PROPOSED FRAMEWORK FOR HOME ENERGY MONITORING AND ANALYSIS

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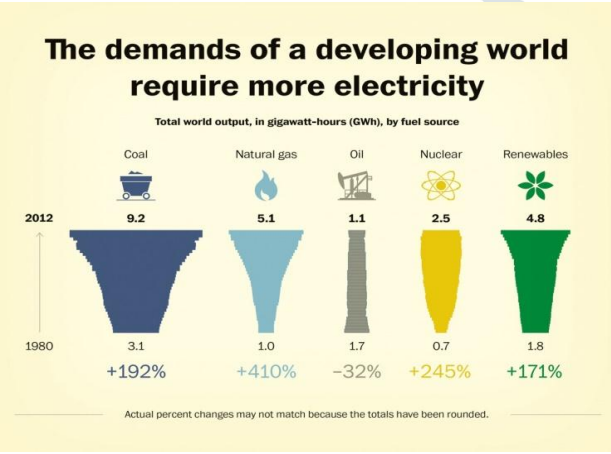
Abstract: ***Energy efficient power consumption and techniques to energy analysis is presented in this paper. The proposed system consists of three phases namely- 1) Capturing data, 2) Analyzing data in cloud and 3) Sending usage statistics. Results for the Home Energy Monitoring Systems (HEMs) are data logs that have been captured by the wireless sensor nodes (WSNs) over a period of time. The hardware components consist of the IOT IOCare controller which is basically comprised of two controllers- Atmega 328 controller and uses Extensa for wireless capabilities. The software written backend is written in PHP, CSS3 and HTML5 for cloud computing and HTML, CSS and JavaScript using Ionic framework for hybrid android application in mobile phones. The outcomes in the paper will help in finding efficient ways to analyze power consumptions in homes and also provide data where energy consumption can be limited to use.***

Index Terms— Energy Management, Internet of things

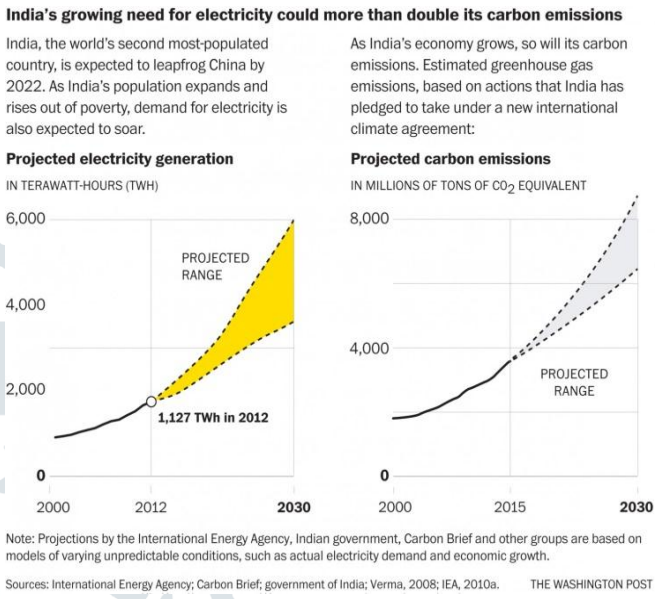
I. INTRODUCTION

THERE has been tremendous consumption of energy in the past few years. This leaves us with two choices- either reducing the consumption of resources or generating energy, sufficient enough to suit people's needs. According to some experts, it is anticipated that even if nuclearplantswere put to use we cannot amount to the daily consumption of resources.

In a world population of roughly 7 billion people, around 1.3 billion people live have no access to power and live in the dark. Nearly a quarter of the entire mass without power, i.e. 300 million Indians suffer from such crisis.



The environmental hazards due to excessive usage of power also seem to be noteworthy. The fossil fuel used for generation of electricity is the largest source in emission of greenhouse gases in the world. The total carbon dioxide emissions for India were 1.7 tons per capita in 2012compared with 6.9 tons for China and 16.3 tons for the United States, according to the World Resources Institute.



The safety in modern homes can also be inspected upon with these models. In the year 2013-14, approximately 52 people in India have lost their lives due to electrical accidents. Some of these include geyser, microwave ovens or other appliances catching fire due to some negligence of residents living in these co-operative houses (buildings). Such catastrophes can be avoided by deploying these models into the market.

Therefore, it is utterly critical to curtail power consumption in countries and regions that use energy at very high rates with an intent to help regions with poor energy availability.

II. LITERATURE SURVEY

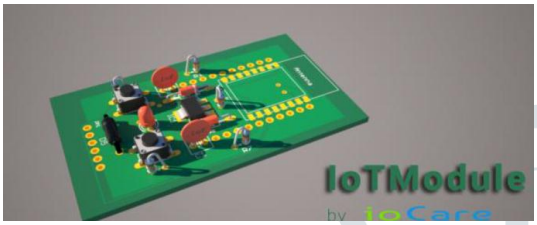
Paper No	[1]	[2]	[3]	[4]
Core Algorithm	SCADA	PPC	HEMS	0/1 Knapsack
Reliability	Timeliness	Well-timed	Timeliness	Well-Timed
Network Topology	Star	Mesh	Star	Mesh
Delay aware	High	Moderate	Moderate	Moderate
Network overheads	Moderate	High	Moderate	Moderate
Scalability level	High	Medium	Medium	High
Energy	Low	Low	Low	Low
Platform/OS	GSM/GPRS	SES	HEMS	ZigBee
Application scope	Time critical	Delay consideration	Energy monitor	Monitoring and scheduling

III. TECHNICAL STUDY

A. Iocare IOT Module

Features

- SDIO 2.0, SPI, UART
- Integrated RF switch, balun, 24dBm PA, DCXO, and PMU
- Integrated 32 bit RISC processor, on-chip memory and external memory interfaces
- Integrated MAC/baseband processors
- Quality of Service management
- I2S interface for high fidelity audio applications
- On-chip low-dropout linear regulators for all internal supplies
- Proprietary spurious-free clock generation architecture
- Integrated WEP, TKIP, AES, and WAPI engines



B. MOC3041

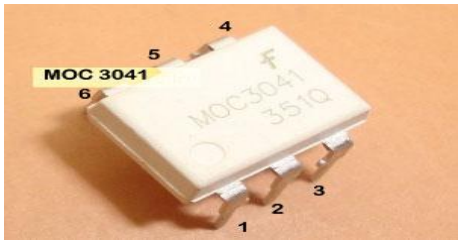
The MOC3041 device consists of gallium arsenide infrared emitting diodes optically coupled to a monolithic silicon detector performing the function of a Zero Voltage Crossing bilateral triac driver. They are designed for use with a triac in the interface of logic systems to equipment powered from 115 Vac lines, such as solid–state relays, industrial controls, motors, solenoids and consumer appliances, etc.

Features

- Simplifies Logic Control of 115 Vac Power
- Zero Voltage Crossing

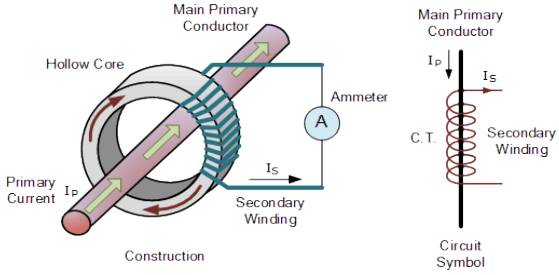
Recommended for 115/240 Vac (rms) Applications:

- Solenoid/Valve Controls
- Temperature Controls
- Lighting Controls
- E.M. Contractors
- Static Power Switches
- AC Motor Starters
- AC Motor Drives
- Solid State Relays



C. Current Transformer (C.T)

The Current Transformer is a type of "instrument transformer" that is designed to produce an alternating current in its secondary winding which is proportional to the current being measured in its primary. By increasing the number of secondary windings, N2, the secondary current can be made much smaller than the current in the primary circuit being measured because as N2 increases, I2 goes down by a proportional amount. In other words, the number of turns and the current in the primary and secondary windings are related by an inverse proportion.



D. DHT11 Sensor (Temperature Sensor)

The DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

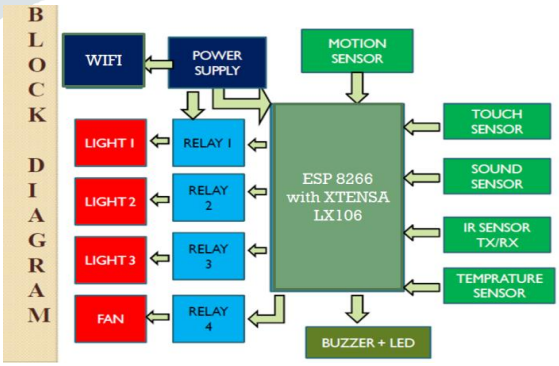
IV. PROPOSED METHOD

The system designed can be broken down for explanation into 3 levels:

A. Controller Level

In this stage, the current transformer calculates the current flow in the electricity board in each room and transmits data wirelessly using Wi-Fi (802.11 standards).

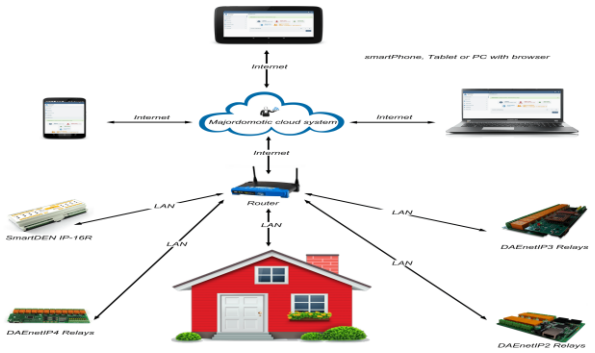
The data acquired from these appliances will be sent to the cloud (we will use the IOCare Cloud) for analysis on the consumption of power.



B. Cloud Computing

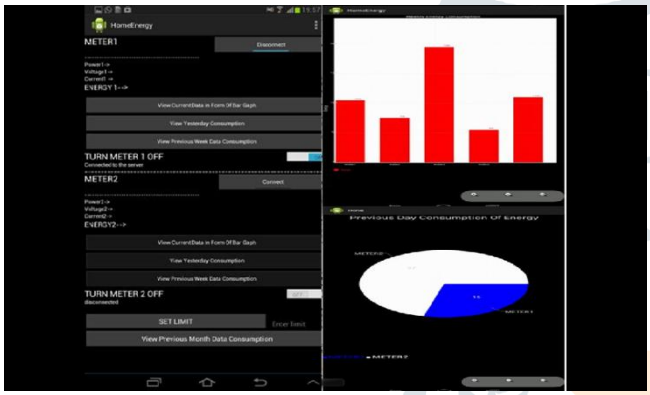
In this stage we will analyze the data sent from the IOT-IOCARE module (consists of the ESP 8266 w/ Xtensa LX106). The data aggregated from the controller will be sent in a particular time frame. The packets which are alive for longer periods of time will be discarded. This is called the TTL (time to live) mechanism.

The cloud platform will be the power consumption of the appliances can be analyzed and conclusions can be drawn upon.



C. Mobile Application

The last stage is where the data analyzed is displayed on the user's smartphone. The user can view the power usage of the appliances at his home. This statistical data may help the user to monitor and control his appliances from anywhere as the module-controller is controlled by the Wi-Fi routers installed in user homes.



V. FUTURE SCOPE

We can use pervasive computing and artificial intelligence by deploying motion sensors to the appliances. Motion sensors will help us detect motion of humans in the house. If motion is detected then the appliance will be automatically switched ON, and if no motion is detected the appliance will be switched OFF. This will help in reduced power consumption

VI. UNITS AND MATH

The units to measure power consumptions can be KWh (Kilowatt hour). The currents may be measured in A (amperes), time in either seconds/minutes/hours (s/min/hr.) depending on different settings.

We need to calculate the power consumed by the system in different regions at different times and generate the result to the observations to curb the power demands of the user. For this purpose, we can use data mining techniques to apprehend the nature of data and employ learning strategies such as SVM (support vector machine) to categorize the data for different usage demands or usage specific to climate (low for winters and high for summers).

VII. CONCLUSION

Please include a brief summary of the possible clinical implications of your work in the conclusion section.

ACKNOWLEDGMENT

We would like to acknowledge our college at Pune, MITCOE Computer Department of Engineering for guiding us through the assignment and assessing our work. We would also like to thank our sponsors at IOCare, for providing us the equipment and infrastructure to test and draw inferences for the paper.

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