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Mohd Ruddin Ab Ghani
Professor of Electrical Engineering, Universiti Teknikal Malaysia Melaka
System Engineering and Control- Energy and Distribution Automation System-Optimization - Operational Research
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W.N.S.E. Wan Jusoh, S.H. Raman, M.A. Mat Hanafiah, M.R. Ab Ghani, W.A.R. Wan Hassan
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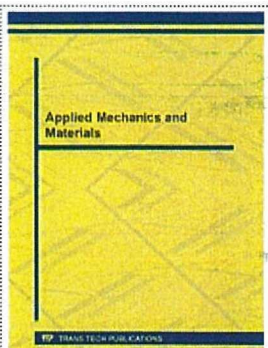

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3:15 B5-6	***Effect of Silicon Oxide Size and Reducing Environment on the Photocatalytic Capability of Poly(Vinyl Alcohol)/Chitosan/Silicon Oxide Beads*** Syazwan Liyana Sulaiman (Universiti Tun Hussein Onn Malaysia, Malaysia); Sufizar Ahmad (University 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)

Remote Terminal Unit Developed for Distribution Automation System (DAS) using MPLAB Software

W. N. S. E. Wan Jusoh[1,a*], S.H. Raman[1,b], M.A. Mat Hanafiah[1,c], M.R. Ab. Ghani[1,d] W.A.R Wan Hassan[1,e]

[1]Faculty of Electrical Engineering, Universiti Teknikal Malaysia Melaka (UTeM), Durian Tunggal, Melaka, Malaysia

[a]M011210005@student.utem.edu.my, [b]M011210004@student.utem.edu.my, [c]ariff@utem.edu.my, [d]dpdruddin@utem.edu.my, [e]wan.ahmas@student.utem.edu.my

Keywords: Remote Terminal Unit (RTU), Distribution Automation System (DAS), MPLAB Software, SCADA system.

Abstract. Remote Terminal Unit (RTU) is a standalone data acquisition and control unit which monitoring and control equipment at some remote location from the central station [1] that utilizes in the Distribution Automation System (DAS). The functions of this RTU are acquisition of information such as measured values, signal, meter readings and RTU also can transmit command or instruction, set points, control variables and monitoring as a function time. In the present Distribution Automation System (DAS), the distribution field of automation allows the utilities to implement flexible control of distribution system to enhance efficiency, reliability, and quality of electric service. The implementation of distribution automation system will be highlight based on two factors which are the benefit of distribution automation system implementation and area of distribution automation system implementation [2]. The hardware design uses PIC16F877A microcontroller to control all the function of RTU. The types of fault detected are under voltage and overcurrent. The design consists of MPLAB software development using C programming and hardware assembly. RTU also designed to communicate with the SCADA system and the result is RTU able to detect under voltage and overcurrent fault.

Introduction

In Malaysia, the power industry is mostly monopolized by Tenaga Nasional Berhad (TNB) which almost 60% of power generation in Malaysia is generated by TNB while the others have 40% which supplied by Independent Power Producers (IPP). Meanwhile the transmission and distribution of power are 100% controlled and maintained by TNB [3]. The need for more effective and reliable power management increase every year because a lot of energy produced is wasted by improper planning but essentially, it is caused by the flaws of the power system itself. The modification can be made at the generation and transmission side which can improve the existing power supply lies at the distribution side.

To identify a fault or a disruption, the efficiency of the power supply in distribution automation will be enhanced in the distribution side. In conventional system, when fault occurs, action such as opening and closing of breakers, reclosers and sectionalizing switches at substations are done manually by the substation's operator or trained personnel. When the system goes down, firstly the operator should analyze the system to identify what type of faults occur at the substation before take any decision to action. Normally, the process will take amount of time depending on the complexity of the system. However, with the implementation of distribution automation, the role is taken over by a computer based system. The computerized controller can be monitor the system and decide on the proper actions instantly and immediately. Therefore the amount of the time needed to act on the fault significantly reduced. The main advantage of distribution automation is it can improve reliability of the system and increased customer satisfaction.

The distribution equipment installation has a pole-mounted equipments required to detect all type faults on each line. Fig.1 shows the typical pole mounting of DAS equipment.

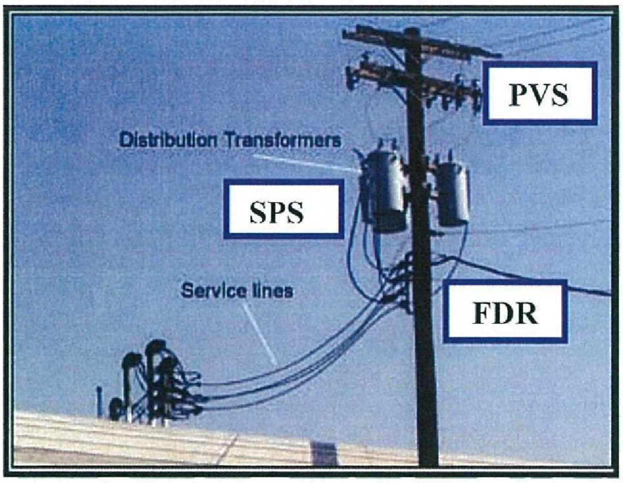

Fig.1 Typical Pole Mounting of DAS Equipment [4]

The distribution automation system equipment is composed of the Switch Power Supply (SPS), Fault Detecting Relat (FDR) and Pole-mounted Vacuum Switch (PVS). The Fault Section Indicator (FSI) is another equipment which installed in substation. The configuration diagram of distribution automation illustrated in Fig.2.

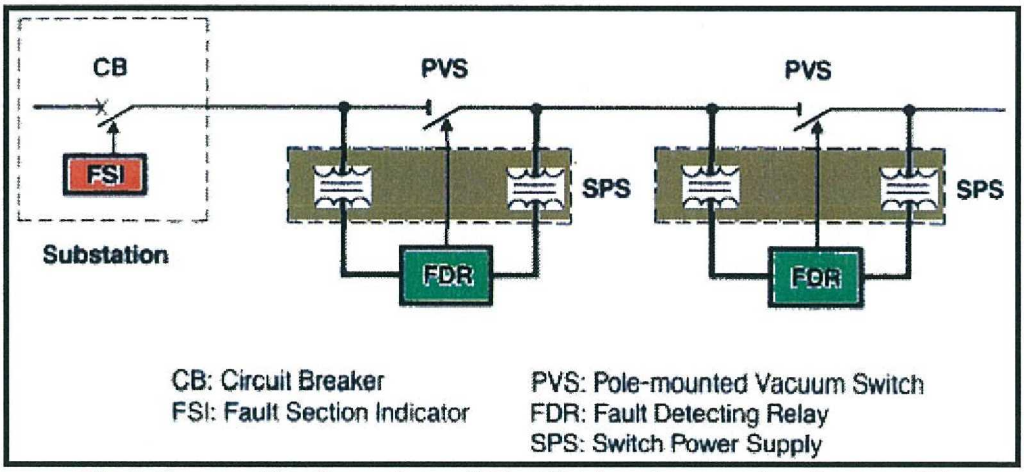

Fig.2 System Configuration of Distribution Automation System [3]

Software Design Architecture

The MPLAB software uses C language with Hi-Tech compiler designed based on what information receive from substation and what information needed to analyzed by supervisory system. At power facilities, a supervisory system uses the RTU to acquire data to control the equipment. All SCADA actions are enabled only when the Supervisory/ Remote (S/R) switch for the device is in the supervisory position and disabled when it is in the remote position. S/R switch is required for safety purpose which to prevent Control Centre from operating the device when there is work at side. The supervisory control scheme shall adhere to the interlocking system for safe operation of the device. The RTU is a part of SCADA system; it essentially allows remote monitoring and control of plant or substation. The roles of RTU are it allows the operator at the Network Control Center to manage and operate the power system, provide historical and Sequence-of-event (SOE) data for fault investigations and monitoring plant parameters that can be used to trigger maintenance as well as data for predictive maintenance.

The main function of interfaces between the SCADA-RTU firstly uses interposing relay to control station equipment and secondly uses transducers, meters and other devices to measuring circuits. There are many advantages using interface and for example it easy to create, simple to design, high reliability and inexpensive. Physically, this interface may be distributed throughout the power station or centralized within one or two cabinets. The consideration of an over-reading also available in panel space and station control layout. The interfaces can be divided into four main categories, analog input interfaces, digital input interfaces, control output interfaces and local user interfaces are shown in Table 1 [5].

Table 1 Main Categories Interface

Analog Input	• For transmission lines, station buses, system generators, transformer banks and distribution feeder measure the performance parameter in unit of watts, amperes, vars and volts which are represented as sampled continuously variable analog values. • Energy output and consumption data (i.e. kilowatt hours and kilovar hours) are also needed for systems performing economic dispatch. • Other quantities such as transformer temperatures, insulating gas pressures, fuel tank levels for on-site generation or head level for hydro generation might also be transmitted as analog values. • Transducers are used to provide a scaled, low-energy signal to represent power system quantities that the RTU can easily accept. Transducers also isolate and buffer the RTU from the power system and station environments. Transducers input circuits often share instrument transformers with station metering and protection systems. Transducers output are usually dc voltages or currents that range upwards of 1-10v or 1-10mA [6].
Digital Input	Digital input interfaces are used to monitor that state of power equipment. Status monitoring is often provided for power circuit breakers, circuit switchers, reclosers, motor-operated disconnect switches and a variety of other two-state, on-off function on power station [7].
Control Output	SCADA control is most often provided for circuit breaker. Control is also applied to reclosers, distribution feeder breakers and switchers of all descriptions and also include control for motor operate disconnects, tap-changing transformers, voltage regulators, valve or even peaking units through a SCADA system. All these control functions share a commonality which is the station control functions must be interfaced to the SCADA RTU. The RTU cannot execute controls directly from its logic levels, but must be interposed to the station control circuits [8].
Local User	It's like a small master station but the slightly different is, the local user only has one remote at the local substation. It interface function can be supported by personal computer, workstation or single-board computer [9].

Software Design Concept

The concept o this design is shown in Fig.3 which consider a simple model of the distribution side. The load is connected to two sources, one as the main supply and the other as the reserve. The switch at the main line is normally closed. The RTU here acts as intermediary betwen the switches and the SCADA. The RTU takes the values of voltage and curent from the line at the certain set time intervals.

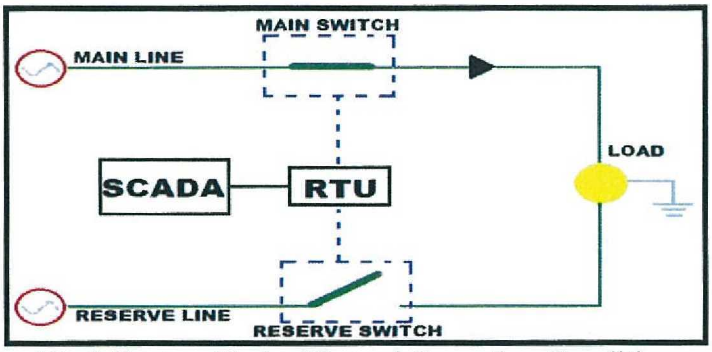

Fig.3 System Under Normal Operating Condition

When fault occurs at the main line, as depicted in Fig.4, the main switch automatically opens and simultaneously sends a signal to the RTU about its status change. The RTU also records the voltage and current values during the occurence of the fault. The RTU then sends this information to the SCADA for record and display. The RTU also sends another signal to the reserve switch to close, so that power can be supplied to the load by using reserve line.

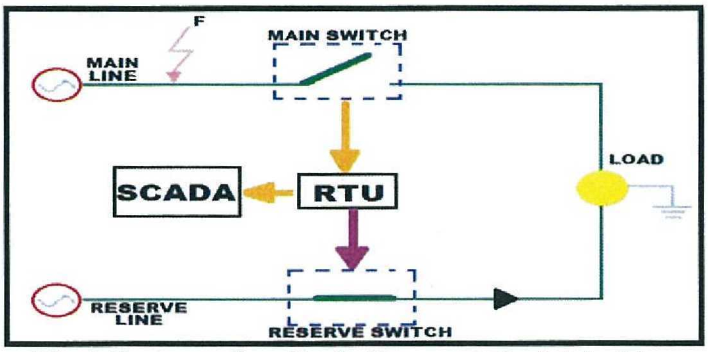

Fig.4 System when Fault Occurs at the Main Line

When the fault at the main line is cleared, the same process is repeated. The RTU will read the voltage and current at the main line and identify type o fault has been cleared. The RTU then sends the command for the main switch to reclose, reserve switch to eopen and all these actions will be sent to SCADA for record and analyzed. Fig.5 shows the system when fault cleared.

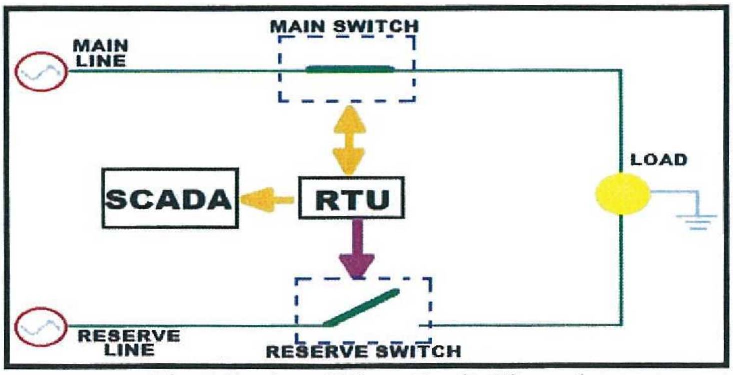

Fig.5 System When Fault Cleared

Result and Discussion

Fig.6 shows the components layout and hardware connection for the RTU device. The main RTU circuit consists of power supply, microcontroller PIC16F877A, analog input output, digital input output, memory and also acsessory part which is LCD display and LED. The microcontoller receives inputs of current and voltage fom power supply via two analog inputs on the main circuit board. It will continuosly read these values according to its set time interval and display it in the PC. The variable resistors are used to simulate the fluactuations of voltage and current. On the circuit board, the main line is represented by the red LED1 while th reseve line is represented by the red LED2.

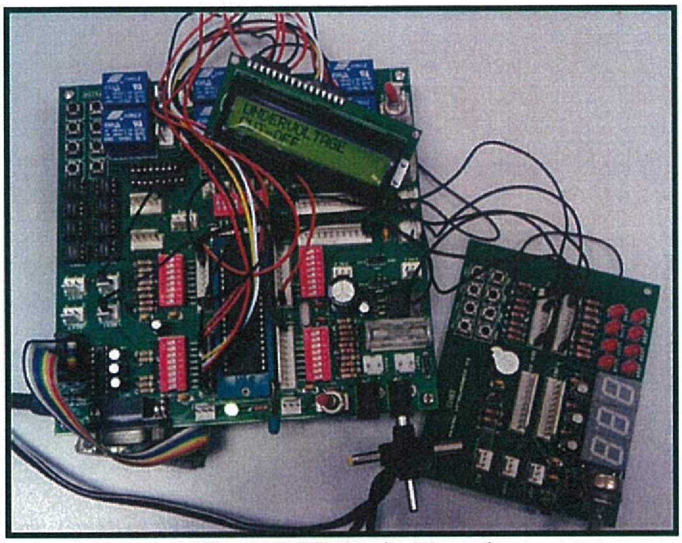

Fig.6 RTU Main Board

The circuit is designed to detect two type of fault, undervoltage and overcurrent. These two type of fault are considered because both of them are the most typical type of faults that can occur at the distribution side which hazardous to the system. The standard voltage regulation tolerance implemented in Malaysia is +10% -5%. This means for a 240V single phase power supply, the voltage regulations should not exceed 264V and should not below 228V. Compared to overvoltage, undervoltage type of faults is more dangerous to the system because it can reduce the frequency and cause major breakdown in the distribution power system. So the program to detect faults uses MPLAB software and the program consists of commands regarding the assigned I/O pin, assigned ports for the timekeeping chip and analog digital converter, cycle of collecting input if actual line, the location for data writing and memory etc. Fig.7 shows the interface of MPLAB programming.

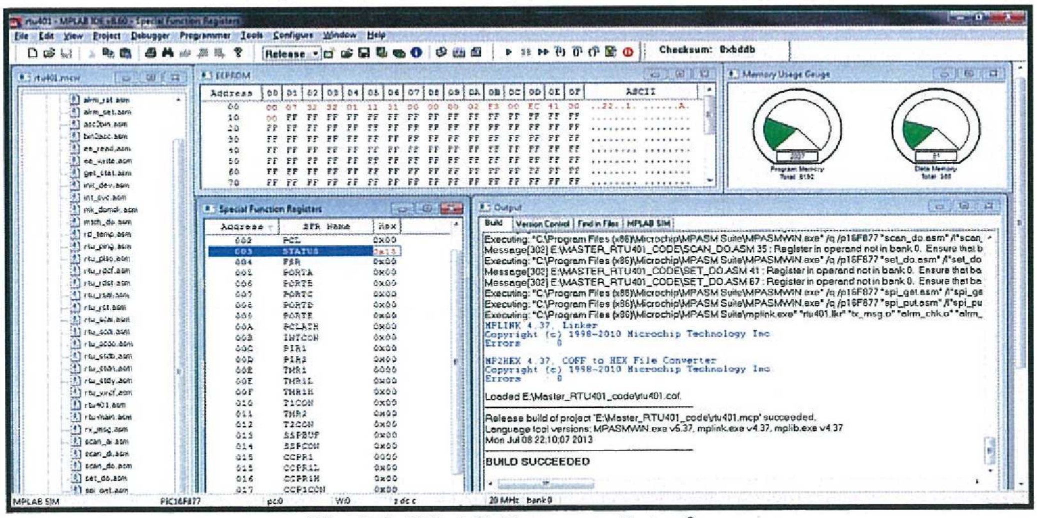

Fig.7 MPLAB Program Interface

Conclusions

It can be concluded that the RTU designed using PIC16F877A microcontroller with MPLAB software can run its function to detect fault of undervoltage type. From the hardware result, RTU operates for all undervoltage test conditions. For the future recommendation, the process of designing this RTU based on microcontroller is still in its initial phase. Therefore, a lot of improvement and future development can be done to the system to improve the operation capabilities.

Acknowledgement

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