Overhead Line Fault Detection Using GSM Technology

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Abstract— **In this paper, a novel technique for the fault detection, classification & protection of transmission lines is proposed. The proposed system uses different protective equipment's, voltage sense section, microcontroller section, LED display section & GSM (global system for mobile communication) module. The faults like all series (1LO,2LO,3LO etc.) & shunt faults (L-G,L-L,L-L-G, L-L-L, L-L-L-G) get detected & classified according to characteristics condition of current & voltage at the occurrence of fault in the three phase overhead lines. The sensed signals are given to microcontroller for detection & classification of faults. . Also wireless mobile communication technique i.e. GSM is used simultaneously to send message to responsible person on mobile. Type of fault gets displayed on fault display section. Simultaneously fault gets interrupted using protective devices. (fuse, circuit breakers etc.)**

Keywords—GSM technology, series & shunt fault detection, voltage sense section, microcontroller section, fault display section

I. INTRODUCTION

Transmission line protection is an important issue in power system engineering because 85-87% of power system faults are occurring in transmission lines

The paper presents design and implementation of transmission line fault detection, classification & protection technique. The three phase voltage sensed is continuously given to microcontroller. The implemented system completely meets the demand of low cost by using the microcontroller and mobile communication technology with the aim to detect the abnormality and fault occurred in the overhead electric line.

1. Electrical networks, machines and equipment's are often subjected to various types of faults while they are in operation. When a fault occurs, the characteristic values (such as impedance) of the machines may change from existing values to different values till the fault is cleared. There may be lot of probabilities of faults to appear in the power system network, including lighting, wind, tree falling on lines, apparatus failure, etc.

2. The fault inception also involves in insulation failures and conducting path failures which results short circuit and open circuit of conductors.

Under normal or safe operating conditions, the electric equipment's in a power system network operate at normal voltage and current ratings. Once the fault takes place in a circuit or device, voltage and current values deviates from their nominal ranges. Usually power system networks are protected with switchgear protection equipment's such as circuit breakers and relays in order to limit the loss of service due to the electrical failures after the occurrence of fault.

3. The design of systems to detect and interrupt power system faults is the main objective of power-system protection. The main types of faults are symmetric and asymmetric.

A symmetric or balanced fault affects each of the three phases equally. In transmission line faults, roughly 5% are symmetric. This is in contrast to an asymmetrical fault, where the three phases are not affected equally.

An asymmetric or unbalanced fault does not affect each of the three phases equally. Common types of asymmetric faults, and their causes:

• Line-to-line - a short circuit between lines, caused by ionization of air, or when lines come into physical contact, for example due to a broken insulator.

• Line-to-ground - a short circuit between one line and ground, very often caused by physical contact, for example due to lightning or other storm damage

• Double line-to-ground - two lines come into contact with the ground (and each other), also commonly due to storm damage.

II. HARDWARE DESIGN

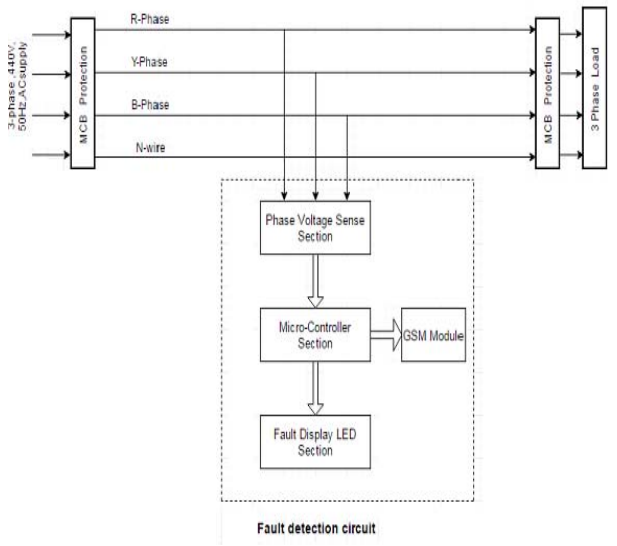

Figure.1 Functional block diagram of the circuit

A. WORKING OF BLOCK DIAGRAM

Figure.1 shows block diagram of the hardware circuit. The three phase parameter i.e. voltage of overhead line will get continuously sensed using phase voltage sense section. Once the fault takes place in overhead line, voltage and current values deviates from their nominal ranges. The faults like all series & shunt faults get detected & classified here. During occurrence of any series (1LO, 2LO, 3LO etc.) & shunt faults (L-G, L-L, L-L-G, L-L-L, L-L-L-G etc.), voltage get sensed and respective signals are given to microcontroller. . Relay is connected for detecting fault in fault display section. Relay is operated by micro-controller and switched after the occurrence of faulty condition. Microcontroller programing is done on the basis of characteristics conditions of overhead line voltages on occurrence of fault. The type of fault gets analyzed by microcontroller. If the fault gets occurred wireless technology GSM (global system for mobile communication) is used to send SMS to a responsible person on mobile. Type of fault will display on fault display section. Simultaneously fault will clear. The fault clearing systemuses various protection devices such as relays and circuit breakers to detect and clear the fault.

The three phase voltage sensed is continuously given to microcontroller. The implemented system completely meets the demand of low cost by using the microcontroller and mobile communication technology with the aim to detect the abnormality and fault occurred in the overhead electric line.

B. FAULT DETECTION CIRCUIT

a. PHASE VOLTAGE SENSE SECTION: Figure.2 shows voltage sense section for one phase. This circuit converts AC line voltage to DC voltage using diode and limiting its current by resistor R_2. For converting this high DC voltage to micro-controller compactible voltage level i.e.5V DC, series resistor and capacitor combination is used. Variable resistor used for fine tuning up to 5V voltage level for micro-controller. Relay is connected for detecting fault. Relay is operated by micro-controller and switched after the occurrence of fault condition.

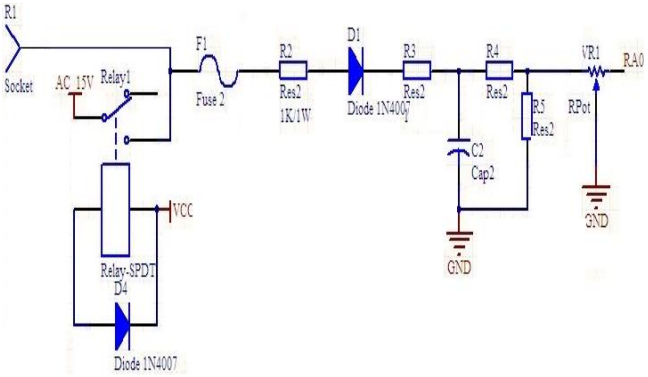

Figure.2 Voltage sense section for one phase

b. MICROCONTROLLER SECTION

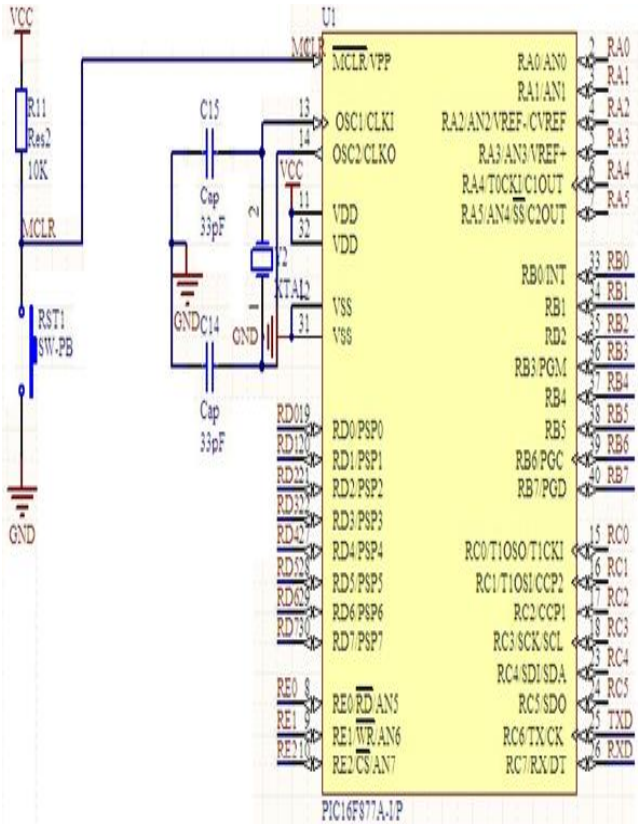

Figure.3 Micro-controller section

Figure.3 shows micro-controller section. Here 40 PIC16F877A micro-controller is used. It is 8 bit microcontroller with 33 input/output pins.it works on 5-10 V external DC supply. Trough C programing micro-controller is able to detect the type of fault (series & shunt) in the case of transmission & distribution lines

c. FAULT DISPLAY LED SECTION: Figure.4 shows fault display LED section. It mainly consists of LED's followed by current limiting resistors. All LED's are 5mm diffused LED's with 5 mA operating current. Resistors are of 1KΩ, to limit the current sourced by microcontroller and given to LED's. All LED's are operated by microcontroller only. During the occurrence of any series or shunt fault, the respective LED gets glow.

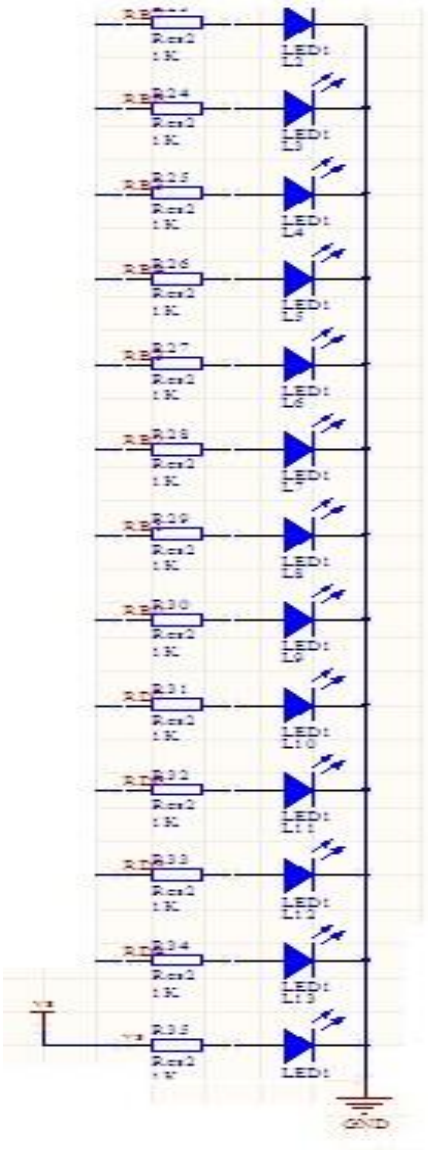

Figure.4 Fault display LED section

d. GSM COMUUNICATION MODULE

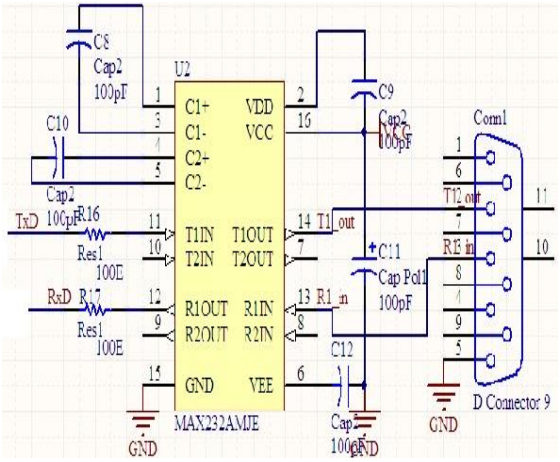

Figure.5 GSM communication module

Figure.5 shows GSM communication module. This section mainly consists of MAX 232 IC for communication of microcontroller with GSM module. Since micro-controller works on 5V voltage level and serial communication with computer system works on 12V voltage level, so for boosting signal from 5V to 12V, MAX232 IC is used.

GSM module works on 5V supply only. MAX232 IC has 5×10µF/50V capacitor connected to it for voltage boosting purpose. It sends data serially from micro-controller to either PC or GSM module.

III. IMLEMENTED SOFTWARE TOOL

A. PROCESS FLOWCHART:

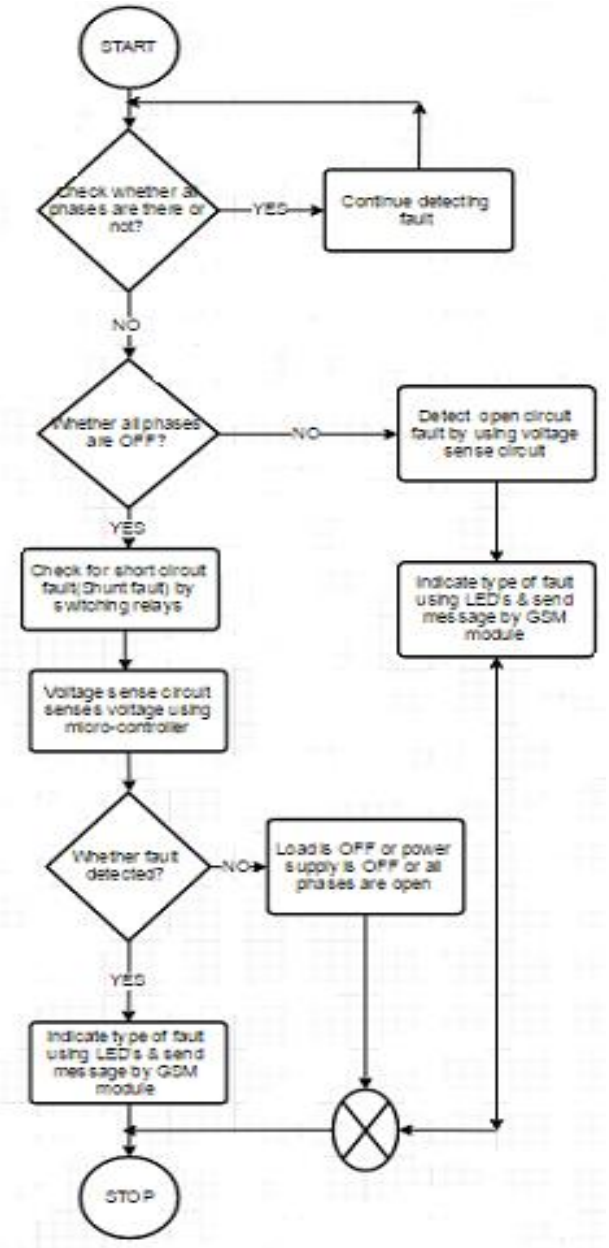

Figure.6 A process flowchart

IV. PERFORMANCE EVALUATION/ RESULTS

Table 1

SR NO	Type of fault	LED GLOWS
	Series faults	
1	Phase R open (RO)	L1
2	Phase Y open (YO)	L2
3	Phase B open (BO)	L3
	Shunt faults	
4	Phase R to ground (R-G)	L4
5	Phase Y to ground (Y-G)	L5
6	Phase B to ground (B-G)	L6
7	Phase R to Y (R-Y)	L7
8	Phase Y to B (Y-B)	L8
9	Phase B to R (B-R)	L9
10	Phase R to Y to B (R-Y-B)	L10
11	Phase R to Y to ground (R-Y-G)	L11
12	Phase Y to B to ground (Y-B-G)	L12
13	Phase B to R to ground (B-R-G)	L13
14	Phase R to Y to B to ground (R-Y-B-G)	L14

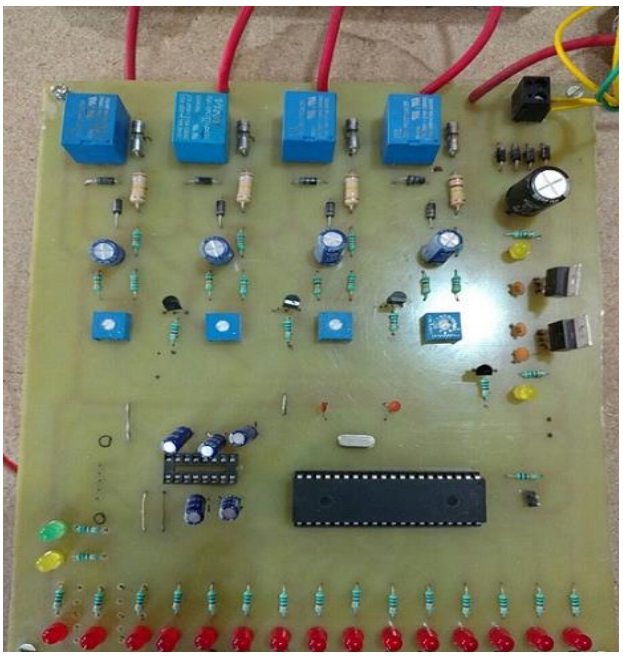

Figure.7 Implemented fault detection circuit

V. FUTURE SCOPE

1. Faulty point exact distance identification.
2. Three phase line parameter data logging.
3. Minimize fault detection time.
4. Application of fault clearing techniques.

VI. CONCLUSION

The implemented system design mainly concentrates on overhead electric power lines. It provides the way to detect all series and shunt fault on transmission and distribution lines. Voltage of the line will get continuously sensed using phase voltage sense section. During the occurrence of any series and shunt fault on the three phase line, voltages get sensed and respective proportional signals are given to microcontroller. The type of fault is detected by microcontroller. . If the fault gets occurred wireless technology GSM (global system for mobile communication) is used to send SMS to a responsible person on mobile. Type of fault is gets displayed on fault display LED section. Simultaneously fault is get isolated using circuit breakers to provide proper protection to the overall system, especially against shunt faults

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