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A Low Cost Wireless Data Acquisition System For Distribution Automation System
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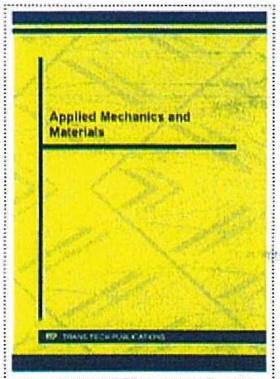

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3:15 B5-6	***Effect of Silicon Oxide Size and Reducing Environment on the Photocatalytic Capability of Poly(Vinyl Alcohol)/Chitosan/Silicon Oxide Beads*** Syazwan Liyana Sulaiman (Universiti Tun Hussein Onn Malaysia, Malaysia); Sufizar Ahmad (University Tun Hussein Onn Malaysia, Malaysia); Hariati Taib (Universiti Tun Hussein Onn Malaysia, Malaysia)
3:30 B5-7	***Mechanical Properties of Friction Stir Double-Side Welded Joints in Aluminum Alloy 5083*** Achmad Zubaydi (Sepuluh Nopember Institut of Technology, Indonesia); Budie Santosa (Sepuluh Nopember Institut of Technology, Indonesia); Dony Setyawan (Sepuluh Nopember Institut of Technology, Indonesia); Nurul Muhayat (Sepuluh Nopember Institut of Technology, Indonesia)
3:45 B5-8	***Characterisation of nanoclay-modified epoxy polymers structure using XRD*** Widia Amir (Universiti Teknologi MARA, Malaysia); Aidah Jumahat (Universiti Teknologi MARA, Malaysia); Anizah Kalam (Universiti Teknologi MARA, Malaysia)

C5: RENEWABLE ENERGY

Chair: Dr Shamsul Anuar Shamsudin

Room: ICE-SEAM 3

2:00 C5-1	***Drying of Oil Palm Fronds using Concentrated Solar Thermal Power*** Shaharin Anwar Sulaiman (Universiti Teknologi PETRONAS, Malaysia); Farid Taha (Universiti Teknologi Petronas, Malaysia)
2:15 C5-2	***Remote Terminal Unit Developed for Distribution Automation System (DAS) using MPLAB Software*** Wan Nor Shela Ezwane Wan Jusoh (Universiti Teknikal Malaysia Melaka, Malaysia); Siti Hajar Binti Raman (Universiti Teknikal Malaysia Melaka, Malaysia); Datuk Prof. Dr. Mohd Ruddin Ab Ghani (UTeM, Malaysia); Mohd. Ariff Mat Hanafiah (Universiti Teknikal Malaysia Melaka, Malaysia); Wan Ahmas Redhauddin Wan Hassan (Universiti Teknikal Malaysia Melaka, Malaysia)
2:30 C5-3	***An Experimental Study on the Performance and Emissions of Diesel Engine Fuelled with Biodiesel Derived from Palm Oil*** Md Norrizam Mohamad Jaat (Universiti Tun Hussein Onn Malaysia, Malaysia)
2:45 C5-4	***A Low Cost Wireless Data Acquisition System for Distribution Automation System*** Siti Hajar Binti Raman (Universiti Teknikal Malaysia Melaka, Malaysia); Wan Nor Shela Ezwane Wan Jusoh (Universiti Teknikal Malaysia Melaka, Malaysia); Mohd. Ariff Mat Hanafiah (Universiti Teknikal Malaysia Melaka, Malaysia); Datuk Prof. Dr. Mohd Ruddin Ab Ghani (UTeM, Malaysia); Zikri Abadi Baharudin (Universiti Teknikal Malaysia Melaka, Malaysia)

A Low Cost Wireless Data Acquisition System for Distribution Automation System

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Keywords: Data acquisition system, Global System of Mobile (GSM) communication, Distribution Automation System (DAS), Human Machine Interface (HMI).

Abstract. This paper presents the design and development of a 16F877A microcontroller-based wireless data acquisition system. Besides that, this paper also presents a study of the possibility of different existing methodologies that linked to field data acquisition from distribution automation systems. Various existing data transmission technique was studied, especially for wireless systems such as satellite, radio, GSM and paging. The hardware and software implementation are described in this paper. The system will be used for reading, storing and analyzing data that obtained from DAS. The wireless communications are based on the GSM network. The laboratory results are compared with the simulation results to make the final conclusion of the algorithm function properly.

Introduction

Power disruption is the situation of loss the electric power to an area due to fault that occurs at power stations, transmission, distribution or substations. In Malaysia, common cause of power outage are divide to three which is Tenaga Nasional Berhad (TNB) system, weather or third party involvement and customer's premises. For TNB system, the reason of the power outage is occur because the short circuit in TNB distribution system and land or underground line cable which have been served. Then, for weather or third party involvement includes accidents which involve TNB installations such as poles and others, pilferage of TNB installation, extreme weather conditions such as floods or third party works beyond TNB's control such as road excavations. Lastly, for cause of power outage that occur at customer's premises are defective wiring system, short circuit in the premises or fault appliances. When the power disruption is occur the customer may report to TNB and TNB's technician will locate and investigate the cause of the disruption. Distribution system is too complex to handle in case of fault. Then, it is may require high number of man-hours to rectify the fault. For minor breakdown, it takes no later than four hours to restore the supply [1]. After that, when some problem may take longer time to solve, so it may affect financial losses to the customers and to the utilities and the customer complaint is getting high too. Therefore it is necessary to develop and build a non-expensive intelligent DAS that can be eliminate or reduce the human intervention for operating and controlling the distribution system that can identify, locate and rectify the fault and furthermore isolate the faulted distribution zone from the rest of the other zones located in the same vicinity.

Various communication networks that can be used for DAS applications. Compare wire and wireless systems, wireless is more relevant to be implemented nowadays. It is because wireless network has flexibility function that does not require operators to be in actual area. Operators can control and monitor DAS in long distance. Among all the communication networks, GSM communication is used. It is because GSM network has low transmission bit error rate, low cost, wide signal coverage and high level of security [2]. GSM network is used in many applications such as health monitoring, meteorological monitoring, decentralized renewable energy plants, remote photovoltaic (PV) water pumping system and so on[3-11].

No research has been done in the service substation side of the downstream distribution systems. This is probably due to the degree of damages. Faults occur in the substations and distributions are more severe and affect wider area compared to faults which occur in the service substations. Although, the fault occur are considered as minor in the services substation, they are handled equipment which are closest to customers. Some minor fault might jeopardize continuous electricity supply to customers [12, 13]. In this paper, a microcontroller-based data acquisition was devised. This system was developed by using PIC16F877A microcontroller and is applied to DAS. This specific microcontroller is selected in order to produce a high speed operations and low cost prototype. The system is transmitted data from sensors goes to microcontroller and passed on to a personal computer via GSM communication. The information is processed and displayed on HMI software. Then, it is stored in computer storages as archive of the systems.

Methodology

In this section, a data acquisition system design and the various methods for remote data transmission are described. The system consists of a set of sensor for measuring parameter in distribution systems such as currents, voltages and powers. The collected data are first conditioned using intelligent electronic devices (IEDs) such as current and voltage transducers. After that, the information will transmit to a personal computer.

The information from the distribution systems can be transmit via wired communication such as RS232, RS485, USB or Ethernet or wireless communication such as Radio, Paging, GSM or Satellite to a personal computer. Then, human machine interface (HMI) software will be used to processed the data and display it. After that, the data will be stored on the computer data storage to function as archives. Figure 1 present a general block diagram of the various options for field data transmission and communication network to a personal computer. Before that, we first analyze the advantages and disadvantages of these systems.

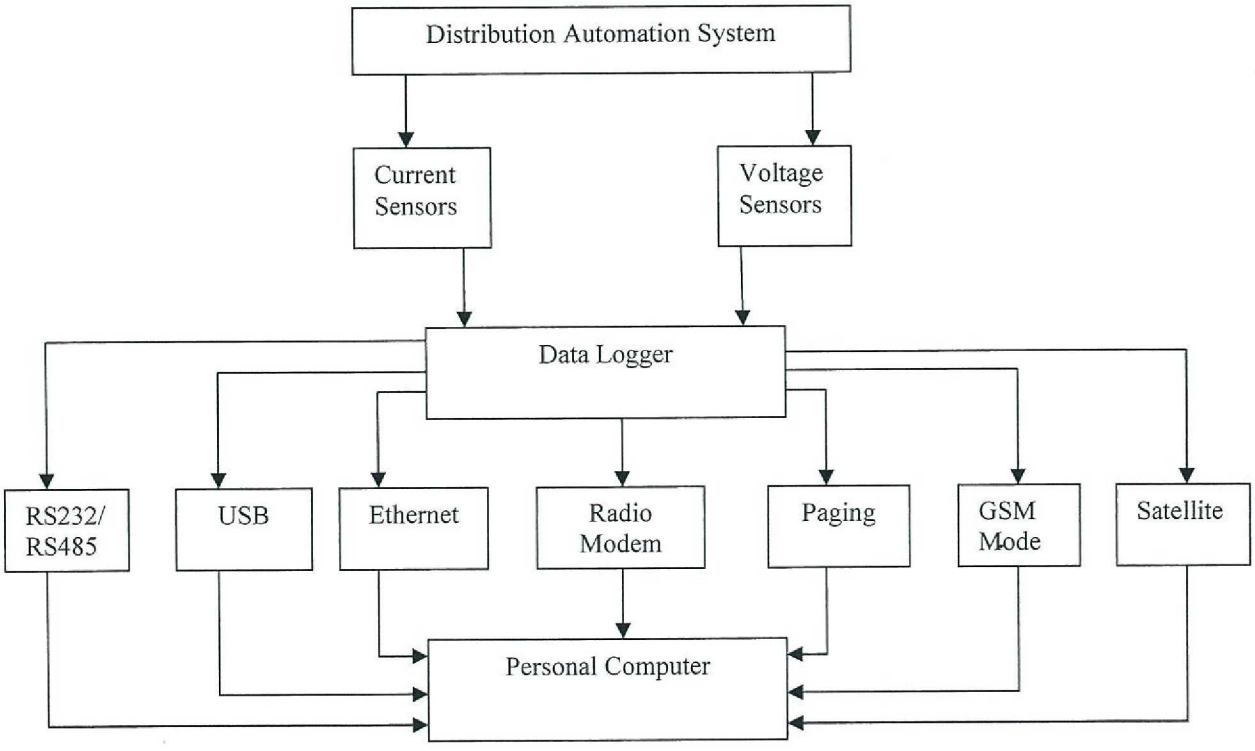

Fig.1. Data transmission methods from DAS to the personal computer.

Various methods were used to transmit information in data acquisition systems. Nowadays, wireless communications was one of the ways to transmit the data form the field systems. Unfortunately, there are many drawbacks when using wireless sensor network especially Zigbee to be a communication media to transmit data. It is because it consumes more energy to operate, higher risk of malicious intrusion and attack, less reliable for data transmission, complex to developed and has limited signal coverage. Different from GSM network, its offer more advantages compared to Zigbee which is contains essential intelligent functions for support of personal mobility, low transmission bit error rate, low costs, wide signal coverage and higher reliability in data transmission[3].

Data Acquisition Developed System

In this section, we are going to present the description of field data acquisition system, developed to collect and transmit the information from the sensor pass to the personal computer through GSM communication network. Figure 2 shows the transmission scheme by using GSM as communication media. Then, Figure 3 presents the general block diagram of the data logger for DAS. The information from the sensor goes to the microcontroller which is PIC16F877A, where it is processed and then sends to external EEPROM memory and it is passed to the GSM Modem brand Maestro GSM/GPRS module by RS232 interface every 24 hours. The function of external EEPROM memory is used to store the remained data when GSM modems have a problem to transmit information.

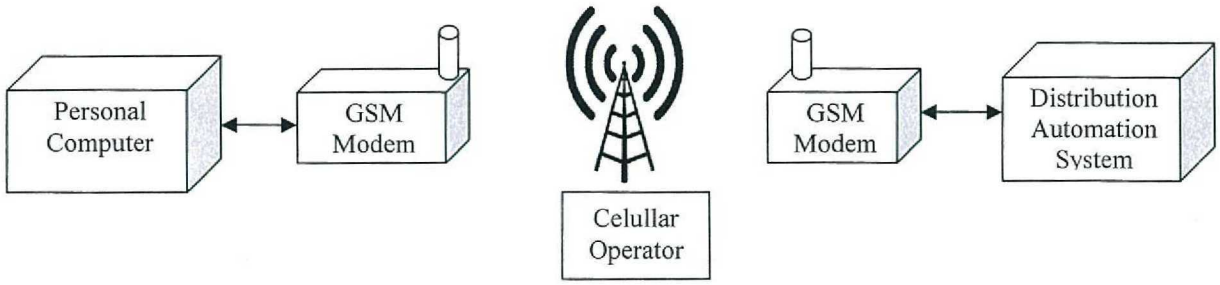

Fig.2. Field data transmission by used the GSM networks.

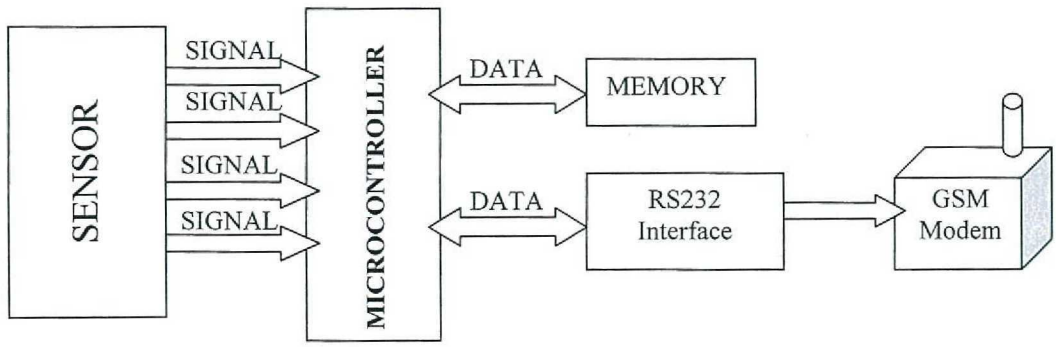

Fig.3. Flow of the information from sensors to a GSM modem.

Experimental Result

The hardware prototype for the proposed system is shown in Figure 4. The result of this method will display on HMI interface of Figure 5. It is consists of serial port part which is used to make sure the GSM modem is successfully connected with personal computer. Then, the operator needs to select the option mode to run the system whether automatic or manual. When the automatic mode is activating, the relays will automatic turn off when the current that pass through the loads is larger than the higher rated interrupting current. Then alarm box will tell the operator that fault current is occurred and microcontroller will automatically cut off the power supply through relay. If the manual mode is selected, the alarm will trigger automatically when the fault current is occur. But the operators need to turn off the relay manually through the HMI interface. Table 1 is the results obtained by the following procedures described.

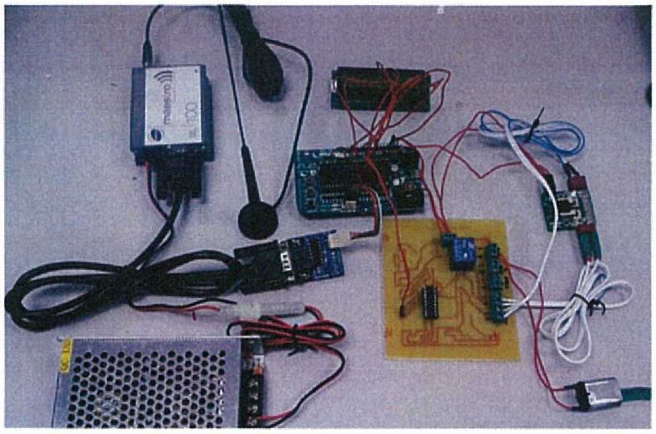

Fig.4. Hardware Prototype.

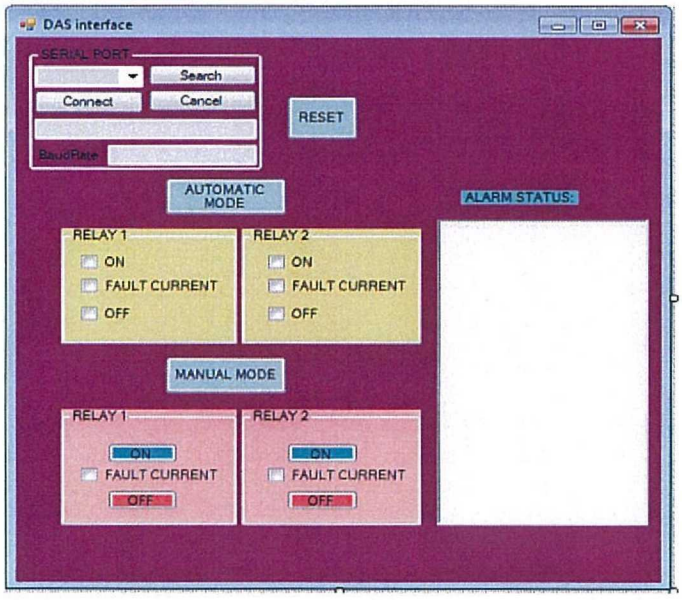

Fig.5. Fault Information Display.

No	Action	Results ● On ○ Off			
		HMI Symbols		Actual Loads	
		1	2	1	2
1	Click on "RESET" button	●	●	●	●
2	Click on "ON" at Relay 1	●	○	●	○
3	Click on "OFF" at Relay 1	○	○	○	○
4	Click on "ON" at Relay 2	○	●	○	●
5	Click on "OFF" at Relay 2	○	○	○	○

Table 1. Manual mode experiment results.

Conclusion

This paper presents the design and the development of a wireless data acquisition for distribution automation systems using microcontroller PIC16F877A. The proposed wireless data acquisition systems is based on GSM networks as communication media and Visual Basic as HMI software for processing, display and storing the collected information. This information has been analyzed in order to evaluate the performance of distribution automation systems. GSM network is used to transmit data to a personal computer based on a Maestro GSM/GPRS module. The contribution of this system is to control the functioning of distribution systems and also produce the data under real conditions. GSM network as a communication media can reduces considerably the cost of system management. The system proposed a good performance as a low cost of data acquisition systems.

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References

[1] What to do when it happens [Online] Available: http://www.tnb.com.my/residential/power-interruptions/what-to-do-when-it-happens.html [accessed on 18 October 2012]

[2] Northcote-Green J, Wilson R. Control and Automation of Electrical Power Distribution Systems. New York: London ;2007.

[3] Shariff F, Rahim NA, Ping HW. PV Remote Monitoring System Based on GSM. Power and Energy Conversion Symposium, 2012.

[4] Salvadori F, De Campos M, Sausen PS, R.F. De Camargo RF, Gehrke C, Rech C, Spohn MA, Oliveira AC. Monitoring in Industrial Systems Using Wireless Sensor Network With Dynamic Power Management. IEEE Transaction on Instrumentation and Measurement, Vol. 58, N0. 9, September 2009.

[5] Sandro CSJ, Paulo CMC, Fabio TB. A low Cost Concept for Data Acquisition Systems Applied to Decentralized Renewable Energy Plants. Open Access, Sensors, Vol. 11, 2011: 743-756.

[6] Rosiek S, Batlles FJ. A Microcontroller-Based Data-Acquisition System for Meteorological Station Monitoring. Energy Conversion and Managemet 49t 2008: 3746-3754.

[7] Mahjoubi A, Mechlouch RF, Brahim AB. A Low Cost Wireless Data Acquisition System for a Remote Photovoltaic (PV) Water Pumping System. Open Acess, Energies, Vol. 4, 2011: 68-89.

[8]Chandra S, Kar S, Srinivasulu A, Mohanta DK. Distribution System Automation Based on GSM using Programmable System on Chip (PSOC). International Conference on Sustainable Energy and Inteligent System, July 2011.

[9] Goel A, Mishra RS, Gupta R. GSM Based Health Monitoring System. BSSS Journal of Computer, Vol.1, Issue 1, 2009: 37-44.

[10]Goel A, Mishra RS. Remote Data Acquisition Using Wireless-SCADA System. BSSS Journal of Computer, Vol.1, Issue 1, 2009: 98-103.

[11]Pandya V, Shukla D. GSM Modem Based Data Acqusition System. International Journal of Computational Engineering Research, Vol. 2, Issue. 5, 2012: 1662-1667.

[12]Raman SH, Ab. Ghani MR, Baharudin ZA, Hanafiah MAM, Wan Jusoh WNSE. The Implemetation of Fault Management In Distribution System Using Distribution Automation System (DAS) In Conjunction With SCADA. Power and Energy Conversion Symposium, 2012.

[13]Ahmed MM, Soo WL, Hanafiah MAM, Ghani MRA, Customized Fault Management System for Low Voltage (LV) Distribution Automation System, Chapter of a book, Fault Detection, Intechweb.com, 2010.