

Three Phase Parameter Data Logging and Fault Detection Using GSM Technology

Ms.Devjani Banerjee*, Prof Dr.Mrs.N.R.Kulkarni**

Electrical Engineering Department, Modern College Of Engineering, Pune-5

Abstract- As we know that electricity losses during transmission and distribution are extremely high due to which many problems are faced such as varying voltage levels, change in the load current etc. This has been experienced due to the varying electrical consumption and power theft. Also these give rise to fault in power transmission line network and so it is necessary to implement fault detection system in transmission line network. The fault detection system is implemented for three phase electrical distribution system. A practical prototype system can be implemented for fault detection in power system and also the system is successfully designed using 8-bit Microcontrollers which allows the detection of faults. Continuous monitoring of the three phase parameters such as voltage, current and energy consumed is done using data logging system on the PC screen through hyper terminal. There is a Master Slave communication using RS 485 protocol. Communication between Master and Microcontroller is done via RS 232. Comparison of energy units between Master and Slave is done. If difference between the Master and Slave energy units is found, wireless technology GSM (global system for mobile communication) is used to send SMS to a responsible person. Introduction of the mobile communication technology GSM and Microcontroller-based RTU (remote terminal unit) i.e. Master-Slave communication is provided in the paper. This RTU functions as fault detection when abnormality or emergency happens. Also wireless mobile communication technology i.e. GSM is used simultaneously to send message to a responsible person.

Index Terms- GSM technology, fault detection, data logging, electric transmission and distribution system.

I. INTRODUCTION

The paper presents design and implementation of a distributed monitoring and centralized control system. If the unmetered electricity is used i.e. if the meter is by-passed or by any means the electricity is used and reading is not considered, in this case the power consumed is monitored at the main distribution station; also the individual power consumed is calculated with a separate microcontroller. The slave station is compared with the main distribution energy units. The difference occurring is considered the unauthorized use of electricity. This will help in finding the electricity theft in the system. This will also help to minimize the shortage of the electricity. The master slave communication with the modbus protocol is implemented. Also using wireless technology GSM, sms is send to a responsible person on mobile. GSM module has made an attractive option for wireless communication applications. The GSM network

provides reliable communication quality with nationwide coverage. Short message service (SMS) has now become the most widely used service based upon GSM standard. At the same time the decreasing cost of GSM devices such as mobile phones and the GSM sms provides a unique address (SIM card number) to the remote control unit and commands can be transmitted in the wireless communication network. In power transmission systems, the majority of voltage and current signal distortions are caused by faults. Faults that occur in power transmission lines can cause an interruption of power supply. A framework is developed in this project to detect the presence of fault in the transmission line. To ensure safe operation of the power distribution system and reduce the loss caused by accidents a remote monitoring and controlling system is demanded. The three phase parameters data such as voltage and current are continuously logged using data logger. The implemented system completely meets the demand of low cost by using the microcontroller based RTU(remote terminal unit) and mobile communication technology with the aim to detect the abnormalities and fault occurred in the distribution line.

II. HARDWARE DESIGN

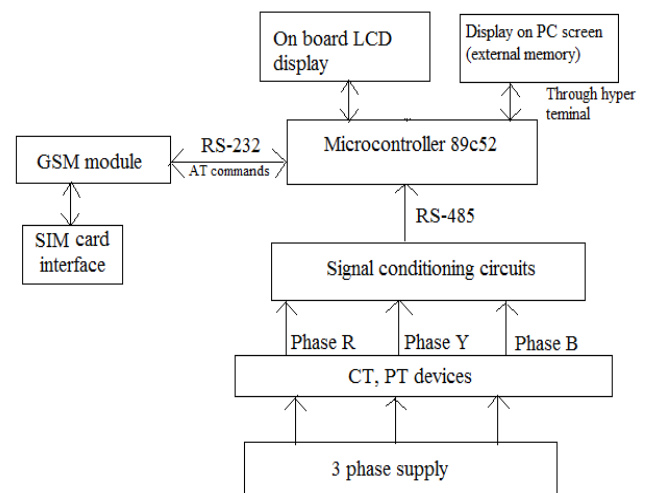


Figure. 1 Functional block diagram of the circuit

A. WORKING PRINCIPLE OF THE BLOCK DIAGRAM

Initially at power ON, the microcontroller 89c52 will get initialized (refer fig.1). The LCD initialization will take place. The welcome message may occur on LCD. The same data will be sent to PC through serial communication. The parameters data will be with reference to date & time. After every three second

the data will be logged. The main system will be installed from where the total distribution is done.

Also, separate microcontrollers are used for every individual station. This microcontroller will separately monitor available at the individual area. The power consumption units will be available on the local display. These units will be sent to the master microcontroller with modbus communication.

B. MASTER STATION BLOCK DIAGRAM

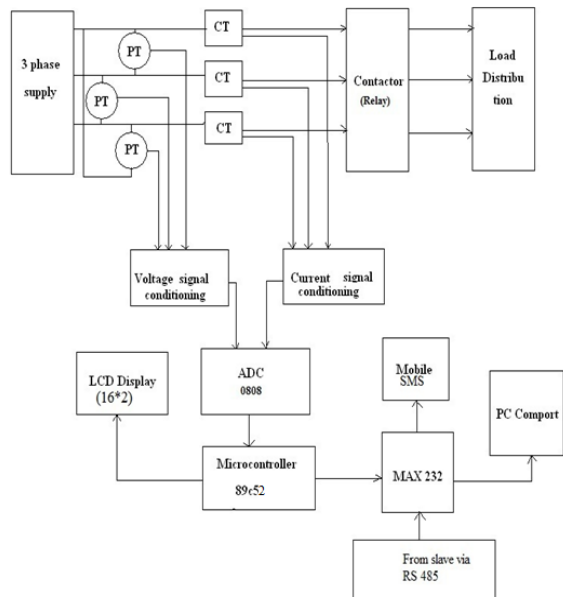


Figure 2. Functional block diagram of master station

C. MASTER – SLAVE COMMUNICATION

The mod-bus protocol RS 485 is used for master & slave communication. The master slave communication is for detection of unauthorized use of electricity or even the loss of electricity due to the poor power factor. The power utilized by each individual consumer will be sensed & calculated separately. It will be sent to the master controller. The addition of all the power units utilized by all individual consumers should match the total units delivered by MSEB station. If the difference occurs then the possibility of un-authorized usage of electricity is there or losses due to poor power factor are there. Thus, we can find theft of electricity. This clear information will be available on PC.

D. SLAVE STATION BLOCK DIAGRAM

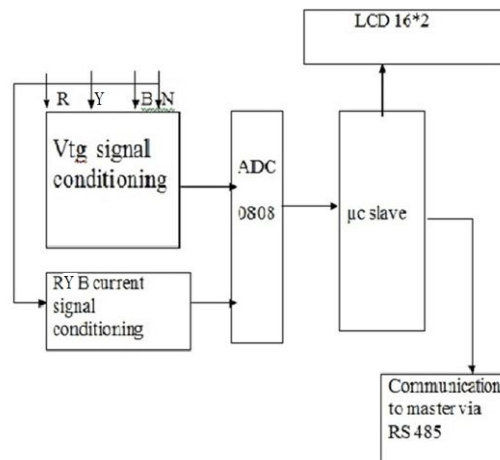


Figure 3 Functional block diagram of slave station

At the slave end, energy units consumed is continuously displayed on the LCD display. The slave sends its information to the master via modbus RS 485. The master compares its data with the slave and acts accordingly i.e. if there is objectionable difference in the energy units between the master and the slave, a message will be sent to a responsible person via wireless communication mode GSM.

III. IMPLEMENTED SOFTWARE TOOL

A. MASTER STATION FLOWCHART

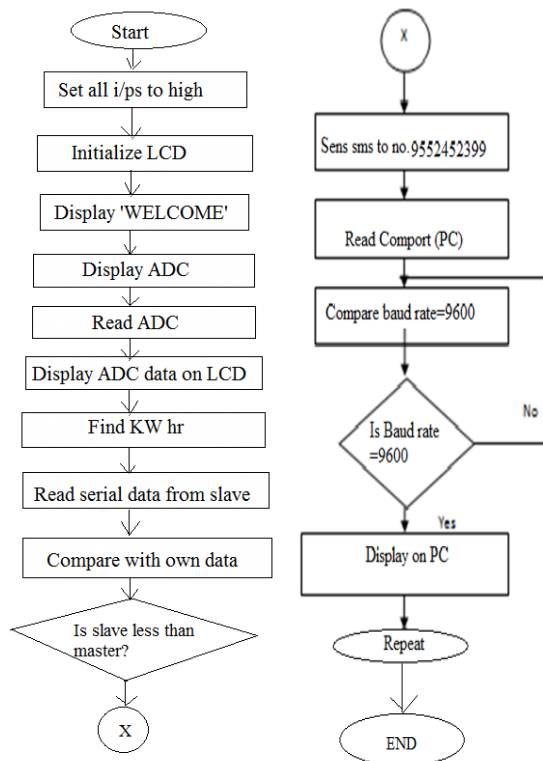


Figure 4. Master station flowchart

- a) MASTER ALGORITHM
- 1) ADC displayed on LCD
 - 2) Receive of serial data via serial port RS485
 - 3) Comparison between master & slave reading.
 - 4) If drastic difference between master & slave occur, transfer SMS data serial buffer i.e. SBUF
 - 5) Send SMS to specific no. 9552452399
 - 6) Sharing of serial port
 - 7) Calculation of energy units,1kwhr
 - 8) Indicate data on PC

B. SLAVE STATION FLOWCHART

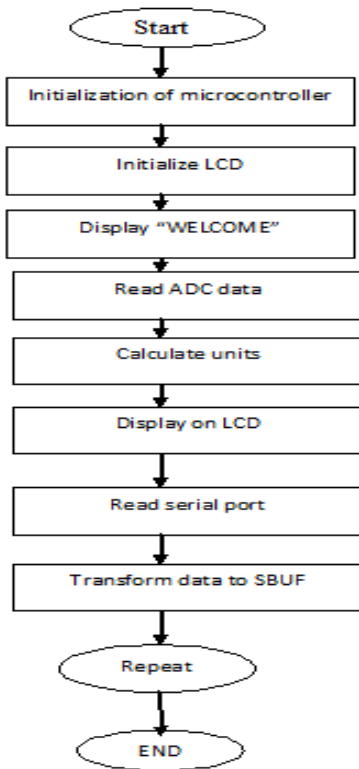


Figure 5. Slave station flowchart

- a) SLAVE ALGORITHM
- 1) At power ON, initialization of microcontroller sets all ports of microcontroller high.
 - 2) Read ADC, initialize LCD
 - 3) Display on LCD
 - 4) Initialize serial port
 - 5) Transfer serial data to serial port
 - 6) Repeat
 - 7) End

IV. PERFORMANCE EVALUATION

In the result analysis part, the major parameters such as voltage and current are continuously monitored at the control end (master) and distribution end (slave). Comparison between the

energy consumed by each phase is done at both ends by the master located at the control end. If any difference in any of the phases occur i.e if any of the slave phases display energy units less than that of the corresponding master phase , it is displayed on the master end, as well as data is logged on PC screen continuously and also a wireless technology i.e. GSM is used to send a message to responsible person at the time of the fault using AT commands.

Readings taken at various cases are shown below:-

CASE –I

Phase	Master energy units (mWhr)	Slave energy units (mWhr)	SMS status on SIM
Phase R	20	18	YES
Phase Y	21	21	
Phase B	22	22	

Table 1

In the above table 1, at Phase R there is difference in the energy units at the slave end i.e. slave reading is less than master. It indicates that there is some power theft or illegal use of electricity at that phase. Hence SMS status becomes active and is send to a responsible person via GSM.

CASE-II

Phase	Master energy units (mWhr)	Slave energy units (mWhr)	SMS status on SIM
Phase R	22	22	YES
Phase Y	23	22	
Phase B	24	24	

Table 2

In the table 2, at Phase Y there is difference in the energy units at the slave end i.e salve reading is one unit less than master. It indicates that there is some power theft or illegal use of electricity at that phase. Hence SMS status becomes active and is send to a responsible no.

CASE – III

Phase	Master energy units (mWhr)	Slave energy units (mWhr)	SMS status on SIM
Phase R	19	19	YES
Phase Y	22	22	
Phase B	20	18	

Table 3

In table 3, at Phase B there is difference in the energy units at the slave end i.e slave reading shows that it has 2 units less than master. It indicates that there is some power theft or illegal use of electricity at that phase. Hence SMS status becomes active and is send to a responsible no.

CASE- IV

Phase	Master energy units (mWhr)	Slave energy units (mWhr)	SMS status on SIM
Phase R	22	20	YES
Phase Y	21	17	
Phase B	20	18	

Table 4

In table 4, at all the three phases there is difference in the energy units at the slave end. It indicates that there is some power theft or illegal use of electricity at that phase. Hence SMS status of all the phases become active and is send to a responsible no.

Many such combinations of phases may occur where fault will exist due to difference in the energy units at slave end.

Hence, detection of these types of faults is essential to take further corrective actions. If these faults are not detected, then never action against these types of energy losses can be taken. It can be seen that the slave end is not all the time receiving the same amount of energy units sent by the master. So, where do the remaining units go? Is it bypassed by illegal ways? If so, why should it be tolerated? Each and every man pays the electricity bill, tax against the electricity that is used. So everybody should get equal share. Hence, keeping all these factors in mind, this is a challenging project. If this project becomes successful in implementation at least in any one part of the country, it will be a great achievement.

A. Sample SMS sent on mobile via GSM



Figure 6. Sample SMS sent via GSM

B. ADVANTAGES OF THE SYSTEM

- 1) The system helps in identification of the electricity theft.
- 2) The continuous parameter monitoring provides information about the energy loss and hence maximizes the profit of the system.
- 3) Micro-controller based development provides major sophistications & flexibilities.
- 4) Minimizes human interface.
- 5) The system used is cost effective.

V. CONCLUSION

The implemented system design mainly concentrates on the distribution system. It provides the way to detect the faults such as wastage of energy and power theft. The system continuously monitors various parameters of the system. It also helps to detect the fault at the appropriate time and hence avoids illegal use of electricity. Automatic monitoring, analysing and recording is done on the PC screen through hyper terminal. The paper has continuous monitoring system integrating the GSM communication technology and the microcontroller technology. The paper introduces working principle of the GSM remote

monitoring system. It also represents the hardware architecture and the software flow. The software module incorporates different algorithms needed for different pathways of the electricity distribution system. The implementation of the system will save large amount of electricity and thereby electricity will be available for more number of consumers in a highly populated country such as India

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AUTHORS

First Author – Ms. Devjani Banerjee, M.E (Electrical)- Control System, e-mail:- devjani.banerjee@gmail.com
Second Author – Prof Dr. Mrs . N. R. Kulkarni, PhD.(Electrical) Control System, HOD- P.E.S Modern College Of Engineering,Pune-05, e-mail:- nrkmcoc@gmail.com