Response may be closely associated with the stress on the networks and the corresponding savings of network investment, but it may later be driven the energy mix and matching demand to the generation available. Trigger points could arrive quickly, so they need to be prepared for. Alternatively, events such as price control windows could be used as the key drivers.

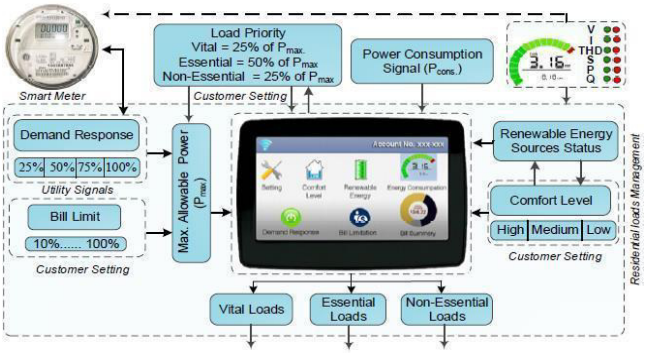

Fig. 3 working model

The feed forward neural network receives the estimated available power, comfort level, battery status, and energy consumption of each electric load. The outputs of ANN algorithm "Zero" is assigned to "no action from proposed system", while the output "One" is assigned to "disconnect action to load". The outputs of the ANN algorithm aims to save energy consumption while considering residential household's preferences and comfort level by effectively utilizing the proposed energy management system. A two-hidden layer feed-forward artificial neural network, trained using the back propagation algorithm, is used in this investigation. It is noticed that when the resident adjusts the bill limitation to zero, comfort level becomes high, battery status is full, the action from the proposed algorithm to battery switch is zero, and the residential loads is at "no action". If the resident adjusts the bill limitation to (10%), the comfort level becomes medium, battery status is full, the action from the proposed algorithm to battery switch is one, the system manages smartly between the utility energy consumption and energy from residential renewable system without effecting energy consumption. However if the resident adjusts the bill limitation to (50%), the comfort level is low, battery status is (50%), the action from the proposed algorithm to battery switch is one, the action to essential and non-essential electrical loads are one, while the action to vital loads are zero

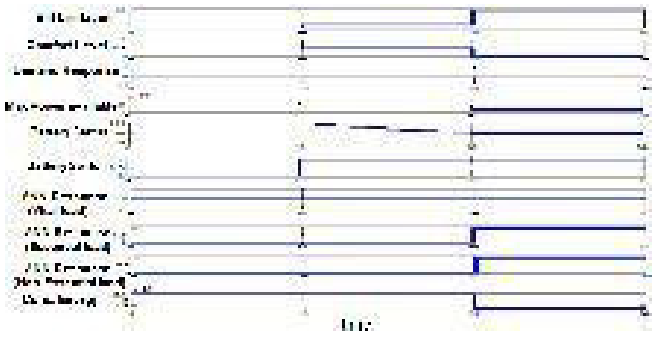

Fig. 4 Simulation results in different energy saving scenarios

V CONCLUSION

This paper has given a brief discussion about smart DEMAND RESPONSE of electricity across a particular area by harnessing the technological usage of IOT concept, simultaneously improving the conservation of the electricity. This idea could be implemented by various electricity boards across the world to save the electricity and to supply uniformly. This system can also be implemented in industries to prevent power wastage. The uninterrupted power supply also plays a huge role in the welfare of public. This could reduce the hurdles caused by the power shutdown, thus creating a smart society. This system can also be further enhanced by including modules which could improve the usage of renewable energy.

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