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Substation Monitoring and Control using Rs485 Transceiver

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Abstract*: Through this project, prioritization of distribution of two power stations by monitoring and detecting the power imbalance at the earliest and reversing the data's so it can be rectified. RS485 is utilized as the solid layer underlying several routine protocols employed to execute industrial control systems. This system is programmed to also convey the real time electrical parameters recurrently and thus enable the main substation to monitor the parameters. This main station apparatus is developed to cut off subsequent substation power whenever the voltage or current exceeds the predefined limits.

Index Terms*: Substation, Monitoring, Transformer, Power Stations.

I. INTRODUCTION

A power station is an area from where electricity is supplied to all surrounding areas. It consists of two sections- Main stations and Substations. Main stations ensure that current supply is continuous to the substations and is cut off when not required. Substations supplies power to surrounding areas and are integral part of any power stations. Amol et al. [1], knowledge of the GSM network to obtain the remote electrical parameters like Voltage, Current and Frequency and send these quantities continuously through the RS-485 to the main power station. Additionally it is intended to ensure the safety of the electrical hardware by using an electromagnetic relay. The Relay gets initialized at whatever point the electrical parameters surpass the predefined values. The Relay can be utilized to work a Circuit Breaker to turn off the primary electrical supply. Client can send directions utilizing the RS485 to monitor the remote electrical parameters. The system will additionally automatically send the real time electrical parameters intermittently which will be displayed at every substation. The project is intended to SMS notification at whatever point the Circuit Breaker trips or at whatever point the Voltage or Current surpasses the limit set by the user. Narejo et al. [5], proposed GSM cellular network based controlling of substation will help the utility companies, by ensuring that their local-substation faults are immediately realized via GSM, to ensure that there is decrease in duration of power interruption. Siemens Guide[10] ,A compound consisting of metering instruments, transformers, voltage regulators, switches, etc. which are utilized to vary voltages and track circuits is called a substation.

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Large quantities of power are lost due to the transportation of power over long distances using transmission lines from the main station where it is produced before reaching the substations. this leads to the depletion in the amount of power collected at the substation. Requesting the quantity of energy being dispatched at the user side has raised an alarm because of the escalation in the temperature over a long distance under succinct duration.

II. PROPOSED METHODOLOGY

The existing model of the system works on sending electrical parameters over SMS service. The device used SMS service for sending and accepting information. The proposed model incorporates the use of RS-485 transreceiver for transfer of electrical parameters such as current and voltage from substations to main-stations and vice versa. The model provides power shutdown messages sent to the citizens using SMS service.

III. PROPOSED ARCHITECTURE

The block diagram of the circuit of system is shown in Fig. 1. The input supply is given to the board by means of laptop or power bank. The entire board is designed in such a way that it incorporates all the required elements for the system. The board consists of Arduino Nano which acts as a microcontroller. The board consists of relay which helps in switching off the main supply to substations when electrical parameters surpass the predefined values. Current and Voltage sensors are placed in substations and they send their values through communication protocols. RS-485 transceiver is used for monitoring and control. It helps in sending data from the substations to main-stations and vice versa. LCD Display is used as display for electrical parameters. The system also uses GSM Module to send messages to the citizens regarding power shutdown.

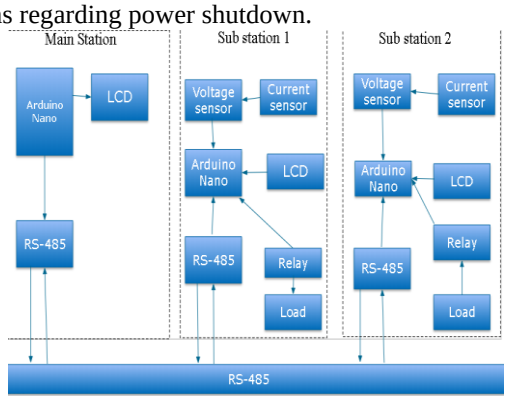

Fig. 1. Block diagram of the proposed system architecture

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A. Proposed Design

The substation of the power station is shown in **Fig 2** and main-station of the power station is shown in **Fig.3**.

The station constitutes of 2 parts. The first part is the substation of power station. The second part is the main station of power station. The whole station is placed on wooden plank to demonstrate the look of power station.

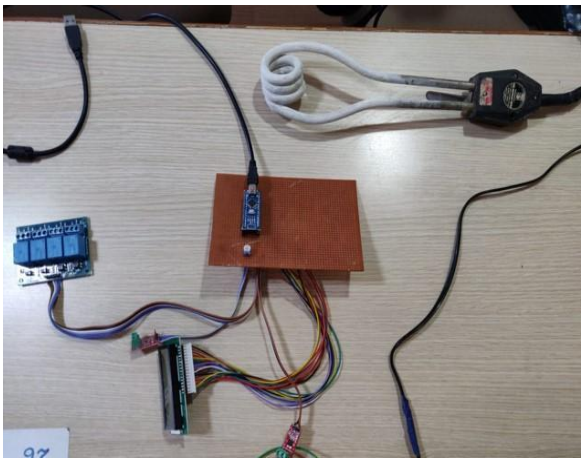

Fig.2. Substation 1

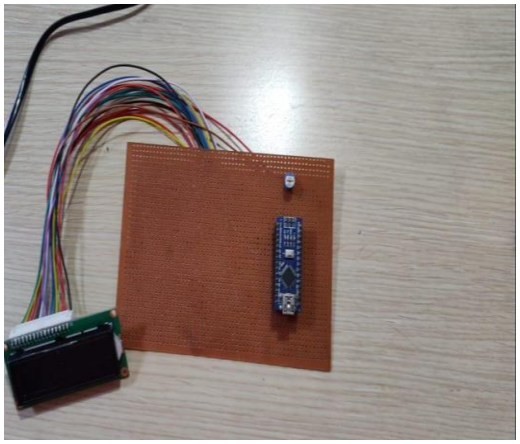

Fig.3. Main-station

```
#include <RS485.h>
#include <SoftwareSerial.h>
#include <LiquidCrystal.h> //Load Liquid Crystal Library
LiquidCrystal LCD(5,6,7,8,9,10);  //Create Liquid Crystal Object called LCD
const int sensor=A0; // Assigning analog pin A1 to variable 'sensor'
float vout;  //temporary variable to hold sensor reading
char message[maxMsgLen+3+1];
char Message1[maxMsgLen+1] ;
String myStr;

void setup()
{
pinMode(16, OUTPUT);
pinMode(17, OUTPUT);
pinMode(18, OUTPUT);
pinMode(19, OUTPUT);
digitalWrite(16,LOW);
digitalWrite(17,LOW);
digitalWrite(18,LOW);
digitalWrite(19,LOW);
```

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A. Proposed Circuitry

The Circuitry for the system is designed in such that all elements such as voltage sensor, current sensor, LCD display, Relay the controller come on a single board. The power is drawn from the laptop. The RS-485 uses its dedicated communication protocol to transfer the data. GSM Module is used to send messages to citizens indicating that there is a power shutdown or any other important message. Industrial current sensor which gives accurate reading upto 10A is used to obtain amount of current obtained by load. Voltage and current sensors are calibrated for maximum limits which are 230V and 10A respectively for any substation limiting the maximum power at substation to 2.3KW.

Sensors give analog values as sensor data for electrical parameters. The entire programming was done using Arduino IDE.

B. Proposed Microcontroller Code

The entire code has been programmed and executed using Arduino IDE. The RS-485 transreceiver uses a secure protocol to communicate between the two stations. The system is given with a unique ID, which is programmed into the system. Fig.4 shows how the substation has been programmed to send and receive data using RS-485. It shows how SMS can be sent using GSM Module to citizens of surrounding areas regarding power shutdown.

The same program can be executed for any number of substations and the contact numbers can be changed depending upon the area the substation covers.

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```
 Serial.begin(9600);
 LCD.begin(16,2); //Tell Arduino to start your 16 column 2 row LCD
 pinMode(sensor,INPUT); // Configuring pin A1 as input
 Serial.println("System Startup");
 RS485_Begin(28800);
 }


void loop()
{
vout=analogRead(sensor);
LCD.setCursor(0,0);
LCD.print("=" );
LCD.print(vout);
LCD.print("watts");
LCD.setCursor(0,1);
LCD.print("V= 220V" );
delay(100);

myStr=String(vout);
strcpy(Message1,"vout1");


 if(RS485_SendMessage(Message1,fWrite,ENABLE_PIN))
 {
 Serial.print("Sending:");
 Serial.println(Message1);
 }
 if(RS485_ReadMessage(fAvailable,fRead, message))
 {
   Serial.print("Receiving:");
   Serial.println(message);
   if(strcmp(message,"*1")==0)
 {
 Serial.print("relay1");
 digitalWrite(16,!digitalRead(16));
 }

 if(strcmp(message,"*2")==0)
 {
  Serial.print("relaY2");
 digitalWrite(17,!digitalRead(17));

 }


if(strcmp(message,"*3")==0)
{
Serial.print("relay3");
digitalWrite(18,!digitalRead(18));
}

if(strcmp(message,"*4")==0)
{
Serial.print("relay4");
digitalWrite(19,!digitalRead(19));
if(digitalRead(19)==0)
{
SendMessage();
}
}
}
delay(100);
}



void SendMessage()
{
  Serial.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
  delay(1000);  // Delay of 1000 milli seconds or 1 second
  Serial.println("AT+CMGS=\"+919940291796\"\r"); // Replace x with mobile number
  delay(1000);
  Serial.println("sorry for the inconvinience,Power will be Shut Down");// The SMS text you want to send
  delay(100);
  Serial.println((char)26);// ASCII code of CTRL+Z
  delay(1000);
}
```

Fig.4. Microcontroller program for substation

```
#include <LiquidCrystal.h> //Load Liquid Crystal Library
LiquidCrystal LCD(2,3,4,5,6,7);  //Create Liquid Crystal Object called LCD
const int sensor=A0; // Assigning analog pin A1 to variable 'sensor'
float vout;  //temporary variable to hold sensor reading
float vout1;  //temporary variable to hold sensor reading

void setup()
{
LCD.begin(16,2); //Tell Arduino to start your 16 column 2 row LCD
pinMode(sensor,INPUT); // Configuring pin A1 as input
vout1=analogRead(sensor);
}

void loop()
{
vout=analogRead(sensor);
vout=vout-vout1;
if(vout<0)
{
vout=0;
}
LCD.setCursor(0,0);
LCD.print("CURRENT= ");
LCD.print(vout);
delay(1000);
  }
```

Fig.5. Microcontroller program for LCD Display

Fig.5 shows how the 16*2 LCD Display has been programmed to display data received data using RS-485. The displays are attached in all the main and substations and helps the operator to see the electrical parameters value.

A. Proposed Android Message

Fig.6 shows how the citizens of surrounding areas will receive a message during power shutdown in their respective substation. It would be helpful to the citizen because they will know when the power will be shutdown. All SMS are sent using GSM Module which receives signal from microcontroller regarding when to send the message to citizens. It generally works on stable network connection which means that power stations should ensure that they have proper network service around their plant.

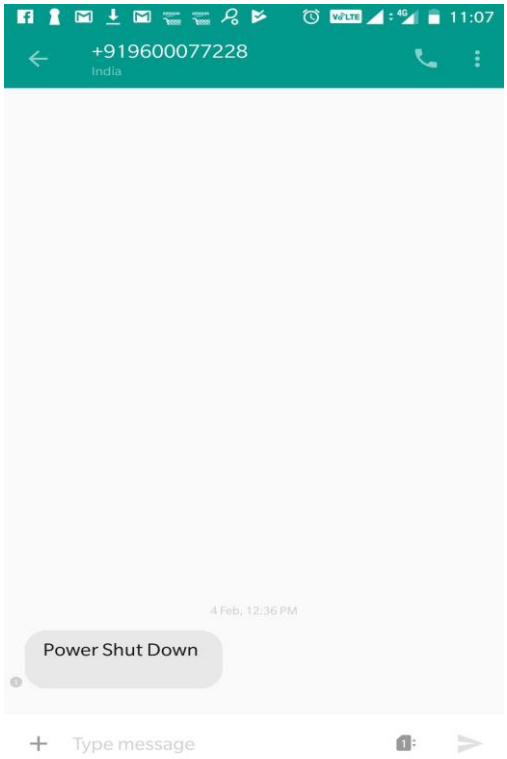

Fig.6. Android Message

IV. Conclusion

This paper presents a different communication protocol for real power station. The parameters of the system are initially identified by suitable physical measurements. The data shows current and voltage readings of the substation. In some cases, however, a slight discrepancy between the responses of model and the recorded data can also exist. The identified model can be deployed for developing a communication platform for a smart grid network. The proposed model is economical and provides a reliable power supply to ensure more supply for a long time. It helps in increasing the power equipment life of expensive equipments like transformer and industrial relays.

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