



# **Wireless ARM-Based Automatic Meter Reading & Control System (WAMRCS)**

V. Vignesh Prashanth<sup>1</sup>, A.Santhosh<sup>2</sup>, B.Deepak<sup>3</sup>, V.R.Kishore<sup>4</sup>, C.T.Manikandan<sup>5</sup>

UG Student [4th year], Dept. of EEE, Panimalar Institute of Technology, Tamilnadu, India<sup>1</sup>

UG Student [4th year], Dept. of EEE, Panimalar Institute of Technology, Tamilnadu, India<sup>2</sup>

UG Student [4th year], Dept. of EEE, Panimalar Institute of Technology, Tamilnadu, India<sup>3</sup>

UG Student [4th year], Dept. of EEE, Panimalar Institute of Technology, Tamilnadu, India<sup>4</sup>

Assistant Professor, Panimalar Institute of Technology, Tamilnadu, India<sup>5</sup>

**ABSTRACT:** In this paper we discuss about Wireless ARM Based Automatic Meter Reading with control system (WAMRCS). This System is used with 32 bit ARM microprocessor for reading power consumption & communicates this data to the utility server for power data processing. GPRS networks are used for communication with utility server in two – way communication link. Power data is used for various purposes such as bill management, for measurement of static power parameters etc. Control systems contains relay circuit, used for disconnection power supply when consumer fails to pay electricity bill in due time.

**KEYWORDS:** Meter Reading, ARM based system, GPRS, Relay control.

## **I.INTRODUCTION**

Problem associates with traditional meter reading have been increased day by day, due to various reasons such as rapid growth in population, tedious location, environmental conditions etc. But with new developments of microcontroller, there are many improvements in automating various industrial aspects for reducing manual efforts. In traditional meter reading system in which utility usages are written on paper by workers, there is lot of chances of human errors. These will cost more to the utility company. Also there are chances that of unavailability of consumers during utility worker's visit for meter reading. In such cases, billing process will be pending & utility workers again require to visit to consumer. Going to each & every consumer's house & generating the bills is very labouries task & require lot of time. It becomes very much difficult in natural calamities specially in rainy season. Moreover it is also difficult for utility workers to find out unauthorized connections or malpractices carried out by consumers manually. This all will result in loss of revenue generation for utility company.

There are another type of customers also, for which not only continues electricity is matter but also about quality of power is also matter. In practical meter reading system, traditional meters does not provide more information about the same. There should be provision for power supply unstable / outage occurs to utility consumer's information to utility company for clearing the fault as quick as possible.

Also the development in the field of wireless technology along with microcontroller leads to unwrap the solution to many problems. The wireless media made the exchange of information fast, secured & more accurate. These wireless media, along with microcontroller or microprocessor leads to digital implementation which causes rapid utilization of devices such as computers & telecommunication devices. Communication media like GPRS, Internet are easily available everywhere. GPRS is widely used due to it's advantages such as always on-line, high speed transmission & charged fee according to the amount of data transmitted. After considering all this GPRS advantages, It is also can be used for sending power parameters on automatic system of reading digital meter.

Considering all above pro & cons of traditional & automatic metering system ,this study proposes a wireless ARM-based automatic meter reading & control system (WAMRCS).It uses Current & Power Transformer to read current &



# International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

Voltage parameters of incoming electrical signal. After this, signal conditioning unit along with ARM-based embedded system (AES) is used to compute the power parameters. These computed power parameters are then sent to Utility company server through wireless communication method such as GPRS. Also data or signal from utility company server is received through wireless communication module to ARM based embedded system. (AES).The code is written using standard C programming used for programming the ARM. The energy meter used provides output pulse indicating the energy burnt. It provides 1600 pulses when it consumes a unit of energy. The pulses are given as input to the ARM based system which counts the pulses and increments the internal counter, which is intended to count the unit, after counting 1600 pulses.

## II. WAMRCS SYSTEM ARCHITECTURE

WAMRCS System Architecture is as shown in fig 1. As shown in figure, WAMRCS is sub –divided in to five sub-parts :

- A. Signal Sampling Unit (SSU)
- B. Relay Control Unit (RCU)
- C. ARM – Based Embedded System (AES)
- D. Wireless Communication Module (WCM)
- E. Utility Control Center (UCC)

### A. Signal Sampling Unit (SSU) :

The main problem of measuring analog quantities such as voltage & current is solved by using Power transformer (PT) & Current Transformer (CT). The analog quantity of voltage as well as current on the primary side of transformer is proportionally transformed on the secondary via power Transformer (PT) & Current Transformer (CT).Burden resistor is used along with CT for setting the desired voltage at the CT's Secondary Side. Along with Power Transformer (PT),Voltage divider is used to drop the voltage to limits of ARM operating voltage range. Finally filter is used to avoid any emf in DC signal, before passing this to ADC of ARM Controller.

### B. Relay Control Unit (RCU) :

This Unit consists of Proactive relay, breaker control circuit & breaker. It is an interrupting device used for fault interruption & load switching. Relay Control Unit is used to shutting off the electric power supply when the signal from AES because due date is over. Electricity will resume automatically with the help of protective relay wired in series with breaker control circuit, so the breaker could be controlled. Depending upon the information received from remote stations, ARM processor can control the relay module to shut off or resume the electric power supply. This relay is driven by ARM processor.

# International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

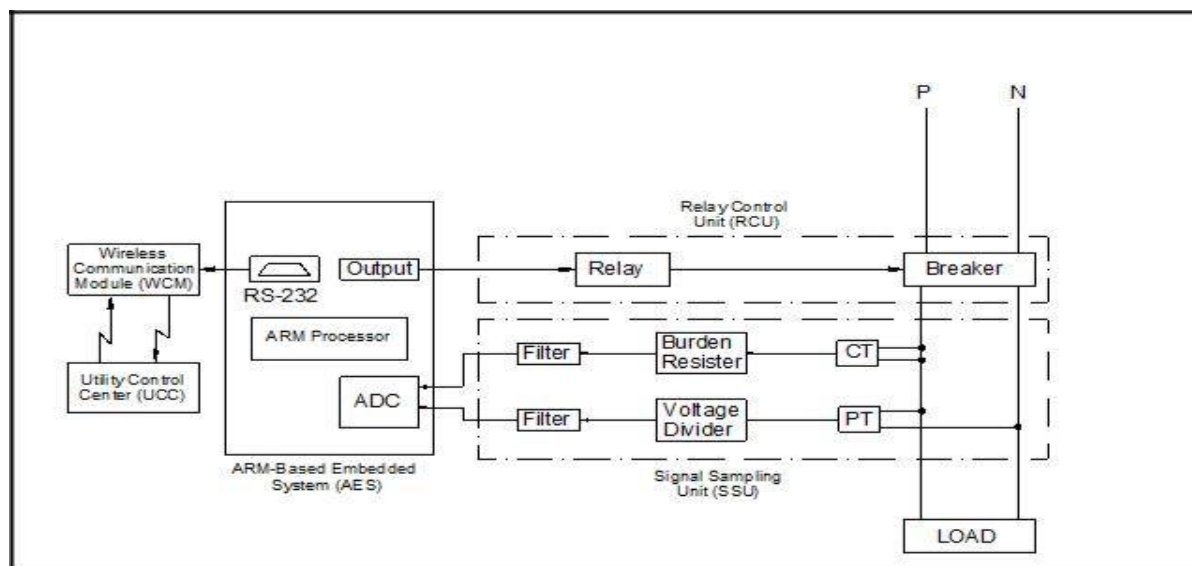


Figure1. WAMRCS System Architecture

## C. ARM – Based Embedded System (AES):

This is heart of the system. Conventional power measure instruments is not able to give required information about power quality. So in order to calculated Root Mean Square value of voltage and current, power factor, real power, reactive power and apparent power, it us appropriate to use microprocessor to design digital reading meter. There are various microprocessor based digital power meters are available in laboratory & in market. These are basically bulky in size & having limited capabilities. Compare with this, ARM-based system occupies small space. It also supports most popular communication protocols. As far as ARM based system is concern, it is widely used in variety of network equipments, such as mobile phone and PDA, and become popular and cheaper. It's also having on chip 10 bit ADC of successive approximation type. In this each analog input has a separate register to avoid interrupt handling & it is having global start command for both converter.

## D. Wireless Communication Module (WCM):

The Wireless Communication Module ( WCM) in WAMRCS is the system is mainly composed of different subsystem such as - central monitoring station and GSM network. Central monitoring station is consist of GSM modem. The wireless remote communication between ARM Based Embedded System (AES) station and Utility Control Center (UCC) is done by the GSM network.

A GSM module assembles a GSM modem with standard communication interfaces like RS-232 (Serial Port), USB etc., so that it can be easily interfaced with a computer or a microcontroller based system. The power supply circuit is also built in such module that can be activated by using a suitable adapter.

The GSM Module used in project uses GSM network which offers GPRS data communications along with GSM services & mobile internet access. It also be integrated via standard RS-232 interfaces [16].

GSM Module in Wireless Communication Module (WCM) offers following features :

- Uses the extremely popular SIM 300 GSM module.
- Provides the industry standard serial RS232 interface.



# International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

- Provides serial TTL interface for easy and direct interface to microcontroller.
- Provides the industry standard serial RS232 interface.
- Provision for 3V lithium battery holder
- Can be used for GSM voice communications, data/Fax, SMS, GPRS and TCP/IP stack can be controlled through standard AT Commands.

## E. Utility Control Center (UCC):

Utility Control center (UCC) is the central server used for information processing & data exchange between various AES systems through wireless communication module (WCM). UCC is located in Utility company. It is having Personal Computer (PC) used as a control server along with required programs & storage media (generally Hard drive). UCC will read & collect power parameters form AES via communication network. UCC server have following specification:-

- 2.4 GHz Intel Pentium III processor
- 512 Megabytes RAM
- 80 Gigabyte Hard Disk
- 15" LCD Monitor
- DVD-Rom Drive
- 100 Mbps. Network Connections
- Dot-matrix printer

For Simulation purpose, we uses a Visual Basic (VB) Graphical user Interface (GUI). VISUAL BASIC 6 is a high level programming language which evolved from the earlier DOS version called BASIC. Among many versions of Visual Basic that exist in the market, the most popular one and still widely used by many VB programmers is Visual Basic 6. With Visual Basic 6, you can create any program such as inventory management system , password cracker, investment calculator, slot machine, reverse, star war, tic tac toe and more.

In this Program, we created a Virtual server in VB showing all details of customer such as -

- Name of Customer
- Address of Customer
- Account Number
- Consumption Unit
- Last Date for Payment
- Billing status.

## III. IMPLEMENTATION AND RESULT

The Proposed system is tested in place of conventional meter & achieved good results. Fig 3 to Fig 6 shows actual photographs of the proposed system. Here we consider if 100 watt load is ON for 10sec then 1 Unit is calculated for demo purpose. Same unit calculation is done for 40W load as , if 40W load is ON for 30 sec then 1 unit is calculated.

ARM-Based Embedded System (AES) is interfaced with GSM Module, Signal Conditioning unit & Relay Control Unit. For demonstration purpose, 100 Watt bulb is used as a load to examine our system. The bulb is connected

# International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

to load & Signal conditioning unit, which is used to measure the average real power information. This test is performed and power consumption is calculated. During the test, voltage & currents parameters are read for specified time interval to generate the bill. Based on this reading , Power is also calculated & display on LCD in ARM - Based Embedded system (AES) . After due date, the ARM- Based Embedded System turned the off the bulb through relay control unit, which proves the accuracy of our system in terms of the power Calculation & remote controlling.

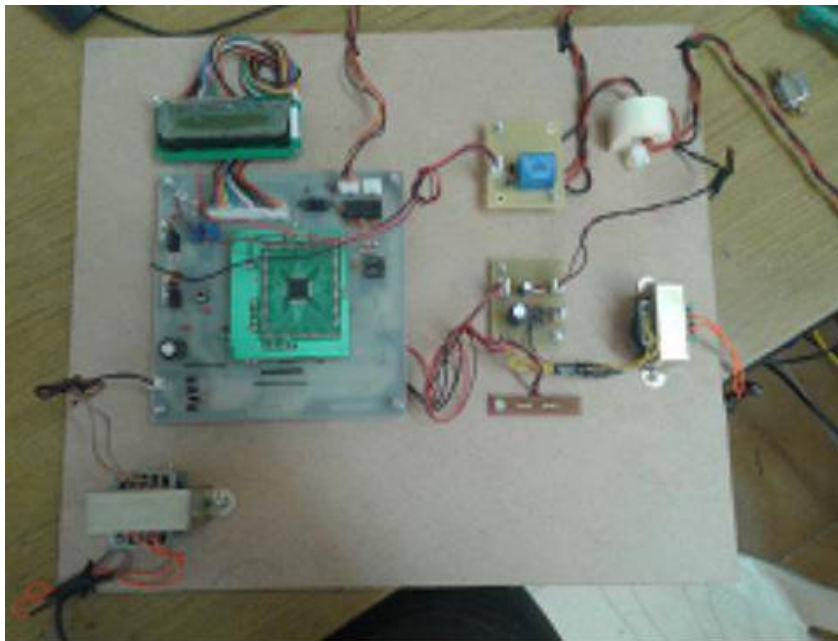


Figure2. Wireless ARM bases meter reading and control system and setup.

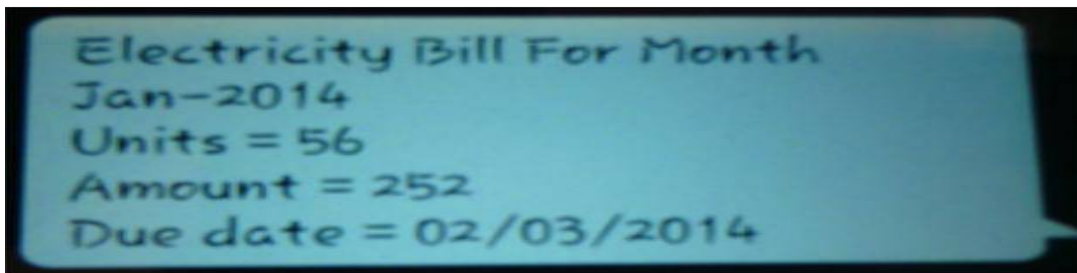


Figure3. SMS generated by WAMRCS system showing billing details

**Table1:** Unit Consumption for various Load.

Load	No.of Hours	Unit Consumed
		Proposed System
40 Watt	0.28	56
100Watt	0.28	168



ISSN (Print) : 2320 – 3765  
ISSN (Online): 2278 – 8875

# International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 5, Issue 3, March 2016**

For demo purpose we assume that for 100W load for 10 sec, 1 unit is consumed. From Table 1, we can say that, if the load is disconnected immediately after the due date then there will not be any loss of energy consumption. But it is not possible through manual operating. So by using proposed system, most of the problem associated with the conventional systems are eliminated.

## IV. CONCLUSION

By using this embedded system along with GSM module, provide automation for electrical distribution system. Along with this, it provides better accuracy in meter reading, better control over distribution & management. Same system can be expanded for multipurpose like water & natural gas. Also many users can share same system.

## REFERENCES

- [1] Patrick, A., Newbury, J., and Gargan, S., "Two-way communications systems in the electricity supply industry," IEEE Trans. Power Delivery, Vol.13, pp. 53 - 58, Jan. 1998.
- [2] Miura, N., Sato, H., Narita, H., and Takaki, M., "Automatic meter-reading system by power line carrier communications," in Proc. C 1990 IEEE Trans Generation, Transmission and Distribution, Vol. 137 Issue: 1, pp. 25 - 31.
- [3] Donovan, D., "Cellular control channel communications for distribution automation applications," in Proc. 2001 IEEE/PES Transmission and Distribution Conference and Exposition, Vol.2, pp. 982 -984.
- [4] Anderson, H.R., "Measured data transmission performance for AM broadcast-VHF radio distribution  
200 IEE 3G Mobile Communication Technologies Conference, pp. 426-430
- [5] Chakrabarti, S. and Mishra, A., "A network architecture for global wireless position location services," in Proc. 1999 IEEE Communications Conference, Vol.3, pp. 1779-1783.
- [6] Constantinos F. Grecas, Sotirios I. Maniatis, and Iakovos S. Venieris, "GIP: an infrastructure for mobile intranets deployment, Wireless Networks," Kluwer Academic Publishers, Vol.9, Issue 4, 2003, pp. 321-330.
- [7] Chih-hsien Kung and Devaney, M.J., "Multirate digital power metering," Instrumentation and Measurement Technology Conference, 1995, pp. 179-182.