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Smart Meter for Energy Management

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Abstract- In this paper, we aim to design a smart meter for energy management system using microcontroller to collect the statistics of power consumptions, power quality and is able to interface devices for load displacement. The device is characterized by easy access to the information and the combination of a smart meter and data communication, capability allow local and remote access. In this way it is possible to manage the power consumption of the power system to leading an overall reduction in consumption and costs. Web server allow with the collection the information and analysis the data's to present the visual presentation now and then, so better energy management scheme can be implemented.
Keywords-Energy management, AMR

I. INTRODUCTION

The paper is part of a major paper aimed to develop technologies, techniques and methods of efficient management of consumption / release of energy in various forms in both households and industrial, malls, etc. As far as industries are concerned the main investment apart from capital includes raw materials, water etc. monitoring all these aspects is necessary and it can be done by the management remotely rather than utilizing man power. .This will lead to an overall consumption and cost reduction. To obtain this goal a Smart Metering approach is proposed. Smart metering consists in the installation of an intelligent meter in residential customers or industrial areas, and a process of regular reading, analysis of the data and feedback of energy consumption data of the customer. Smart meter is an advanced energy meter that measures the energy consumption of a consumer and provides addedinformation to the utility by using a two-way communication scheme . Consumers are better informed in their consumption of their energy, so they can make betterdecisions when they are using the energy. Suppliers on the other hand won't need the old fashioned way of manually reading the energy consumed as they would get this information automatically. The system that utilizes one-way communications to collect the data is referred to as automated meter reading (AMR) system. While the system that utilizes two-way communications with the ability to control and monitor the meters is referred to as advanced metering infrastructure(AMI) system. The combination of automatic reading and two-way communication are the reason why the meter is called smart and they are also the difference between the traditional energy meter and the smart meter. The idea ofAMR technology is to do the meter reading automatically and accurate. The benefit of AMR is reducing the meter cost to the supplier and billing the customers with actual meter readings.In addition, AMR will increase the accuracy of the readings and it can allow frequent reading . Smart meters are able to send the readings over communication lines and recognize their addresses and to Activate/deactivate internal modules. To have that capability,AMR requires a specific infrastructure which would make it bidirectional. Such an infrastructure is called AMI. The communication medium in an AMI system must ensure the communication between the smart meters and the centralcomputer at the service provider. The AMI network has the ability to register meter points, communicate into the customerpremises, service connecting and disconnecting and othercapabilities.

II. PROPOSED SYSTEM

The power meter is able to measure the electric power Consumed by each appliance during time periods. Furthermore, It is possible also send data via Ethernet to Web Server.The user is able to see the daily consumption by means ofdisplay installed at home. In this way it is possible to manage the power consumption for energy (dispatchment) optimization purposes, both in terms of costs for the customer and energy saving. In this paper the customer can monitor the energy that is being consumed with the help of an ARM processor

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A. Hardware profile

PIC microcontroller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality and ease of availability. It is ideal for machine control applications, measurement devices, study purpose and so on.in both the automated meter reading systems **PIC 16F72** microcontroller is used. Since the input is an analogue signal an ADC is used to convert the analogue signal to a digital signal.When configuring and using the ADC the following functions must be considered. Port configuration, Channel selection, ADC voltage reference selection, ADC

conversion clock source Interrupt control. There are two memory blocks in the PIC16F72 device. These are the program memory and the data memory. Each block has separate buses so that concurrent access can occur. PIC16F72 devices have a 13-bit program counter capable of addressing a 8K x 14 program memory space. The address range for this program memory is 0000h - 07FFh. Accessing a location above the physically implemented address will cause a wraparound. The RESET Vector is at 0000h and the Interrupt Vector is at 0004h.A Universal asynchronous receiver/transmitter, abbreviated UART is a piece of computer hardware that translates data between parallel and serial forms. UARTs are commonly used in conjunction with communication standards. The universal designation indicates that the data format and transmission speeds are configurable. The electric signalling levels and methods (such as differential signalling etc.) are handled by a driver circuit external to the UART. The Universal Asynchronous Receiver/Transmitter (UART) takes bytes of data and transmits the individual bits in a sequential fashion. At the destination, a second UART re-assembles the bits into complete bytes. Each UART contains a shift register, which is the fundamental method of conversion between serial and parallel forms. Serial transmission of digital information (bits) through a single wire or other medium is less costly than parallel transmission through multiple wires

B. Hardware architecture

Fig.1 shows the hardware architecture of the smart metering system. Automated meter reading(AMR) is the module with sensors placed in them. It is used to measure the various parameters like air quality, temperature, gas, oil level etc.

All the data's that are measured in AMR are wirelessly transmitted to the integrated meter reading (IMR).the customer can view the reading in the IMR and take the necessary steps to control the energy.in industrial scenario's the management can monitor the different parametersand take the necessary actions.

The AMR1 as showed in fig.2 represents the AMR unit for measuring power consumed in an industry

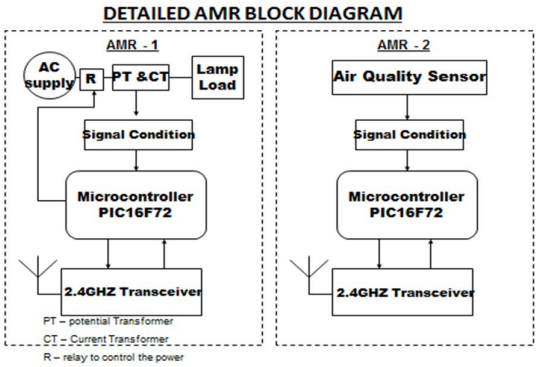

Fig.1 automated Meter Reading

The AMR1 consists of a potential transformer, a current transformer, a signal conditioning circuit, a PIC16752 microcontroller and a 2.4ghz RFM transceiver. From the ac supply the current is passed through the potential transformer, the current transformer then to the load . The measured parameters(current and Voltage) are then passed through a signal conditioning circuit and is wirelessly transmitted to the ARM processor. A relay switch is used to cutoff the AC supply to the load if the amount of power exceeds the threshold power. Fig.3 shows the experimental setup of

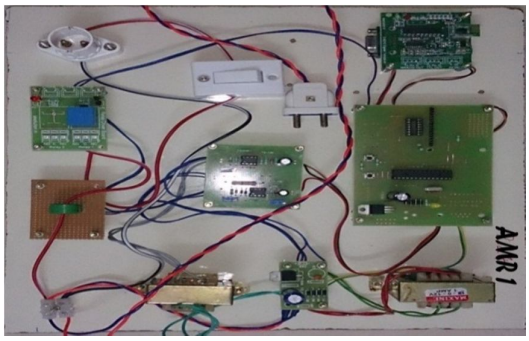

Fig.2 Experimental setup of Transmitter

Similarly, the AMR 2 as shown in figure 2 represents the set up to measure the air quality of an environment. The AMR 2

consists of a temperature sensor. The LM35 series are precision integrated-circuit temperature sensors, whose Figure voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its Figure to obtain convenient Centigrade scaling. Fig.4 shows the experimental setup of AMR 2 which is used to measure the temperature and humidity.

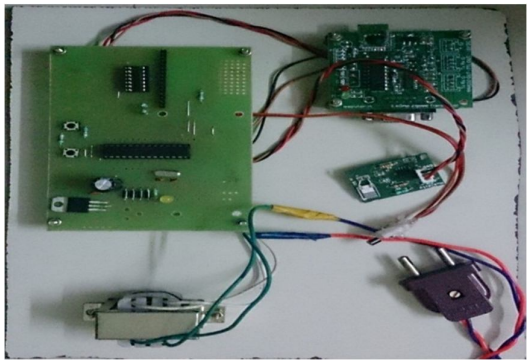

Fig.3.Experimental setup of receiver

After receiving the data from both the AMR's the data is sent to the IMR unit which receives the data via a transceiver. The IMR unit is connected to the system using a RS232 connector.an application is developed using .net which monitors the parameters and plots the graph to represent the variations. Fig.5 shows the experimental setup of the IMR unit.

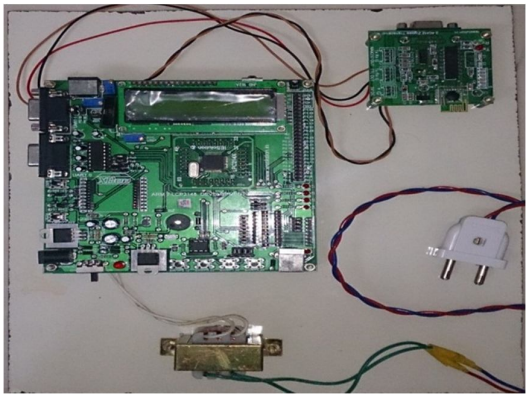

Fig.4 Integrated Meter Reading(IMR)

III. DISPLAY UNIT

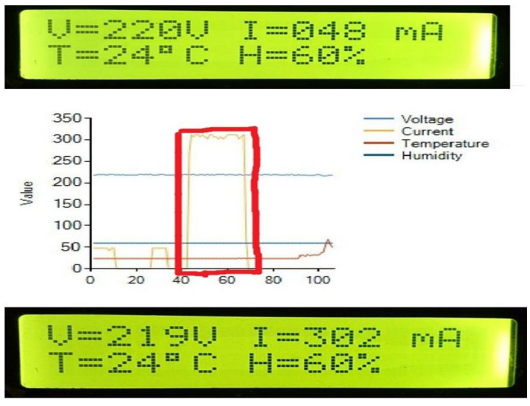

Fig.5. Variation of current.

As shown in Figure 1 the graph represents the variation of current from 0.48mA to 302mA.the variation is seen in the LED

display as well as the graph. The yellow line in the graph represents the current variation. The variation of humidity is ALSO MEASURED IN THE SAME WAY

IV. CONCLUSION

Energy Management System using Smart Meter and ARM was developed. Not only measurements regarding the amount of electricity used, but also allow the customer to manage temperature, humidity of a particular environment. In this way the combination of such a smart meter with an appropriate communication infrastructure could provide remote access and facilitate planning.

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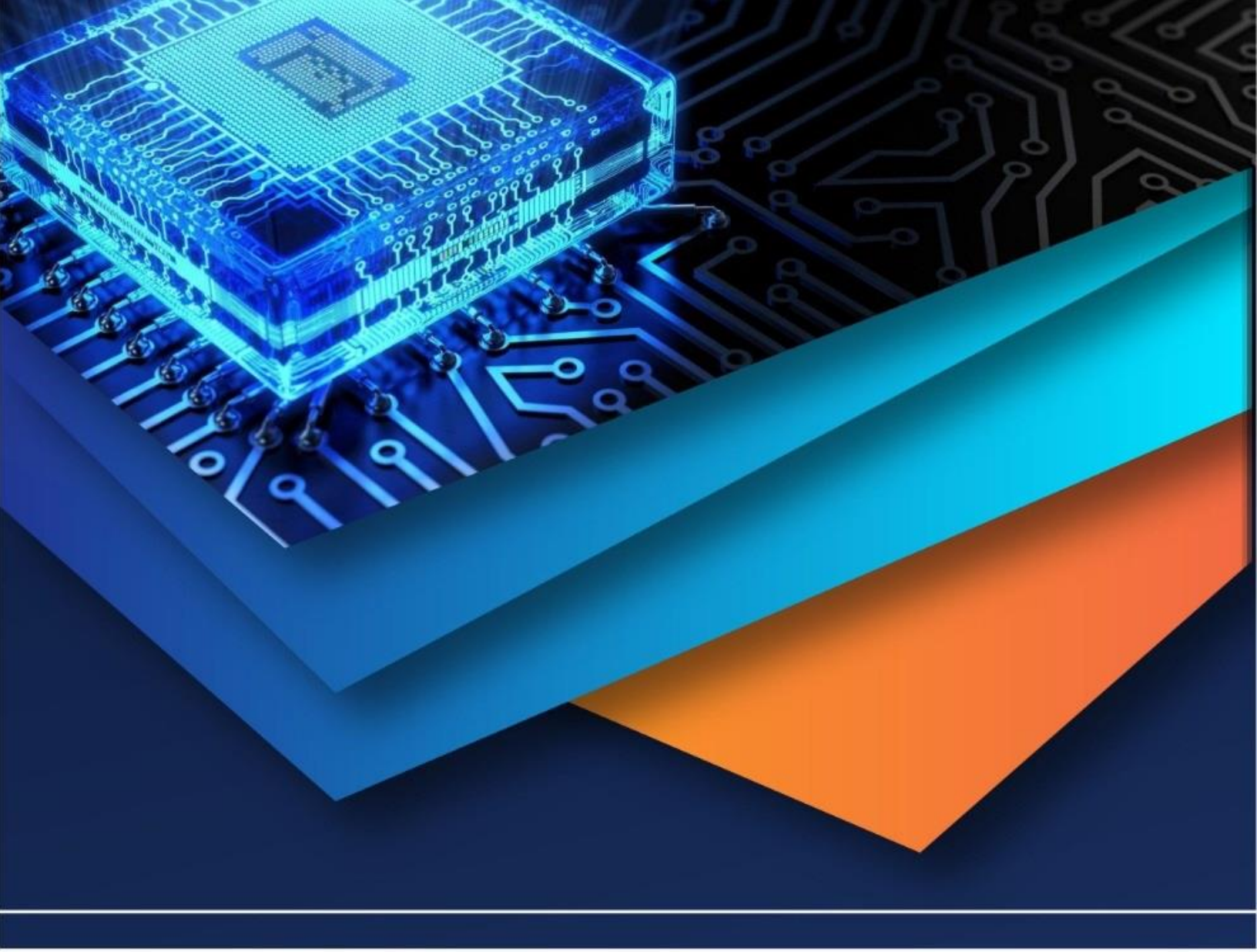

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