Designing of an Exchange Power Supply Tripped Condition Warning System for a Telecommunication Company

Ruwansiri TVA[1]
Vidanapathirana KP[2]

ABSTRACT

This study was carried out with the aim of developing an exchange power supply tripped condition warning system for a telecommunication company. Switching section is the most important segment of such a company. Main Molded Case Circuit Break (MCCB) tripped condition of the exchange is a major problem faced by the switching section. In switching section, there is a system to identify the power failures of Master Switching Unit (MSU). This existing system provides an alarm to the terminal. However, this can be recognized at the daytime only, because the authorized staff members are unavailable at night time. In this study, an electronic PIC® Microcontrollers based system was developed as a solution to this problem. The system monitors the availability of electricity and informs to authorize officers when there is a tripped condition in main MCCB, by using a *Short Message Service* (SMS) through Global System for Mobile Communications (GSM) network.

(KEYWORDS: Exchange, Master Switching Unit, MCCB, Network Management Center, Remote Switching Unit, Switching section)

INTRODUCTION

The company under study is a leading telecom operator in Sri Lanka. It is a company that has gainfully carried forward the legacy of the incumbent whilst successfully integrating related businesses plus a modern organizational structure and culture. Master Switching Unit (MSU) is the main important part of the entire telecommunication network in the company. A single MSU may consist of several Remote Switching Units (RSUs). The MSUs mainly depend on the commercial power supply or on a battery bank inside the MSU. With a battery bank, it can supply power to the MSU for about three to four hours when there is no commercial power.

When a MSU is down due to a power failure, it can be detected by an alarm at the MSU terminal. Then the technical staff of the MSU can respond to the alarms at the day time. But at night, the alarm detection process is transferred to the head office due to no technical staff at the MSU. So at night, if there is a power failure, it is recognized by the staff of the Network Management Center (NMC) and there is an external alarm system, exchange to security office. Then they inform that to the appropriate technical staff. This is not a direct way of identifying the failure of the MSU by the technical staff. This existing system will take some time to inform the matter to the technical staff. it can badly affect the smooth function of the company.

Research Objectives

It was decided to introduce a new method to detect the power failures and also directly inform that failure to authorized staff members of company switching section. This direct informing method is very important at night time because staff members of switching section are not available in the office. It will help to correct fault as soon as possible.

Research Question/Problem

Telephone exchange is a very important part of the entire telecommunication network. Continuous power supply is important for holding proper working condition of the MSU.

[1]Graduate, Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka.

[2]Senior Lecturer, Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka.

A three-phase power supply is connected to MSU through main MCCB in the RSF unit for safety. Main MCCB may trip due to following reasons.

- Unbalanced conditions of public 3 phase power supply system.
- Leakage of the power supply with an earth leakage condition.
- Current variation in the power supply.
- Lightning conditions.
- Flicker of current.
- Short circuited condition.

If any tripped condition occurred or at power unavailability, backup battery sets start to supply power to MSU. But these batteries can supply service up to around 3-4 hours and it also depends on the battery condition which may vary with time and aging. If any staff member doesn't involve in normalizing the main MCCB, the entire switching system will get inactivated. This may be a big issue to the companies' balanced workflow.

If the system closes down, process of recovery will be time consuming and complex. Following are the bad effects that can be occurred due to a failure of an exchange.

- Revenue loss.
- Billing details loss/Call duration data loss.
- Sub management data loss such as recent changes of facilities.
- There may be future conflicts on proper performances.

There is no direct way to identify this faulty situation by the technical staff. This situation directly affects to the time taken to correct the fault. The longer the time taken to correct, the effects both to the company and to the customer are higher. So it is very important to explore a solution to this problem.

Potential Benefits to the organization by solving the Question/Problem

- The proposed system is a SMS based solution to identify the tripped condition of MSU directly. This system helps to reduce the time taken to correct the fault, which gives commercial benefits to the company. This also helps to upgrade the reputation of the company up to some extent.
- Other advantage is that even though the officers are away from the exchange, they can immediately attend to warning SMS that will be sent directly to their mobile phone.
- Proposed warning system will avoid problems which are currently faced such as revenue loss, billing details loss/call duration data loss, sub management data loss and future conflicts on proper performances.
- Subscribers also get facilitated from this solution. They can use the telephone network with minimum disturbances.

RESEARCH DESIGN WITH A RATIONALE

The training was carried out at the company's switch/exchange. The staff members of the exchange highly concern about exchange failure alarm system that display on the terminal. As an initial step, previous records on failures were collected. After that the failure records were classified according to the cause of tripped MCCB.

For this study, information were obtained from the engineer and the technical staff. Details were obtained from the written documents such as exchange log book, previous records. Master Switching Unit failures data were collected for the years 2007, 2008 and 2009.

Percentage values of hourly failures were calculated according to the date. The graph of percentage vs. hour of the day was plotted in order to get a direct idea about the nature of MCCB tripped condition. According to those results it was found that MCCB tripped probability is high at night time. At that time the authorized staff members are away from the office. So there is no way to monitor the alarm. Therefore, it

was decided to provide a solution to inform this MCCB tripped alarm, to authorized staff members.

DATA COLLECTION STRATEGY WITH A RATIONALE

Different data collection strategies were used in this study. Those data helped to provide a solution to the problems. By analyzing data, a solution was developed to inform this MCCB tripped alarm, to an authorized staff member. Data collection strategies that were used in this study are given bellow.

- Literature reviews were done using the internet and annual report. This data helped to find out PIC based electronic solution for main MCCB tripped condition warning system.
- Surveys were carried out using unstructured interviews with the staff members. The aim of this type of data gathering is to reveal practical experience related to problem. These interviews were conducted with Engineer, Assistant Engineer, technical officer and technical staff of the exchange/switch.
- Company maintains written documents such as exchange logbook, previous records. Usable data were collected from previous documents and books.

DATA ANALYSIS STRATEGY WITH RATIONALE

- From the log book records and terminal displayed data, exchange main MCCB tripped data with tripped time and recovered time were selected.
- Percentages of occurrence of tripped conditions at each and every hour in a given day were calculated and the graph of percentage tripped ability vs hour of the day was plotted.
- The recovery time for each and every tripped condition was calculated.
- This percentage values helped to provide PIC base electronic solution to the exchange.

DESIGNING OF THE EXCHANGE TRIPPED CONDITION WARNING SYSTEM

Designing the Circuit

The DTR (Data Terminal Ready) pin of 16F877A intrigued circuit was connected to a +3 to 12 V supply and RTS (Request to Send) to a -3 to -12V supply. The easy way to achieve this was by using a Max232 or similar transceiver for the RS232 TX and RX pins and then connecting the DTR pin on the serial cable to the V+ pin on the Max232. Similarly processes were done for the RTS. However it was connected to the V- pin on the Max232. The V+ and V- pins were derived from internal charge pumps that double the input voltage.

As the next step, ***universal asynchronous receiver /transmitter*** (UART) in the phone was synchronized with the PC or microcontroller. This was done by sending a string of 0x55 or 'U' 128 times. At this stage BUS is ready to be used for sending frames. (Wikipedia 2009)

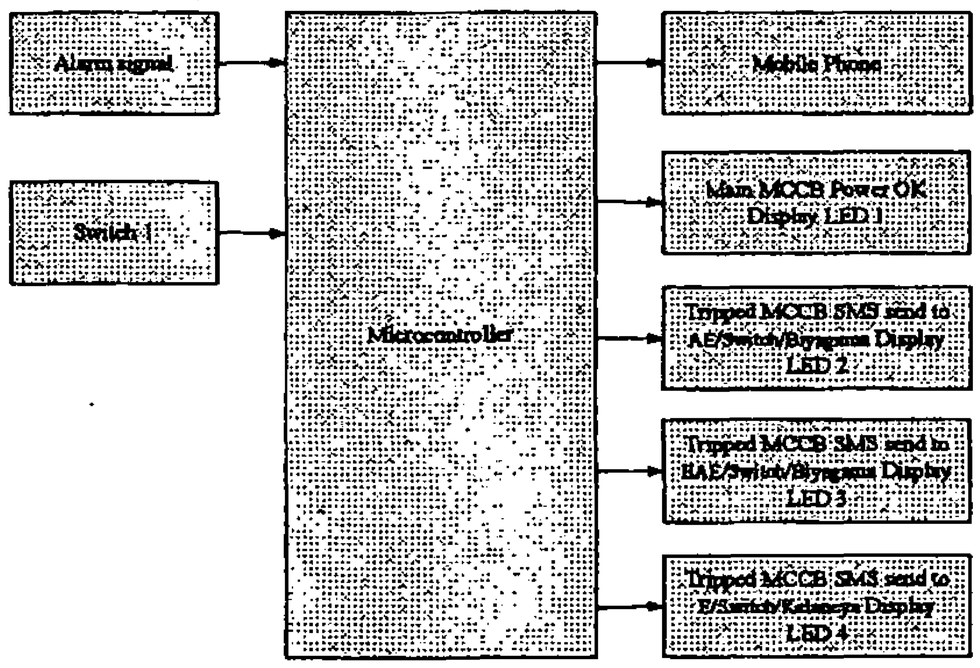

Figure 1: Block diagram of Exchange Tripped Condition Warning System

Implementation of the Exchange Tripped Condition Warning System

Implementation of the circuit

The exchange tripped condition warning system circuit is shown in Figure 2.

PIC16F877A microcontroller was used in this circuit development. Proteus 7 edition software was used to draw the circuit and to simulate the program. (Hall, D. V. 2004)

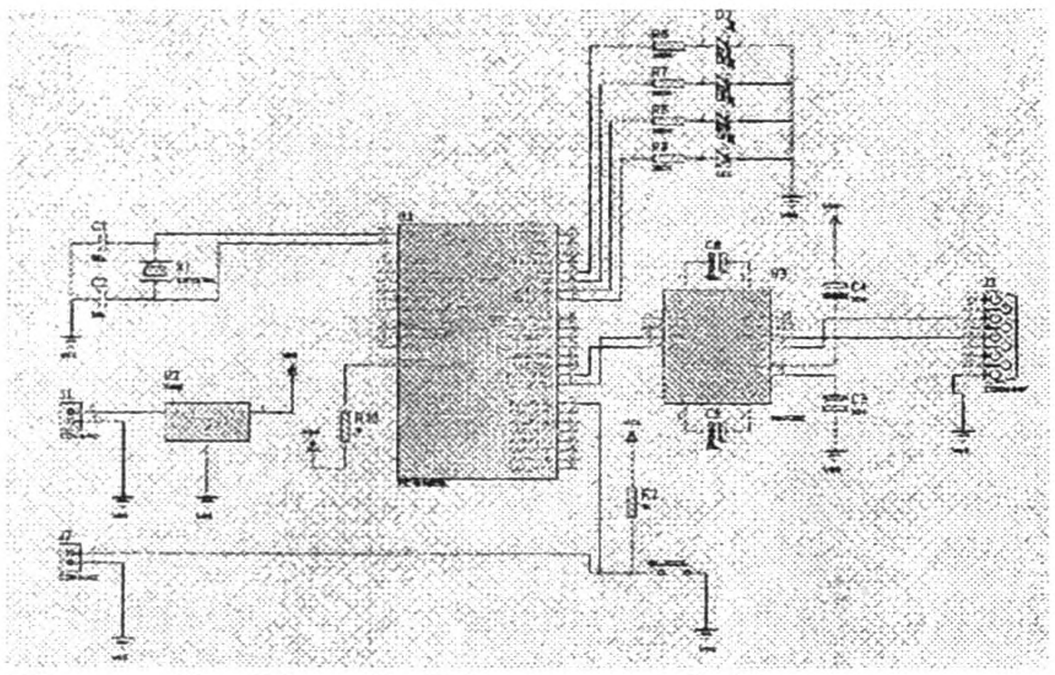

Figure 2: Circuit Diagram of the Exchange Tripped Condition Warning System

Implementation of the circuit to printed circuit board ***(PCB)***

Screen printing technique was used to prepare the ink-blocking stencil. The attached stencil formed open areas of mesh that transfer ink as a sharp-edged image onto a substrate. A roller was moved across the screen stencil, forcing or pumping ink passing the threads of the woven mesh in the open areas. The circuit diagram after implementing it into a PCB is shown in Figure 3.

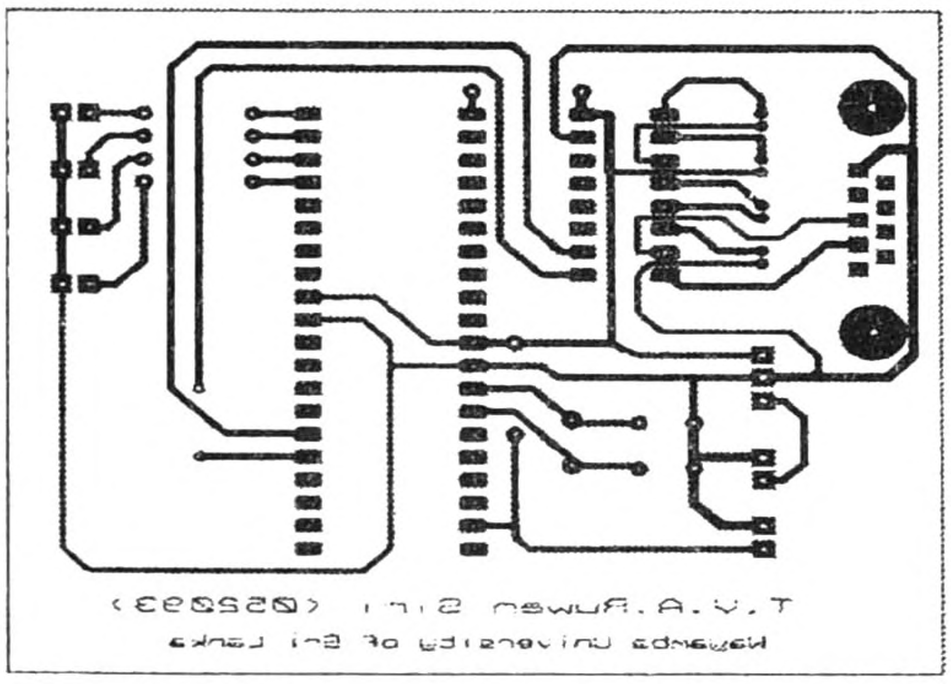

Figure 3: PCB of the Exchange Tripped Condition Warning System

Implementation of the Final Product

The final set up of the system is shown in Figure 4. This circuit monitors the availability of electricity and informs the authorize officers when there is a tripped condition in main MCCB by using a short message (SMS) generated from PIC based electronic system through GSM network.

SMS sending hierarchy of the system,

- Assistant Engineer /Switch – After 1 minute of tripped condition.
- Assistant Engineer /Switch – After 15 minute of tripped condition.
- Engineer /Switch – After 1 hour of tripped condition.

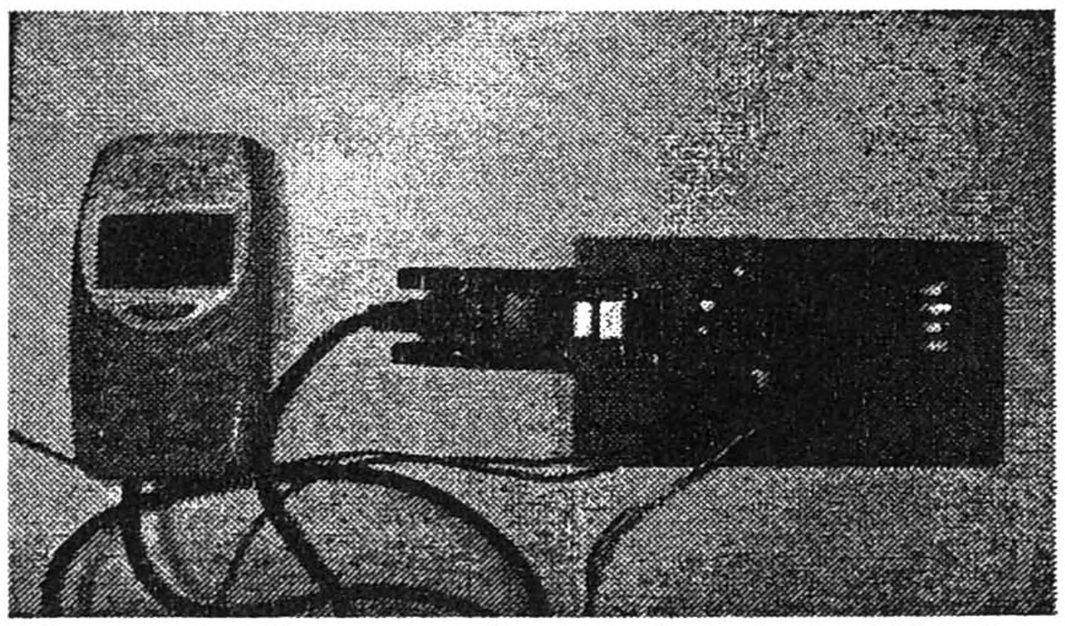

Figure 4: The experimental setup of final implementation

List of Alternative Solutions

- A system can be introduced to identify the power failure immediately as it happen by designing a SMS sending transceiver to inform the responsible staff members by using GSM modem. The proposed solution uses a mobile phone for the sending warning SMS. But GSM modem can be used for this purpose.
- To avoid switch failures, the responsibilities of handling maintenance activities of the switch can be assigned to an employee who is settled near the switch. Then the accommodation facilities should be provided to the employee near the switch.

Selection of Best Feasible Solution and Rationale

- According to first alternative solution, a GSM modem is required. The GSM modem is expensive than mobile phone. Therefore low cost method was selected as a solution for the problem identified.
- According to second alternative solution, one of the employees should be allocated for this sensing process. But this solution is not cost effective and efficient method. Therefore this solution has been neglected.
- So it was identified that designing a SMS sending transceiver is the best low cost method. This will speed up the failure recovery process of the Master Switching Unit.

LIMITATIONS OF THIS RESEARCH/ STUDY

- When a power failure occurs at the exchange, all the power sources may not work properly. Therefore, an external power source has to be used for the designed electronic system. A backup battery current was used as the external power source of the electronic system.
- The synchronization procedure in between mobile phone and microcontroller was very complex.
- It was very difficult to find a suitable mobile phone. This is because some of the mobile phones don't support for the AT command and AT command supported phone work with different kind of modes such as PDU, TEX.....etc. (Hicks, P. E. 1994).

FURTHER/FUTURE RESEARCH OPPORTUNITIES

In this study, SMS sending technique and mobile phone dialing techniques were used. But SMS reading technique can be used as future research opportunities. According to this technique, the staff member can find out main MCCB conditions of the MSU by sending SMS from staff member's mobile phone. In this method, the main MCCB can be monitored by the staff member very easily.

DISCUSSION AND RECOMMENDATION

The SMS based system will monitor the MSUs MCCB tripped condition by informing the relevant officer in charge by sending an SMS though GSM network.
This is a very low cost method and it does not need any drastic change in the present system of the company to implement it.
It is recommended to fix the system in every switching station belongs to the company. By doing so company will be able to minimize the damages caused due to setting down of the entire switching station.

CONCLUTION

The proposed system allows the company to attend to main power tripped condition at a MSU very quickly in any time of the day. This will provide solutions to the problems faced by the company and also to maintain its reputation.

REFERENCES

- CMOSFLASHMicrocontrollers (September2009), http://acg.media.mit.edu/people/simong/hotpants/ tech/media/PIC16F87X.pdf,p.8-9.
- Wikipedia.(November2009), "Crystal Oscillator, MAX232 "online available at http://en.wikipedia. org/wiki/ Crystal Oscillator, MAX 232 Accessed on 2nd November, 2009.
- Hicks,P.E.(1994).Industrial engineering and management. McGraw-Hill.
- Hall,D.V.(2004).Microprocessors and interfacing, Programming and hardware McGraw Hill.
- Pont,M.J.(2002). EmbeddedC. Addison Wesley. CMOSFLASH Microcontrollers, http://acg.media. mit.edu/people/simong/hotpants/tech/media/PIC16F87X.pdf,p.8-9.