SMART MONITORING AND CONTROLLING SYSTEM FOR POWER MANAGEMENT USING ZIGBEE

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***Abstract*:** The customer domain of the smart grid naturally blends with smart home and smart building systems, but typical proposed approaches are “distributor-centric” rather than “customer-centric,” undermining user acceptance, and are often poorly scalable. To solve this problem, we propose a detailed architecture and an implementation of a “last-meter” smart grid—the portion of the smart grid on customer premises—embedded in an internet-of-things (IoT) platform. Our approach has four aspects of novelty and advantages with respect to the state of the art: 1) seamless integration of smart grid with smart home applications in the same infrastructure; 2) data gathering from heterogeneous sensor communication protocols; 3) secure and customized data access; and 4) univocal sensor and actuator mapping to a common abstraction layer on which additional concurrent applications can be built. A demonstrator has been built and tested with purposely-developed ZigBee smart meters and gateways, a distributed IoT server, and a flexible user interface.

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

A wireless data communication system for future micro grids (MGs) is presented in this paper. It is assumed that each MG has a central controller and each distributed generation unit in the MG has a local controller. The communication system is responsible for transmitting and receiving data amongst these controllers. This communication system is based on ZigBee technology, which is a low cost and low power consumption device. However, its main limitation is the low data transfer rate.

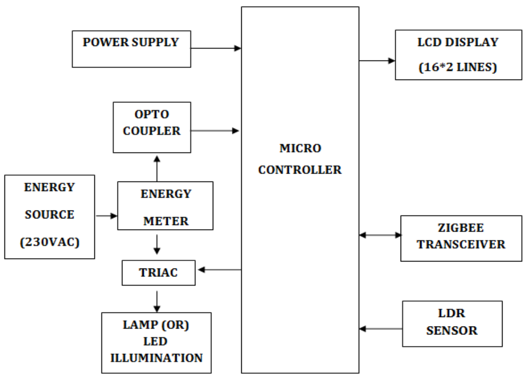

Fig 1: Node Section

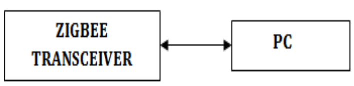

Fig 2: Receiver section

To reduce the number of data transactions, a data management scheme is presented in this paper. The required data to be transferred are defined and a suitable coding is proposed. Finally, the number of transmitted symbols and the processing time of the proposed data management scheme are numerically analyzed. In addition, the dynamic operation of an MG is evaluated considering the delays that are imposed by this communication system.

III. METHODOLOGY

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.

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.

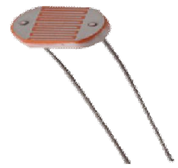

Fig 3: LDR

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.

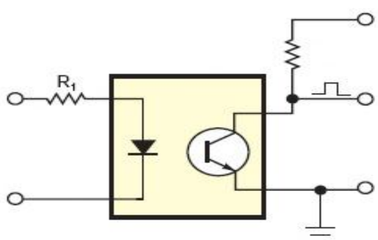

Fig 4: Optocoupler structure

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.

ZIGBEE:

Zigbee modules feature a UART interface, which allows any microcontroller or microprocessor to immediately use the services of the Zigbee protocol. All a Zigbee hardware designer has to do in this case is ensure that the host's serial port logic levels are compatible with the XBee's 2.8- to 3.4-V logic levels. The logic level conversion can be performed using either a standard RS-232 IC or logic level translators such as the 74LVTH125 when the host is directly connected to the XBee UART. The X- Bee RF Modules interface to a host device through a logic-level asynchronous Serial port. Through its serial port, the module can communicate with any logic and voltage Compatible UART; or through a level translator to any serial device.

Data is presented to the X-Bee module through its DIN pin, and it must be in the asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because the input data goes directly into the input of a UART within the X-Bee module, no bit inversions are necessary within the asynchronous serial data stream. All of the required timing and parity checking is automatically taken care of by the X-Bee's UART.

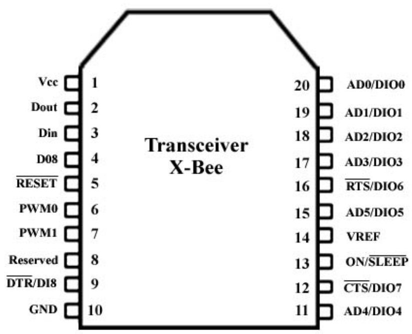

Fig 5: ZIGBEE pin diagram

IV. 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.

V. REFERENCES

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