SINGLE PHASE POWER OUTAGE ALERT SYSTEM VIA SMS

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Abstract— **The greatest resources found for mankind is electricity. Electricity is a basic utility for everyone around the globe regardless of location and usage. The utilization of electricity is crucial in industries which so lie depends on electricity when come to production. But in practical power failure is a very common scenario in buildings. The power interruption from the service provider is a minimal scenario comparing to the faulty power failures in Malaysia. In most cases this is due to the ELCB (earth leakage circuit breaker) or RCD (residual-current device) which is an automatically-operated electrical switch are used to disconnect electricity supply when there is a fault within the electrical path. It is a written standard in Malaysia to install a circuit breaker which is designed to protect an electrical circuit from damage caused by overload, short circuit and earth high impedance shock. However, the electric trip cannot be noticed unless the circuit breaker is detected at tripped position. In a large area such as industries, public facilities, remotely operated stations and not to be notified when there is a power failure. In assisting such scenario using wireless technology the Power Outage Alert System via SMS (POAS) is designed to alert the user on the event of power failure is detected. The medium used to alert the user is via short messaging system (SMS). The POAS distribution board is an intelligent real-time system which is not only capable of alerting the users on a typical power failure, but going a step advance by alerting the user on the specific fault of their distribution board. The POAS is able to identify the type of power failure and the faulty component in a distribution board. The POAS helps many individual or private users in ensuring continues power supply to industries and any electrical based application which requires instant alert system for power failure to the users regardless of time and location in the shortest time possible. With the implementation of POAS, it will help many possible users to reduce any damages due to electricity failure to their electrical appliances.**

Keywords — **Power failure, short messaging system, microcontroller, electrical distribution board, electrical, component monitoring**

I. INTRODUCTION

A conventional main distribution board (or panel board) is a component of an electricity supply system which divides an electrical power feed into subsidiary circuits, while providing a protective fuse or circuit breaker for each circuit, in a common enclosure. Normally, a main switch, and in recent boards, one or more Earth Leakage Circuit Breaker (ELCB) or Miniature Current Breakers with Overcurrent protection (MCB), will also be incorporated. The circuit breaker is defined as a mechanical switching device that capable to break currents under specified abnormal circuit conditions, such as those of a short circuit or lightning occurrence. The ELCB unit works by monitor s the amount of currents flowing through the Live (Phase) conductor and returning back down the Neutral conductor. The ELCB has rating of 30mA as allowable difference between the Live and Neutral. Should this difference of currents be exceeded, then the ELCB will trip. As well as a MCB unit which built with an electro-mechanical relay technology function to supply power to each load independently and only that particular MCB unit connected with the appliances will be tripped when a short circuit occurred [5 - 6]. Standard electrical distribution board is as shown in Figure 1.

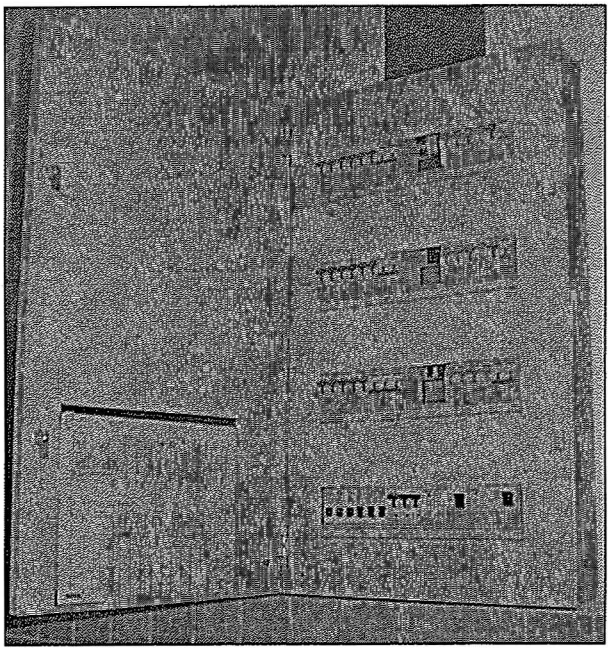

Figure 1: Standard electrical distribution board

Although continuous electricity is supplied to the premises, some errors due to technical problem may cause the supply of electricity to the users to be broken. One of the major technical problems that may arise is the power outage. A power outage refers to the short- or long-term loss of the electric power to an area. There are many causes of power failures in an electricity network. Examples of these causes include, faults at power stations, damage to power lines, substations or other parts of the distribution system, a short circuit, or the overloading of electricity mains. Power failures are

particularly critical at sites where the environment and public safety are at risk such as hospitals, sewage treatment plants, mines etc. In some places, normally in heavy industrial and remote location areas, electrical appliances need to operate for longer period (usually 24 hours). Electricity is needed to ensure the instruments (e.g. network servers) are fully operated for longer period. These areas usually are not monitored and if any electrical fault (power outage) occurred will not be noticed. The discontinuity of electricity due to power failure would cause operation of machines, equipment or devices to stop and delaying any work that going on. In computational industries, sudden power outage will cause any unsaved data on network to lose permanently [1].

So, if the electrical has been tripped or any electrical faulty occur, either ELCB or MCB will push down to avoid electrical shock to the electrical appliances or loads connected with the electrical installations. At this moment, no electrical trip or warning indication is displayed or triggered. This will make the electrical faulty or trip occurrence is not visible and not able to notify any user. Moreover, the electrical trip that has occurred does not notifying which component is faulty actually and which component causes the electrical trip. The trip also will be come to known if there is any person that saw for personally in the Distribution Board or sense for no electricity when electrical appliances stop working or suddenly stopped [1].

II. POWER OUTAGE ALERT SYSTEM

The power outage alert system is designed to be an intelligent system for monitoring electrical fault at remote locations which has installed the Distribution Board. This system is fully automated and operates without human intervention at all time. The power outage alert system has many features which enable the monitoring area locations to be alert in a glance of seconds when an electrical fault occurs due to short circuit or lighting. This self-operated system enables the monitoring station to be informed on any changes of electricity break at a certain location on real time basis. The electrical protection system require regular monitoring especially when high voltage of appliances are used or rainy season since lighting can cause the ELCB to be tripped due to high impedance of shock. The power outage alert system can be implemented at critical power dependent locations such as hospitals and also in remote areas for effective monitoring [10].

The most valuable information given by this system is instant electrical fault alert information. This information will include the details of the faulty electrical component, location where the component is installed and also the time of electrical fault occurred. If a system capable to sending such information in real time to the monitoring station without human intervention and regardless of the distance between monitoring station and the system installed, quick action can be taken. Apart from alerting the monitoring stations, the system can display instantly the faulty electrical component in the distribution board using a LCD display. The power outage alert system consists of a number of components working together to perform simple repetitive task. The basic system requires electrical wiring and relays used to detect the electricity break, a control unit to process between the inputs and output, and a GSM modem to establish wireless communication between electrical system protections (DB) and the monitoring station.

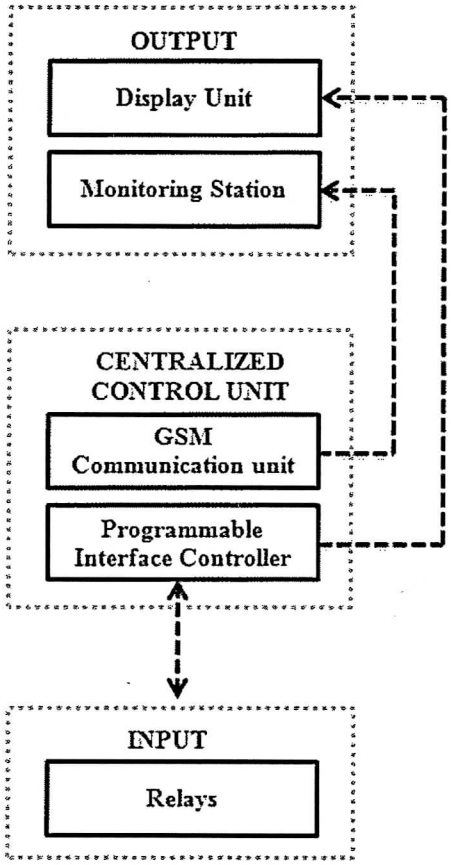

Figure 2: Block diagram of the power outage alert system

The electricity trip in distribution board can be detected by the electrical wiring and relays which connected to the control unit as an input. The relays will play a role when the AC power which supplied to the coil of the relay is allowed and disallowed at certain period. The relay then connected to a control unit (Programmable Intelligent Controller) sends signal to process the electrical fault information to be sent to the monitoring station as programmed, via the short messaging system(SMS). The power outage alert system consists of display systems to make ease by popping up the electrical faulty component in a LCD display. Hence, it can help to identify specifically which component has been caused for the electrical trip.

A. Relay

Relays are most suitable device to act as a sensor to detect the electrical trip due to its electrical operated switching ability. Electric current through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions (they are double-throw). This relay type has 8 pin types and works by switching the Common pin to either NC pin or NO pin when the coil is energized by AC current source. In this system, the relays are connected respectively to each of the electrical component so it will process the different type of inputs. That inputs will identifying which electrical component that has been tripped in the output.

The relays are connected to the relay base which can be mounted on the DIL rail and will hold in a stable structure. The wiring connections for relay base also can be done easily by tapping the wires and screwed to connect to the relay pins respectively. There are few causes that leading to unexpected electrical trip to occur. Table 1 shows the examples of the types of causes and type of electrical component that fault:

Table 1: The causes of electricity trip and effects

Cause	Electrical component fault
No electric supply	Main Switch
Short circuit	ELCB, MCB
Overload Current	MCB
Lighting	ELCB

B. Controller

The controller unit used for the Power Outage Alert System is the Programmable Interface Controller (PIC) microcontroller. The PIC will interface between the inputs and outputs as programmed using C # language programming. The PIC will receive input signals from the relays and process information to produce the output to be sent to the monitoring station via the short messaging system (SMS) [2 – 3].

The communication between the Power Outage Alert System and the monitoring station is established using a GSM modem to send real time electrical fault information to enable further action to be taken once the alert message is notified. The PIC able to interface directly to the GSM modem and perform streaming communication as programmed in the controller unit.

The controller unit also programmed to display the electrical faulty component to popping up on the LCD display. For any changes that happen in the distribution board electrical components, the status of the LCD display content will be changed instantly. A PIC which has many available ports to be used is better for future usage when the number of MCB is increased according to the electrical installation and usage [9]. Figure 3 shows the prototype of a power outage alert system.

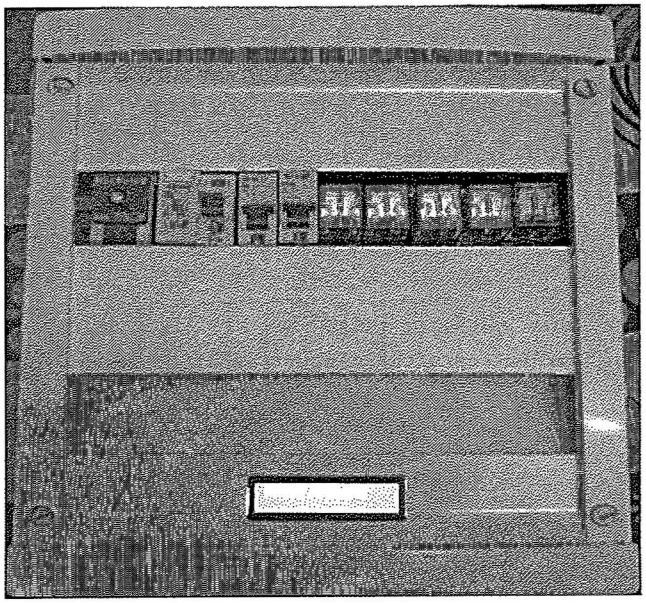

Figure 3: Prototype of power outage alert system

C. Display unit

The power outage alert system has two indicators that will alert the electrical trip happens in the main distribution board. A running text display connected to the controller unit so any changes happen in distribution board can be shown its status in the LCD display also. The LCD display is placed on the distribution board where it is visible and easy to be read by anyone. The LCD also used to specify which electrical component has been tripped or fault in the distribution board, where a user can easily recognized that particular component. The LCD screen has in blue background light where the font is in white color, which is easy to be seen even in the dark places [8 - 9].

Apart from showing indication on text display, the Power Outage Alert System capable to send alert notification to the monitoring station via short messaging system (SMS). The SMS notification is the best medium of wireless communication where factor of distance between the control system and monitoring station can be negotiated. The real time information that processed and sent via SMS always contain the accurate details such as the electrical faulty component, exact location and the time where the trip has occurred. The GSM modem (SIM300) used in this POAS system is capable to send SMS even in the remote location area. This can help to ensure the notification is successfully sent out when the system depending on the alert system via SMS [7].

III. THE OPERATION OF A POWER OUTAGE ALERT SYSTEM

The Power Outage Alert System works to detect electrical trip by monitoring the electrical system and send alert display via SMS. Each AC relay used is connected with each component that will probably cause the electrical blackout or dropout. The coil of relay is wired through the LIVE and NEUTRAL wire from each component. Then the relay will detect if any electrical occur by connecting its Common (C) pin to the Normally Closed (NC) pin which is connected to the SK40B PIC general purpose circuit and send high voltage to be compared. The SK40B which programmed using the C# language compiler will analyses the type of failure occurred and produce output according the command. The SK40B PIC circuit is supplied with 5Vdc and wired to ground. This will control the input detection by using the voltage comparison which defined the 5Vdc as high input and OV as low. Figure 4 shows the operation flow for the power outage alert system.

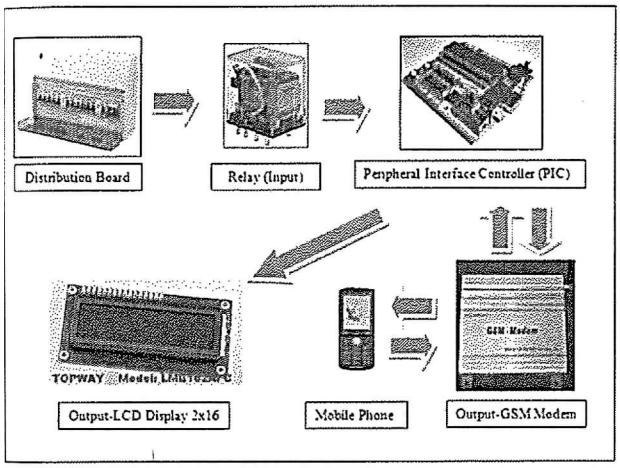

Figure 4: POAS operation system

Then, the SK40B produces output to be displayed on LCD display. This will notify the current status of power operation on Distribution Board. If any electrical trip occurs, it will display which component had failure or tripped. This can help notify any user that currently checking the distribution board or electrician who responsible to repair the electrical faulty. A the same time also, a Short Messaging System (SMS) contains the details of exact location and type of electrical failure is sent to a mobile phone to alert the user about the power operation current status. This will help the user to respond quickly over the electrical trip [4].

IV. TYPE'S OF FAULT DETECTED

The new revolution in alerting both the remote station personnel and users on real time electrical trip information using Power Outage Alert System is an effective and efficient technique. Instant alerts on electrical trip using sms is the most common technology that humans are engaged with during working hours and during their leisure time. A wide coverage of network can ensure the sms which contain the information to be sent as quick and exact to the receiver (user). There is sometimes this delay happens when the period to send the sms is the peak time or having technical error with the communication tower, the sms still can be sent out whenever the coverage line is detected back by the GSM modem.

The Power Outage Alert System is an upgrade system of a conventional main distribution board which able to detect the electrical trip and the electrical faulty component and alert the monitoring station on any electrical changes in DB. For an instance, a prototype of Power Outage Alert System is invented which consist of 1 Main switch, 1 ELCB and 2 MCBs. There will be 6 available electrical changing statuses that can be as the input to be displayed in the LCD display. The 6 types of available inputs are:

A. POWER FAILURE

This message will pop up on LCD display when the condition is no power source from the main electric substations or TNB.

B. POWER ON

This message will pop up when there does power source exist and the power operation in Distribution Board is going on normal condition.

C. MAIN SWITCH FAILURE

This message will pop up on LCD display when the condition MAIN SWITCH is faulty or tripped due to excessive current.

D. ELCB FAILURE

This message will pop up on LCD display when the condition ELCB is faulty or tripped due to excessive current.

E. MCB 1 FAILURE

This message will pop up on LCD display when the condition MCB 1 is faulty or tripped due to excessive current.

F. MCB 2 FAILURE

This message will pop up on LCD display when the condition MCB 2 is faulty or tripped due to excessive current.

V. CONCLUSION

The Power Outage Alert System in an intelligent system which is capable of sending real time electrical trip occurrence information from a remote location to a monitoring station which could be at a distance away,

regardless of time. The system also features alerts unit to display warnings and alerts to the users via text displays in the event of power failure [12].

One of the special features of the Power Outage Alert System is that it is self-monitoring. Self-monitoring ensures the system performs efficiently and reliably for the monitoring station in the event of power failure, which includes the electrical trip detection unit and power supply unit.

The implementation cost is invaluable to the efficiency and usefulness of the system towards mankind. The practicality of the system helps to minimize the overheads due to electrical trip and prevents the delaying to use electrical appliances.

A system for electrical trip monitoring and alert system was developed so that it can help mankind to perform quick respond due to electrical trip occurrence.

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REFERENCES

[1] Scadan,Brian. (1996). Electric Wiring Domestic. Basingstoke Machillan.

[2] Brian W. Kernighan.(1998).The C programming language.Englewood Cliffs, NJ: Prentice Hall

[3] D.S. Malik. Fourth Edition. (2008).C++ Programming: From Problem Analysis To Program Design. Boston,USA. Course Technology

[4] SIM300 AT Commands Set, SIM300_AT_V1.03, 2008

[5] Ray C. Mullin and Robert L. Smith, Electrical Wiring Commercial: Based on the 2005 National Electrical Code, Cengage Learning, 2004, pp. 252 - 282

[6] Paul Gill, Electrical Power Equipment Maintenance and Testing, *Volume 32 of Power Engineering (Willis) Series*, CRC Press, 2008, pp. 15 -32

[7] A. Henry-Labordere, Vincent Jonack, SMS and MMS interworking in mobile networks, *Artech House mobile communications series*, Artech House, 2004, pp. 215 – 220

[8] Steve Oualline, Practical C++ programming, *Practical Series, Safari Tech Books Online*, O'Reilly Media, Inc., 2003, pp. 76-85.

[9] D. W. Smith, PIC in practice: a project-based approach, Newnes, 2006, pp. 229 - 243

[10] IEEE Industry Applications Society. Rural Electric Power Committee, 1996 IEEE Rural Electric Power Conference, the University of Michigan, 1996.

[11] Institution of Electrical Engineers, Computer and control abstracts, Volume 16, Part 2 - Volume 19, Part 2, Institution of Electrical Engineers, 1981, pp. 2536 & 2863

[12] Phillip A. Laplante, Real-time systems design and analysis, Wiley-IEEE, 2004, pp. 12 - 19