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A SYSTEM TO DETECT VOLTAGE AND CURRENT FLUCTUATIONS IN AC MAINS SUPPLY

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ABSTRACT

Power producers and consumers, power utilities, transmission and distribution can be considered as the main parties connected to power systems where power quality can be seen as a complex issue. Inadequate power quality has an adverse effect on the dependability of loads in the power supply system and can cause serious financial and environmental consequences. The design is focused on the importance of monitoring the fluctuations of the voltage and current of utility supply and alerting the electrical power distributor and collecting data for analysis for subsequent improvements. It gives an optimal solution for the requirements of the electrical power distributor. It is also a compact and portable device giving accurate data. In addition to these features the measured data can be sent to the electricity provider or distributor via Global System for Mobile Communications (GSM) network. Then they can gather data with the help of a short message service (SMS) Gateway and send them to a database. Knowledge on Microprocessor Based System is used for all the data manipulations and displaying purposes. Voltage and current measuring is done using PIC micro controller based circuits with relevant sensors. Mobile communication strategies were used for data transmission. Additionally, this system can be developed by adding extra features such as secure digital (SD) card to store data itself, real time clock, and Remote controller unit to change the functionality of the system.

Keywords: *Voltage fluctuation, Data acquisition system, Power quality*

1.0 INTRODUCTION

Electronic equipment found at present demand a high level of power quality for their proper functionality. In order to achieve high levels of product throughput and product quality in the manufacturing sector this key element of quality power supply is essential. Hence interest on Power Quality has increased significantly among individuals and organizations. The degradation of Power Quality affects industrial, commercial as well as

residential consumers which in turn has an impact on the economy of the country as well as the quality of life. Thus the increasing expectations of electricity end-users have placed an increasing demand on electricity suppliers and distributors to improve the level of Power Quality to the expected standards. The improvement of Power Quality depends very much on the identification of the nature of disturbances, their duration, the frequency of occurrence and ultimately the impact on the end-user equipment. The role of power quality monitors for effective troubleshooting is therefore undeniable.

Most of the industries depend on local power suppliers where fluctuation of supply would cause severe damage not only to the machinery but also to the employees. Fluctuating voltages bring errors in an electronic controller which can frequently break machines or sometimes working with errors in some environments can lead to process failures. That is a direct impact and damage for operation resulting in major financial loses which would affect the whole country's economy at large scale.

Telecommunication service providers, Steel mills and Textile industry are some of the critical industry areas affected by the voltage and current fluctuating issue. And most of the modern household equipment are also sensitive to such fluctuations. Any interruption in the network results in a loss of revenue that cannot be recovered. This consequently requires the power supply to be uninterrupted and constant. To overcome these issues power quality monitoring and measuring is important.

With the objective of providing increased and efficient service to the consumers the Ceylon Electricity Board's consumer services section has invented several equipment[1] with limited functions. And they are looking for a system which can measure, store and transmit data about fluctuations in AC voltage supply. For this requirement, the present system was developed.

1.1 Existing Products

Three types of instruments are commonly used for collecting and storing data. They are Real-Time Data Acquisition Systems, Chart Recorders and Data Loggers[2]. Chart recorders and real time data acquisition systems are more expensive than data loggers. Data loggers offer more flexible data storage capabilities and are available with a greater variety of input types while data acquisition systems offer a great deal of flexibility and are certainly useful

when high sample rates are required, however, the main disadvantage is that the computer must also be present and active when collecting the data. Its ability to collect and store data independently of a computer makes data loggers ideal for applications requiring portability.

A major drawback in some of the existing devices is the inability to get the voltage and current readings simultaneously. Many chart recorders used in the industry are analog devices, so that the accuracy is not up to the desired level. Another major issue is the difficulty in analyzing such data acquired through an analog device.

Most of the AC power supply fluctuations detecting systems have the feature of sending the measured data to the electricity provider or distributor via local area network (LAN) or serial port interface but not via GSM. Receiving such information as soon as possible is so much important when considering about the critical issues that can occur because of such fluctuations.

2.0 EXPERIMENTAL

The device designed in the present work is a microprocessor based system. The microcontroller was used for all the data manipulations such as measuring voltage and current, controlling the data transmission module and displaying purposes. For programming, a requirement of the microcontroller, mikroC[3]was used while AT commands were used for configuring the GSM module[4]. For data analyzing requirements SMS gateway and database were used. AnLCD display was used for displaying purposes while a GSM module was used to transmit data to the faults handling center. Subunits (figure 1) of the device are:

Voltage Reading unit	Current Reading unit[5]
Power supply unit	Data displaying unit
Data transmitting unit	

Systems installed in the faults handling center are the Database and the SMS gateway.
The above systems were configured according to the requirements.
A Hall Effect sensor and a voltage divider circuit were basically used for measuring current and the voltage respectively. The following equations were designed for the purpose of observing the actual Voltage and the Current measured.

For Voltage reading (Volt) $= \frac{\text{Real value using multimeter (V) X ADC read value}}{\text{ADC converted reading on display}}$ [1]

Current value $= \frac{\text{ADC value - 507.9}}{4.0152}$ [2]

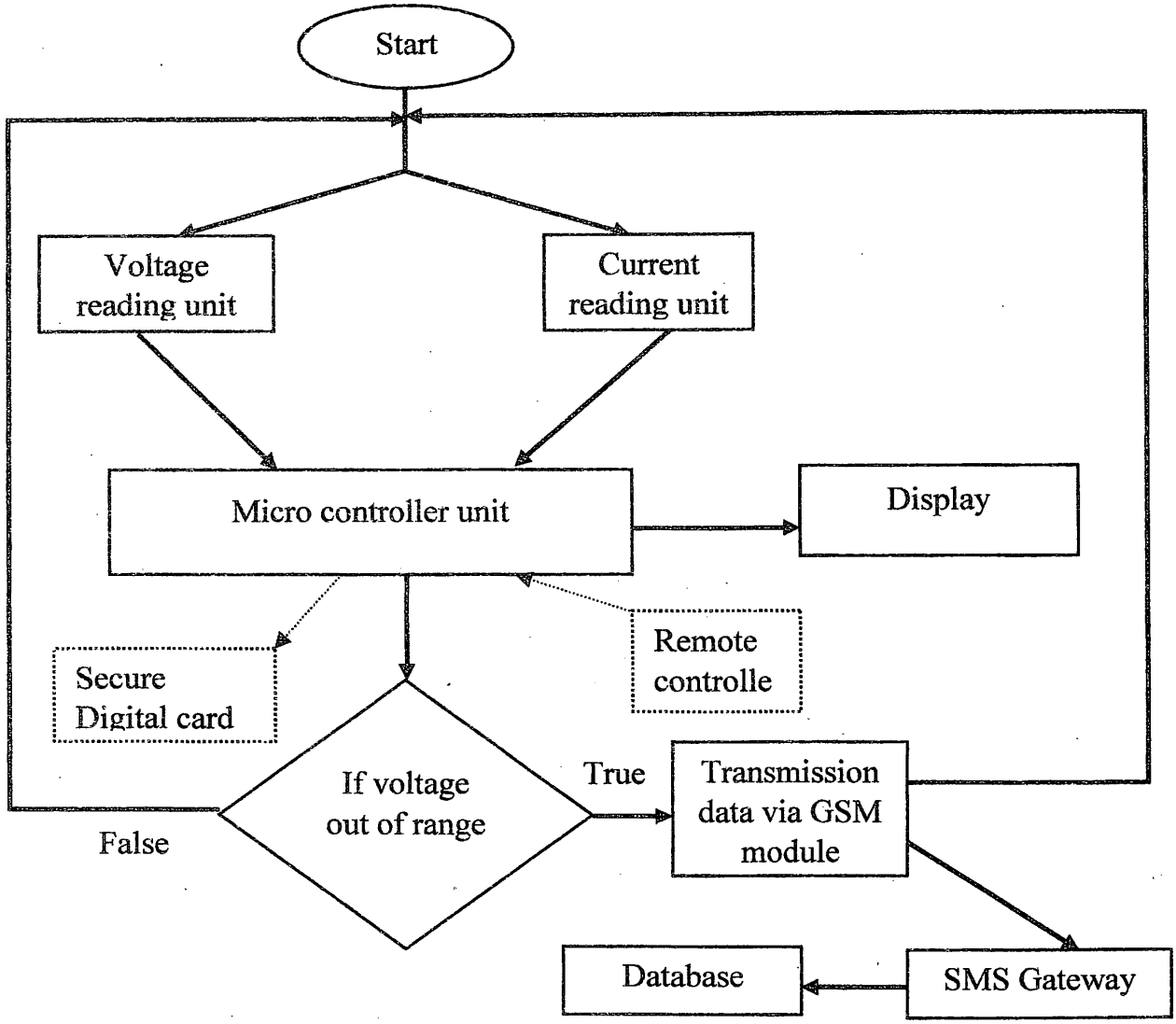


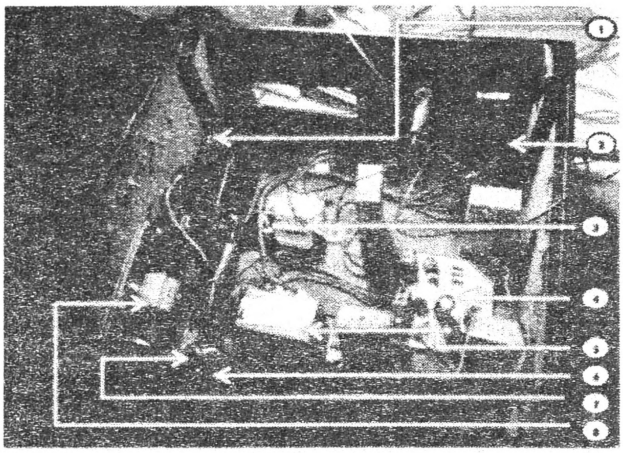
Figure 1 : Block diagram of the system with extended features

3.0 RESULTS AND DISCUSSION

This system fulfils the requirements which were mentioned in the Introduction and also this will be a mature technique of detecting fluctuations in utility supply as well as, a well organized data acquisition system to the modern electronic base environment. The basic circuitry design was also made while considering the future development opportunities. For more accurate readings the system equations were designed after taking the means of

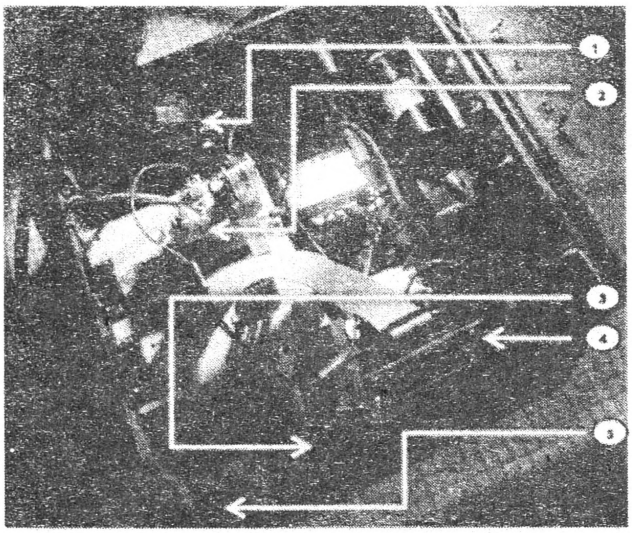
several test observations. Using a real time clock inside the system will add additional efficiency to the system.

3.1 Overview of the final product



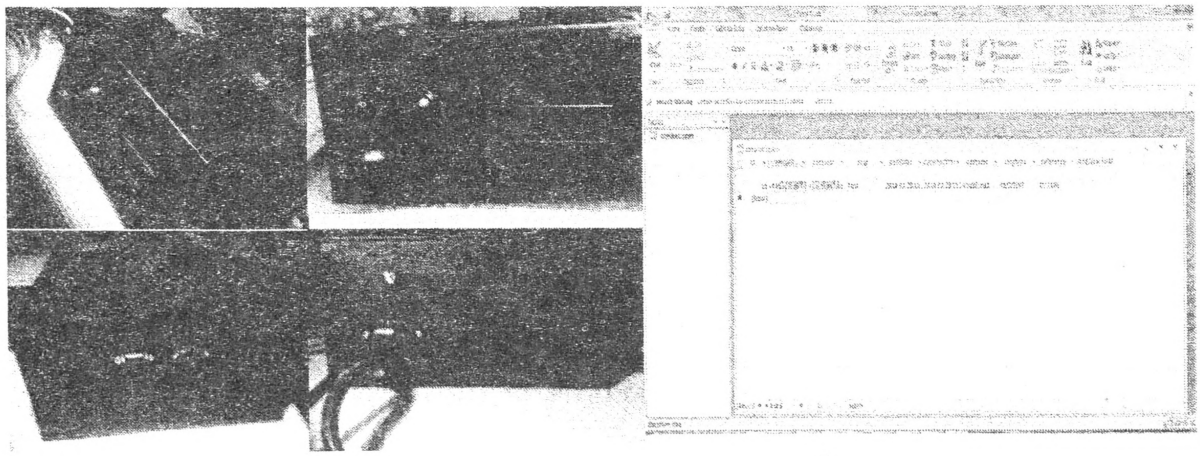
1. Battery
2. AC switch
3. Transformer
4. AC to DC converting PCB
5. Transformer 2-Power
6. AC in
7. Fuse for the system
8. Current measuring unit and fuse

Figure 2 : Bottom layer of the final product



1. Fan
2. Main PCB
3. Indicator
4. LCD Display
5. DC switch

Figure 3 : Top layer of the final product



a **b**

Figure 4 :(a)Outside view of the final product (b)Database

3.2 Further Developments

Without transmitting data via GSM module, it also can store data by itself with a Secure Digital (SD) card. This system was designed with an inbuilt range of voltage values to transmit data but this also can be developed to adjust the range according to the users' requirement using a remote controller. Use of an advanced database will allow filtering the important values and plot drafts for better visualization of the received data.

4.0 CONCLUSION

The study and the implantation presented in this paper was an attempt to fulfill one of many real time data acquisition system requirements existing in the electronic related industry. The concepts in Electronics and computer science were merged together in order to achieve the project goal. This developed equipment will be important to Ceylon Electricity Board (CEB) not only to detect and measure the fluctuations in power supply but also to take relevant steps to overcome faults after studying and analyzing the observed data.

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