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AN ENERGY AWARENESS SMART METER IN AN INTERNET-OF-THINGS PLATFORM

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***Abstract*:**

Building the smart grid means integration of advanced information, communication and networking technologies in the traditional electric grid to make it smarter and faster in making decisions. IoT platform provides very high redundancy, virtually unlimited data storage and worldwide data access. Through the IoT, consumers, manufacturers and utility providers will uncover new ways to manage devices and ultimately conserve resources and save money by using smart meters, home gateways and connected appliances. In this paper, we propose an architecture for monitoring power in smart grid applications using wireless sensor network (WSN) technology embedded in an Internet of Things platform (IoT).

Key words: *Energy meter, GPRS, WIFI, sensors.*

I. INTRODUCTION

The last-meter smart grid is the portion of the smart grid closer to the home, and the one with which customers interact. It allows a two-way data flow between customers and electric utilities, transforming the "traditionally passive end-users into active players" [1] in the energy market. Considering the seven domains of the conceptual model of smart grids proposed by the national institute of standards and technology [2], [3], the last-meter smart grid corresponds to the "customer domain." It enables residential, commercial, and industrial customers—based on their different energy needs—to optimize energy consumption and local generation, and to actively participate to demand-response policies [4], one of the most disrupting aspects of smart grids. Nontechnical customers need a simple way to control energy consumption and production, and to exchange power usage data at the proper level of granularity with energy providers or distributors. From the point of view of market acceptance and penetration, the last-meter smart grid is just one aspect of the broader concept of smart home and smart buildings. The consequence of this consideration is that one can hardly imagine a situation in which the consumer side of the smart grid and other smart home applications rely on different and separate infrastructures or platforms.

II. HARDWARE SYSTEM

This system principally monitors electrical parameters of household appliances such as voltage and current and subsequently calculates the power consumed. As WSN's are having many advantages, here we have designed smart meters predicting the usage of power consumption. However it is low-cost, flexible, and robust system to continuously monitor and control based on consumer requirements, GPRS technology for networking and communication, because it has low-power characteristics, which enable it to be widely used in home and building environments.

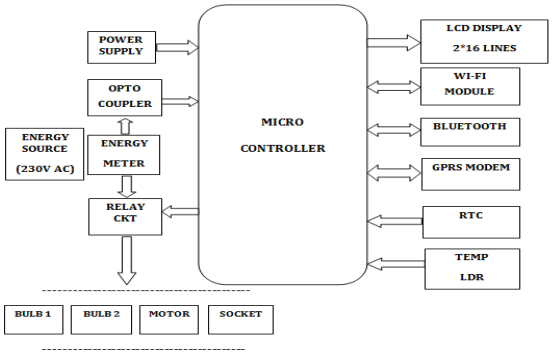

Fig 1: Block Diagram

III. BOARD HARDWARE SYSTEM FEATURES

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

Temperature sensor:

A thermistor is a type of resistor whose resistance is dependent on temperature. Thermistors are widely used as inrush current limiter, temperature sensors (NTC type typically), self-resetting over current protectors, and self-regulating heating elements. The TMP103 is a digital output temperature sensor in a four-ball wafer chip-scale package (WCSP). The TMP103 is capable of reading temperatures to a resolution of 1°C.

Fig 2: Temperature sensor

LDR:

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically. The animation opposite shows that when the torch is turned on, the resistance of the LDR falls, allowing current to pass through it. This is an example of a light sensor circuit: When the light level is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Consequently the LED does not light. However, when light shines onto the LDR its resistance falls and current flows into the base of the first transistor and then the second transistor. The LED lights on. The preset resistor can be turned up or down to increase or decrease resistance, in this way it can make the circuit more or less sensitive.

Fig 3: LDR sensor

GPRS:

GPRS (general packet radio service) is a packet-based data bearer service for wireless communication services that is delivered as a network overlay for GSM, CDMA and TDMA (ANSI-I36) networks. GPRS applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. Packet switching is where data is split into packets that are transmitted separately and then reassembled at the receiving end. GPRS supports the world's leading packet-based Internet communication protocols, Internet protocol (IP) and X.25, a protocol that is used mainly in Europe. GPRS enables any existing IP or X.25 application to operate over a GSM cellular connection. Cellular networks with GPRS capabilities are wireless extensions of the Internet and X.25 networks.

Fig 4: GPRS module

Bluetooth:

Bluetooth is a wireless technology used to transfer data between different electronic devices. The distance of data transmission is small in comparison to other modes of wireless communication. This technology eradicates the use of cords, cables, adapters and permits the electronic devices to communicate wirelessly among each other.

The key features of Bluetooth technology:

- Less complication
- Less power consumption
- Available at cheaper rates
- Robustness

Bluetooth technology was discovered to have wireless protocols to connect several electronic devices and as a solution to synchronize the data. The Bluetooth standard is maintained by the Bluetooth Special Interest Group.

At the physical layer, the Bluetooth RF transceiver is positioned. At around 79 Bluetooth channels are placed with a space of 1MHz. Transmission of data and voice are achievable at short distances and thereby creating Wireless PANs.

A Bluetooth device is comprised of an adapter. A Bluetooth adapter can be available in the form of a card to connect the device or integrated into an electronic device.

Link Management Protocol (LMP) is responsible for peer – to – peer message exchange when the electronic devices interfere in each other's radio range. This layer creates the link and negotiation of packet size. If required this layer can perform the segmentation and reassembling of the packets.

The Bluetooth device enabled by the Service delivery protocol joins the piconet and enquires with all the services available. A piconet has a star topology with one master and seven slaves. The concept of Master and Slave is used in the Bluetooth technology. Only after the master takes the initial action, the devices

can begin to talk. Bluetooth GloballD is exchanged among the electronic devices and a connection is build up after the profiles are matched. Get in-depth of Bluetooth Protocol Stack here.

Frequency hopping is used in the Bluetooth technology to avoid interfering with other signals. After the packet is transmitted or received, the Bluetooth signal hops to a new frequency. Each packet can cover five time slots.

The Bluetooth technology supports asynchronous data channel, or 3 simultaneous synchronous voice channels, or a channel which supports asynchronous data and synchronous voice.

Fig 5: Bluetooth Module

WIFI:

Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. A common misconception is that the term Wi-Fi is short for "*wireless fidelity*," however this is not the case. Wi-Fi is simply a trademarked phrase that means *IEEE 802.11x*. Wi-Fi works with no physical wired connection between sender and receiver by using radio frequency (RF) technology, a frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space.

The cornerstone of any wireless network is an access point (AP). The primary job of an access point is to broadcast a wireless signal that computers can detect and "tune" into. In order to connect to an access point and join a wireless network, computers and devices must be equipped with wireless network adapters Wi-Fi is supported by many applications and devices including video game consoles, home networks, PDAs, mobile phones, major operating systems, and other types of consumer electronics. Any products that are tested and approved as "Wi-Fi Certified" (a registered trademark) by the Wi-Fi Alliance are certified as interoperable with each other, even if they are from different manufacturers. For example, a user with a Wi-Fi Certified product can use any brand of access point with any other brand of client hardware that also is also "Wi-Fi Certified". Products that pass this certification are required to carry an identifying seal on their packaging that states "Wi-Fi Certified" and indicates the radio frequency band used (2.5GHz for 802.11b, 802.11g, or 802.11n, and 5GHz for 802.11a).

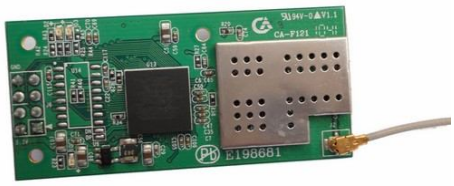

Fig 6: WIFI Module

VSD03 is the new third-generation embedded Uart-Wifi modules studied by VSD TECH. Uart-Wif is an embedded module based on the Uart serial,according with the WiFi wireless WLAN standards, It accords with IEEE802.11 protocol stack and TCP / IP protocol stack， and it enables the data conversion between the user serial and the wireless network

module. through the Uart-Wifi module, the traditional serial devices can easily access to the wireless network. VSD03 does a comprehensive hardware and software upgrades based on the products. its main features include:

Interface:

- 2*4 pins of Interface: HDR254M-2X4
- The range of baud rate: 1200~115200bps
- RTS / CTS Hardware flow control
- single 3.3V power supply

Wireless

- support IEEE802.11b / g wireless standards
- support the range of frequency: 2.412~2.484 GHz
- support two types of wireless networks:
    - Ad hoc and Infrastructure
- support multiple security authentication mechanisms:
    - WEP64/WEP128/ TKIP/CCMP(AES)
    - WEP/WPA-PSK/WPA2-PSK
- support quick networking
- support wireless roam

OPTO COUPLERS:

There are many situations where signals and data need to be transferred from one system to another within a piece of electronics equipment, or from one piece of equipment to another, without making a direct electrical connection. Often this is because the source and destination are (or may be at times) at very different voltage levels, like a microcontroller which is operating from 5V DC but being used to control a triac which is switching 230V AC. In such situations the link between the two must be an isolated one, to protect the microprocessor from over voltage damage. Relays can of course provide this kind of isolation, but even small relays tend to be fairly bulky compared with ICs and many of today's other miniature circuit components. Because they are electro-mechanical, relays are also not as reliable ó and only capable of relatively low speed operation. Where small size, higher speed and greater reliability are important, a much better alternative is to use an Optocoupler. These use a beam of light to transmit the signals or data across an electrical barrier, and achieve excellent isolation.

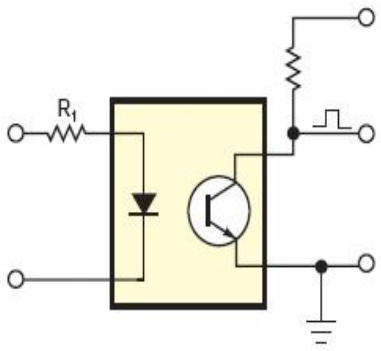

Fig 7: Optocoupler structure

ENERGY METER

An electricity meter or energy meter is a device that measures the amount of electric energy consumed by a residence, business, or an electrically powered device. Electricity meters are typically calibrated in billing units, the most common one being the kilowatt hour. Periodic readings of electric meters establishes billing cycles and energy used during a cycle. In settings when energy savings during certain periods are desired, meters may measure demand, the maximum use of power in some interval. In some areas the electric rates are higher during certain times

of day, reflecting the higher cost of power resources during peak demand time periods. Also, in some areas meters have relays to turn off nonessential equipment.

IV. RESULTS

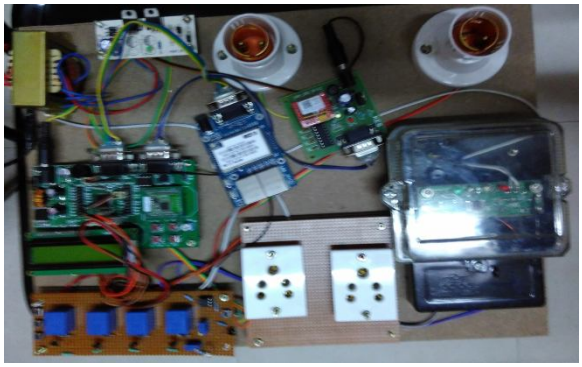

Fig 8: HARDWARE CIRCUIT

Fig 9: EEPROM INITILISATION

Fig 10: GPRS STAUS INDICATION

Fig 11: TIME CALCUATION FOR BILL GENERATION

Fig 12: BILL PAYMENT SECTION

V. CONCLUSION

We have presented architecture, an implementation, and a demonstration of the Customer Domain of the smart grid, based on a platform for the IoT that can host a broad range of smart home applications. Hence, by implementing this project it is easy for monitoring and controlling the power, towards the implementation of an intelligent building.

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BIOGRAPHIES

Indrala Vishal currently a PG scholar of VLES in ECE Department. He received B.TECH degree from JNTU. His current research interest includes Analysis & Design of VLSI and embedded System Design.

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