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Circuit Breaker trip detection and intimation via WiFi using Raspberry Pi.

S.Sivasubramanian

Department of Electrical and Electronics Engineering, SSN College of Engineering

Abstract **- The Circuit breaker status needs to be constantly monitored for proper functioning of the power system. This can be done with the help of Wifi which sends the notifications about the current position of the circuit breaker to a mobile phone. This is achieved by constant monitoring of the voltage level from the circuit breaker. There is no need of human to computer interaction for Data transfer. The system consists of sensor types like the voltage sensor. The Raspberry Pi tool is a prime component involved in determining the breaker position. We present a general -Raspberry Pi based sensing and transmitting network which reliably determines the voltage level from the breaker with good accuracy and transfers the corresponding to a mobile phone. The implementations and experiments were tested and it was better than the previous techniques since it can notify multiple mobile devices at the same instant. Finally the device was installed in a substation and the accurate results were obtained.**

Index Terms**— Circuit breaker status, Raspberry pi, voltage sensing.**

INTRODUCTION:

A Circuit Breaker is an automatically operated electrical switch which is used to protect an electrical circuit from damages caused due to excess current resulting from an overload or short circuit. Once a fault is detected, the circuit breaker trips, thereby interrupting the flow of current. The main difference between a fuse and a circuit breaker is that once a fuse is operated, it must be eventually replaced by a new one whereas in case of circuit breakers, they can be reset (either manually or automatically) to restore the power. The various types of Circuit Breakers include:
Low Voltage CBs, Magnetic CBs, Thermal Magnetic CBs, Magnetic Hydraulic CBs, Air CBs, SF6 CBs, Vacuum CBs.

The system with which we are primarily working on is Air Circuit Breaker. The previous systems involved the Circuit Breaker trip detection using an Electronic Circuit Breaker finder. The transmitter section has a mechanical contact with the device whose status is to be found. The receiver section beeps and flashes once it passes over the circuit with the transmitter in contact with the device.The main disadvantage of this system was that this process was not automatic and required constant monitoring from a person.

Another system was proposed in which the circuit breaker trip was detected using sensors and a message was sent to the respective mobile with the help of Subscriber Identification Module cards (popularly known as SIM cards). Once the breaker trips, the GSM MODULE gets activated and a message will be sent. Though this system is simple, it has many disadvantages:

1) The message could be sent to only one device i.e. only one person can receive the message throughout the operation.
2) The SIM card to be used needs to be recharged from time to time, else the device will fail.

In the proposed system the power utility maintains a server. The server uses WI-FI modem and WI-FI module respectively to communicate with each other using the WI-FI network. The system consists of potential transformers, voltage sensor, MCP3008 ADC, Raspberry pi 3 model b and a relay. The potential transformer is used to step down the incoming single phase 230V AC to 12V. The potential transformer is connected to the voltage sensor network which has a bridge rectifier, capacitors and resistor. The voltage sensor detects the incoming voltage as 3.3V and passes it to the MCP3008 ADC. It converts the incoming analog values into digital signals and is connected to the Raspberry pi3. This means that 3.3V detected in MCP3008 refers to 230V in incoming supply.

This Raspberry Pi network is used to monitor the voltage level constantly because we need accurate information to be passed on to the consumer at all times. Once the voltage level falls below a particular value, the Raspberry pi network activates the alarm signal and when connected

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with wifi sends a text message to the respective phone numbers.
The main advantage of the proposed system is that there is no need of constant maintenance from the consumer. Also the messages could be sent to more than a single device from the Raspberry PI.

PROCESSING METHODELOGY

EXISTING SYSTEM:

The existing system consisted of GSM network which senses the voltage in a substation and sends the corresponding to a mobile phone. This is useful in circuit breaker monitoring and is of low cost. The microcontroller transfers data from field side to a mobile phone through GSM networks periodically. Another existing system is based on use of PLC and SCADA software. It is very much costly but highly reliable where PLC trips the relays and circuit breakers once a fault occurs.

DISADVANTAGES:

- Complex program.
- Huge Manpower needed.
- Constant monitoring of the system.

PROPOSED SYSTEM:

The proposed system relies on the basic principle that once a breaker trips, the voltage level of the distribution platform drops. The system uses the following hardware components.

•Transformer:
The Transformer used in the system is a step down transformer. It takes 230V AC as input and steps it down to 12V.

•Voltage sensor:
The Voltage Sensor is one of the prime components of the proposed network. It has a bridge rectifier which converts the incoming AC to DC. Capacitors of capacitances 50µF and 10µF are also connected along with a resistor of 220 ohms.

•MCP3008:
The MCP3008 is a 8 channel 10 bit analog to digital converter. Its cost is significantly lower. It is used in the system because a Raspberry pi cannot directly detect analog signals. The MCP3008 takes 3.3V DC as the input from the Voltage sensor. This means that 3.3V DC in MCP3008 corresponds to 230V AC in the input side.

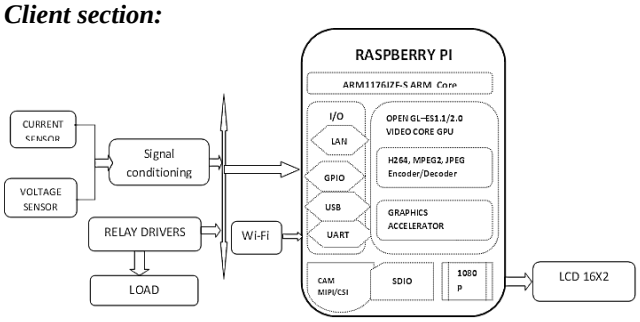
•Raspberry pi3 model b:
As mentioned earlier, Raspberry Pi 3 forms the heart of the entire process. It constantly monitors the input through the ADC. Once the voltage drops beyond a particular level, the Raspberry pi triggers an alarm circuit.
• Alarm circuit:
The alarm circuit is triggered once the breaker trips due to the fault conditions. It has a led indication to notify that the supply has been cut off.

• Relay:
The Relay used is of 10A capacity. It is mounted on PC board.

ADVANTAGES:

- Wireless form of communication is achieved. The system can send a message to the pre - programmed mobile numbers in any part of the world once the required condition is met.
- The main advantage is that the messages could be sent to more than a single mobile device. This means that the device, once triggered due to occurrence of a fault can send multiple messages to multiple numbers at the same time. This was the major drawback of the previous versions.
- The device is much simpler and costs less than corresponding versions like SCADA
- Real time operation is possible.

BLOCK DIAGRAM:
Client section:



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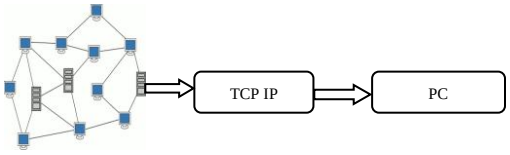
SERVER SECTION:

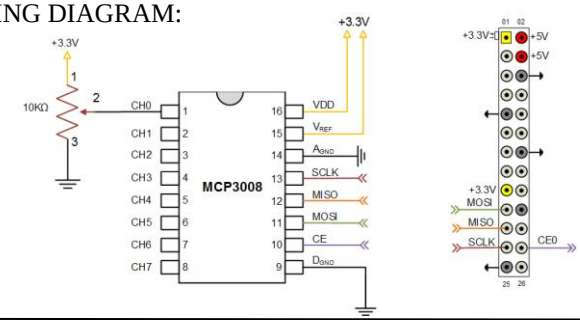


BLOCK DIAGRAM EXPLANATION:

Many technologies and methods have been used in IOT based system to achieve the smart meter management and processing of the data, here the data is collected from the different sensors and sent to a Raspberry Pi. The key section of data processing includes data acquisition, storage, inquiry, and analysis. In this project, a data processing framework is applied in the online monitoring system to deal with massive number of heterogeneous data collected from the underlying physical layer. The framework is composed of various layers and the device Layer consists of various kinds of sensors which are used to measure parameters (such as current transformer, power transformer, etc.) of the equipment. It is at the bottom logic structure of the system.

Data processing layer mainly deals with the large amount of data generated by online monitoring system. Its task includes validation, storage and analysis of the data. Device management layer is made up of two kinds of flows. The function of the data flow is to convert the heterogeneous data, which is obtained by different protocol technology in the physical layer, into a unified format data. The function of the process flow is to response to services requests from upper layer, and then converts it into the commands which can be performed by different underlying technologies. In this proposed project we are controlling and monitoring the different sensors which are connected to the device and finally the collected data we will transmit to the admin system which is connected to Wi-Fi.

WIRING DIAGRAM:



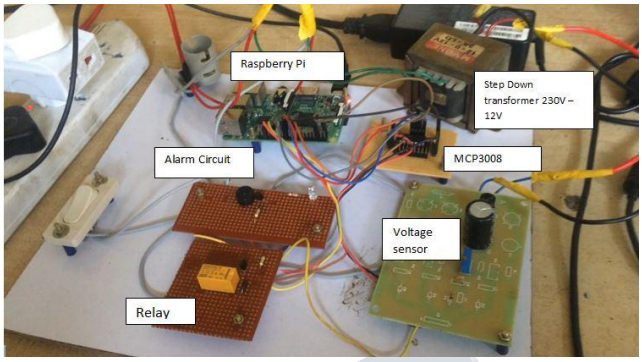


Fig 1: Entire setup which detects the circuit breaker trip and intimates the corresponding to a mobile number.

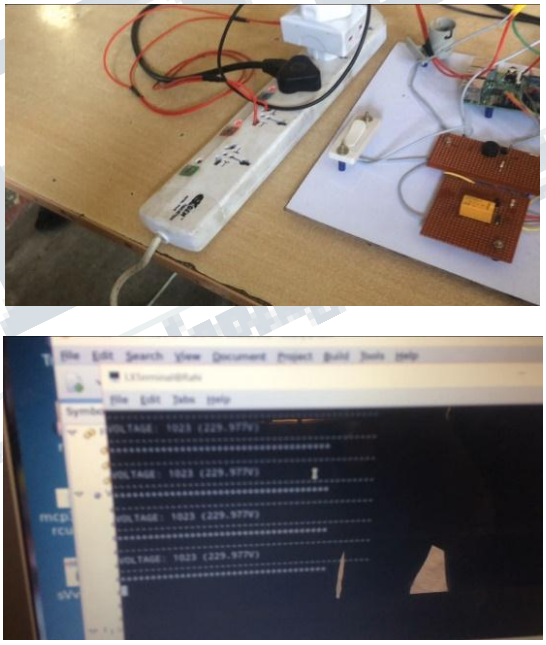


Fig 2: The circuit detects the normal voltage when power is switched on.

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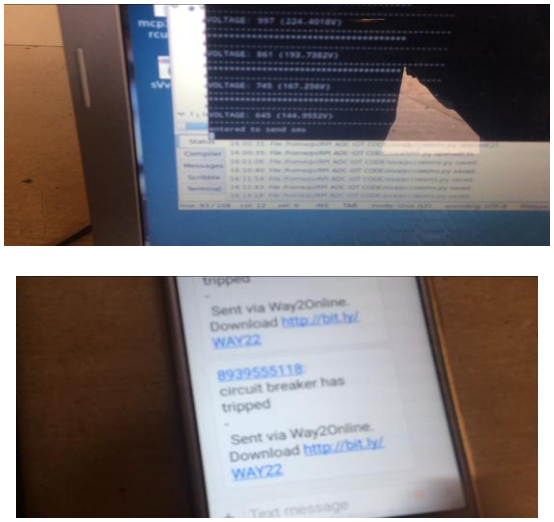

Fig 3: Once the voltage level drops, the circuit detects it and below a particular level, an alarm is sent to the corresponding mobile number.

SOFTWARE TOOLS:

The following codes are in Python language which is processed by the Raspberry Pi.
The main program is:

```
#!/usr/bin/python
#header or libraray decleration
import RPi.GPIO as GPIO
import spidev
import serial
import time
import decimal
import os
import subprocess
#GPIO pin declaration and selection
GPIO.setmode(GPIO.BCM) #Here we take a GPIO pins in RPi, it's not a BOARD pin, given in RPI diagram in desktop
GPIO.setup(12,GPIO.OUT) #Here we declare a GPIO 12 is an OUTPUT pin
GPIO.setup(16,GPIO.OUT) #Here we declare a GPIO 16 is an OUTPUT pin
GPIO.setup(5,GPIO.OUT) #Here we declare a GPIO 5 is an OUTPUT pin
port=serial.Serial("/dev/ttyAMA0", baudrate=9600, timeout=3.0)#set baudrate and timing for SPI communication
#Here intially all the GPIO pins are LOW or 0(ZERO)
GPIO.output(12, False)
GPIO.output(16, False)
GPIO.output(5, False)
# Open SPI bus
spi = spidev.SpiDev()
spi.open(0,0)
 # Function to read SPI data from MCP3008 chip
# Channel must be an integer 0-7
def ReadChannel(channel):
  adc = spi.xfer2([1,(8+channel)<<4,0])
  data = ((adc[1]&3) << 8) + adc[2]
  return data
 # Function to convert data to voltage level,
# rounded to specified number of decimal places.
def ConvertVolts(data,places):
  volts = (data * 3.3) / float(1023)
  volts = round(volts,places)
  return volts
 # TMP36 data, rounded to specified
# number of decimal places.
def ConvertTemp(data,places):
   # ADC Value
  # (approx)   Volts
  #    0        0.00
  #   78        0.25
  #  155        0.50
  #  233        0.75
  #  310        1.00
  #  465        1.50
  #  775        2.50
  # 1023        3.30
  temp = ((data * 330)/float(1023))-50
  temp = round(temp,places)
  temp = temp *1.5
 return temp
 # Define sensor channels
voltage_channel = 0
 # Define delay between readings
delay = 3
HB = 0
try:
  while True:
    voltage_level = ReadChannel(voltage_channel)
    voltage_volts = ConvertVolts(voltage_level,2)
    voltage = (voltage_volts*69.69)
    # Print out results
    print "--------------------------------------------"
    print("VOLTAGE:                                {}
({}V)".format(voltage_level,voltage))
```

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```
   print "-----------------------------------------"
 if(voltage < 150):
     GPIO.output(5,True)
     GPIO.output(16,True)
     time.sleep(1)
     GPIO.output(5,False)
     GPIO.output(16,False)
     time.sleep(1)
     subprocess.Popen("sudo python
pccoesms.py",shell=True).communicate()
     subprocess.Popen("sudo python
siva.py",shell=True).communicate()
 file=open("/home/pi/log.txt","w")
   file.write("VOLTAGE: ")
   file.write(str(str(voltage)))
   print ("************************************")
   file.write("\n")
    except KeyboardInterrupt:
  GPIO.cleanup() .
```

The program to send a message to the mobile is:

```
#!/usr/bin/python
 import urllib2
import cookielib
from getpass import getpass
import sys
username = "123456789" # the mobile number with
which we want to log in
passwd = "qwertyuiop"
message = "Circuit breaker has tripped"
number = "9488277311" #the mobile numbers to which
the message needs to be sent
message = "+".join(message.split(' '))
print "entered to send sms"
#Logging into the SMS Site
url = 'http://site24.way2sms.com/Login1.action?'
data =
'username='+username+'&password='+passwd+'&Submit
=Sign+in'
 #For Cookies:
cj = cookielib.CookieJar()
opener =
urllib2.build_opener(urllib2.HTTPCookieProcessor(cj))
 # Adding Header detail:
opener.addheaders = [('User-Agent','Mozilla/5.0 (X11;
Linux x86_64) AppleWebKit/537.36 (KHTML, like
Gecko) Chrome/37.0.2062.120
Safari/537.36')]
 try:
   usock = opener.open(url, data)
except IOError:
   print "Error while logging in."
   sys.exit(1)

jession_id = str(cj).split('~')[1].split(' ')[0]
send_sms_url =
'http://site24.way2sms.com/smstoss.action?'
send_sms_data =
'ssaction=ss&Token='+jession_id+'&mobile='+number+'
&message='+message+'&msgLen=136'
opener.addheaders = [('Referer',
'http://site25.way2sms.com/sendSMS?Token='+jession_id
)]
 try:
   sms_sent_page =
opener.open(send_sms_url,send_sms_data)
except IOError:
   print "Error while sending message"


print "SMS has been sent."
```

Thus the above codes are used for implementation of the equipment.

CONCLUSION

In this paper, we have proposed a device which constantly monitors the signal taken from a circuit breaker. In normal conditions, the device takes an input and alarm is off. Once the breaker trips, the device is turned on and a LED glows along with an alarm buzzer indication. Within a few moments upon the trip, when there is a strong WiFi connection, there will be an instant message sent to the corresponding mobile phones which were programmed in the device. This device can be implemented in the substations and therefore can benefit the consumer to a huge extent.

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