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IoT based Electrical Power distribution through Telegram Bot and Web Cloud

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ABSTRACT

The convenience of distributing electrical power and monitoring the load in homes, offices, as well as industries is very important. This enables the periodic and easy monitoring of changes or disturbances that occur in a load globally. This project monitors and controls the Electrical Power distribution system through a Telegram Bot and web cloud (Thingspeak.com). The Telegram Bot, which is available on Telegram, a social media application, is used to send commands to the electrical loads and also receive feedback in the form of a voltage (V), current (I), and Power (P) parameters. Meanwhile, the Web cloud (Thingspeak.com) is used to display the parameters in graphical or numerical form. Furthermore, the "peak to peak" method produces accurate voltage and current measurements using the ZMPT101B and ACS712 sensors. The result showed that the sensor readings are carried out alternately using a Multiplexer (Mux), to provide flexibility for another additional sensor. Therefore, the load control system is equipped with a TPR (Thyristor Power Regulator) circuit to regulate the amount of power.

Keywords: *Telegram Bot, IoT, Thingspeak, and Peak to Peak*

1. INTRODUCTION

The load control system and electrical energy are usually carried out in one direction, without adequate feedback, especially for long distances. Currently, consumers are unable to freely control and monitor the use of electrical energy. However, there is a possible future rapid growth on the use of laptop, PC, Smartphones and gadgets devices to monitor and control electrical power distribution for consumers to deal with issues of energy use more efficiently, in order to avoid abnormal changes and unpredictable errors on loads. Several studies and projects have been conducted on the use of IoT in several applications [1] to [11]. However, these do not involve Telegram Bot as one of the control elements in the system and the application has not analyzed the distribution of electrical power using alternating voltage(V),Current(I), and Power(P). Therefore, this project aims to create a control system to facilitate the distribution of electrical power and monitor load behavior. Furthermore, the load control and monitoring were carried out by writing a command on the Telegram Bot and sent to NodeMcu via the internet network.

NodeMcu is used to translate the command line into a control action for the selected load, or sends back the parameters read (V, I, and P) on the sensor to Telegram Bot. The monitoring process can also be conducted through a Web cloud (Thingspeak.com), where electrical parameters are displayed in graphical and numerical form. In the future, the technology for distributing electrical power to household, office, and industrial appliances tends to use IoT along with changes in a more efficient and modern lifestyle. Subsequently, the combination of IoT and Artificial intelligence (AI) is likely to play an essential role in a more economical and efficient electric power distribution. Furthermore, users can be assisted in making proper decisions regarding changes in electrical parameters on the load side.

2. LITERATURE SURVEY

In [1], This paper proposes a system based on IOT and sensors for biomedical parameters monitoring. The system can be used to measure heart rate (bpm) and temperature rate. With the help of sensors patient's vital signs are *monitored continuously*. The system uses WI-FI to transmit vital parameters of human body to any cloud or app. Due to enhancement in wireless technologies and sensor devices patient monitoring has become convenient and cost effective. The output parameters of this project are heart rate BPM (beats per Minute), and TEMPERATURE which can be viewed through the cloud or the phone application. There are two sensors are used in this system, first KY-039 HEART BEATSENSOR which consists of IR LED and a Photo-transistor, the sensor is connected to the Arduino microcontroller, second The DS18B20 Stainless Steel Temperature Sensor which can convert temperature to a 12-bit digital word in 750ms (max). Besides, it can Measures temperature from -55°C to +125°C (-67F to +257F). This sensor also connected to Arduino and ESP8266 Microcontroller.

In [3], This paper aims to describe on how to monitor water quality continuously through IoT platform. Water Quality catchment-monitoring system was introduced to check and

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monitor water quality continuously. The system includes five sensors which are Analog pH sensor (SENO161) , Light Intensity sensor (GA1A12S202) for measuring turbidity , Temperature (DS18B20), GPS (LOCOSYs LS-23060) for Coordinate Acquisition , and IMU (BNO055) for Identify water flow which can be accessed directly from ThinkSpeak from any internet connected terminal. The testing of the system was done on separate site on the lake. For each location, the data including Temperature, applying box-plot graph technique and plotting its mean directly on the map analyzed pH, Light intensity and IMU.

In [4], This paper proposed method provides the communication between the Electricity Board section and the consumer section using Internet of things (IOT) for transmitting the customer's electricity consumption and bill information that is calculated using ATmega328 microcontroller and Wi-Fi module. Daily consumption reports are generated which can be monitored through Android application and/or web portal. The live readings from the energy meters are collected by the microcontroller. This can be viewed through an LCD display, which is connected to the micro controller. The LCD display shows the readings of the energy meters and the theft status. Then the relay will operate and this can be used for disconnecting the load. The user anywhere can check the power consumption globally. Also, The Main Improvement for the future is going to make some Wi-Fi hotspots in each area through which all the energy meters are get connected. IoT energy meter consumption is accessed using Wi-Fi and it will help consumers to avoid unwanted use of electricity. So, in future following objectives can be achieved to save power and avoid thefts.

In [5], The system proposed in this paper gives advance solution for the monitoring and controlling of the industrial machine parameter from anywhere, anytime by using Internet. It mainly consists of sensors, Arduino UNO, LCD display, along with Wi-Fi module and controlling device such as fan/heater. This system is used to monitor and control the various parameters of the industrial operational process such as temperature, pressure, speed etc. Temperature sensors detect the current temperature and send it to the analog to digital converter of Arduino UNO. Wi-Fi module is used to send temperature data to webpage/app, so the temperature can be monitored from remote location with the help of Internet. The sensor, which is used, is LM35 as a temperature sensor which has operating range in between -550C to 1550C. LM35 generates 10mV per change in degree change in temperature. The button which is added on the page is used to indicate the alert if the temperature is exceeds beyond threshold level. If we press that tab then fan will be turn on to cool it. Fan is used as controlling device and it will turns on.

In [8], This project is based on Vibration Detection using the Internet of Things. Vibration monitoring is the measurement of passing movements in a structure. This project uses Arduino Uno board wired to ADXL335 accelerometer module (connected across CON2) with its ADC inputs, namely, X-axis to A0, Y-axis to A1 and Z-axis to A2. Two pushbuttons through the supply of 5V are wired to Arduino Uno interrupt pins 2 and 3 that are pulled down to ground via resistors R2 and R1. These buttons are used for incrementing and decrementing the threshold of vibration detection. A 16×2 LCD (LCD1) is wired in a 4-wire mode with Arduino pins contrast control and backlight enabled. Since it is done on a small scale, as it is lab-based analysis, it could further be implemented on real data.

In [9], The objective of this project is to develop a system, which can sense the amounts of toxic particles in air using the MQ135 sensor. MQ135 is a gas sensor used for detecting the presence of a various type of gases (NH3, NOx, alcohol, Benzene, smoke, CO2). The amount of gas is measured in parts per million. If the amount of gases exceeds the threshold value, the danger light will be switched on automatically along with the buzzer and air purifier. The system is connected to Think to speak .com as a cloud service that stores the data from the sensor. These data stored during each execution will be plotted as a line chart. On the x-axis time of execution is noted. On the y-axis amount of pollution corresponding to each time slot will be plotted, the resultant line graph can be viewed in the browser.

In [10], By using Internet of Things we can control many devices such as light, power plug, Fan, computer, security system and etc. It reduces human efforts and power efficiency. The main objective of internet of things is used to help specially challenged people and old age people to control electrical appliances and security purpose. IoT is very useful for these people in crucial situations. The hardware system contains of Arduino Uno board, Arduino wi-fi shield, sensors and home appliances. The software system consists of a java based android application also Arduino language (Arduino IDE) is used to configure the Arduino uno board and the sensors.

4. METHODOLOGY

4.1 Block Diagram

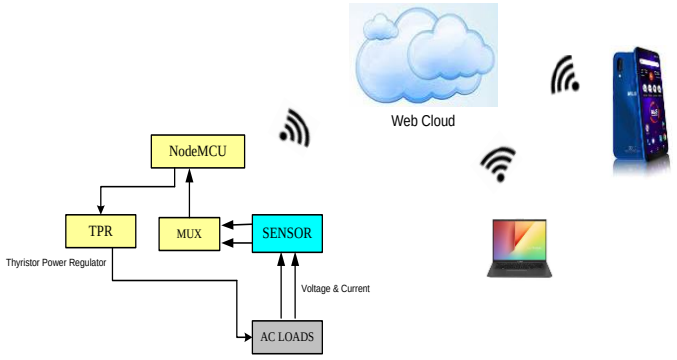

Fig. 1: Block diagram

NodMCU functions as a central processing unit for receiving, sending, and processing data, which comes from sensors or written commands in the Telegram Bot. The first sensor is ACS712, which can detect AC currents up to 30A. Meanwhile, the second sensor is the ZMPT101B, which can detect changes in AC voltage up to 250V. These data are stored on a cloud server for monitoring the load accessible through the WEB cloud (Thingspeak.com). The commands written in Telegram Bot have functions to control and monitor the amount of power distribution in the form of current, voltage, and power. This makes it possible for the user to check the power consumption irrespective of their location globally. The Multiplexer circuit (MUX) functions as a gate for the voltage and current sensors to port A0 on NodeMcu, and this is carried out alternately. There are 2 types of loads used in this project, namely lighting lamps or other household devices, and AC electric motors whose speed can be changed by adjusting the duty cycle (D) at the PWM signal output of the NodeMCU. Changes in the value of the duty cycle (D) changes the trigger angle (Ø) of the thyristor in the TPR (thyristor power regulator) circuit. Therefore, the power distribution can be changed according to the needs of the user.

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4.2 Flow Chart

The flow chart of the developed software is distributed sequentially as follows: Initialization, Parameters Calculating, Delivering Data to Cloud server, and Reading Instruction written on the Telegram Bot, as shown in Figure 2.

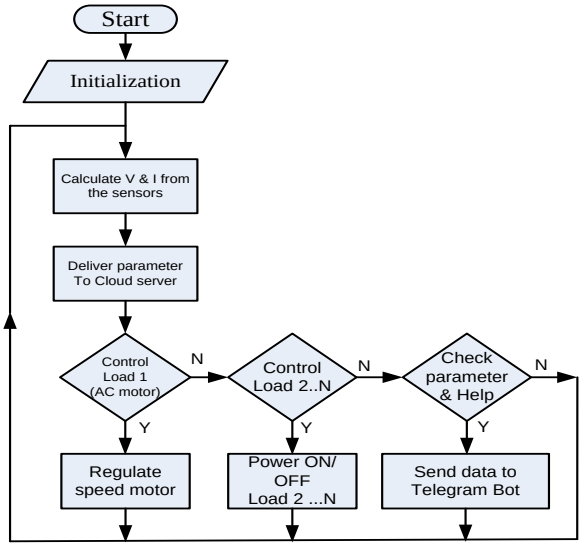

Fig. 2: Flow chart

4.3 The Peak to peak Method

This project starts by calibrating the ZMPT101B type voltage sensor to ensure the output on pin A0 (NodeMCU) has an excellent sinusoidal signal with appropriate Trimpot (variable resistor). The sensor maker ZMPT101B is unable to provide an equation for converting the input voltage (Vin) to the sensor output from the ADC circuit. Therefore, the peak to peak method needs to be used to calculate the V_{rms} voltage value at the sensor output, which becomes a sinusoidal waveform.

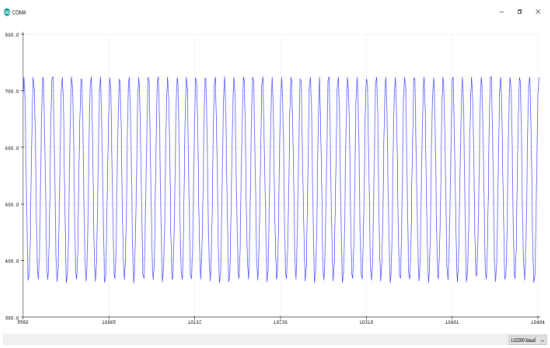

Fig. 3: Output of ZMPT101B sensor

The voltage sensor's output is connected to Pin A0 (NodeMcu), which is then read through the **ReadAnalog (A0)** command on the Arduino Ide. This is followed by applying the peak to peak method with a proper sampling rate and sample size, as shown in the following sub-program of the sketch:

```
 float getVpp()
 {
float result;
float bit_Vmax=0;
float bit_Vmin=1023;
    count = 0;
    prevMicros = micros() - sampleInterval;
    while (count < numSamples)
 {
 if (micros() - prevMicros >= sampleInterval)
 {
  float adc_voltage = analogRead(sensorIn);
  if(adc_voltage > bit_Vmax)
  {
    bit_Vmax = adc_voltage;
  }
  else if (adc_voltage < bit_Vmin)
  {
     bit_Vmin = adc_voltage;
  }
  count++;
  prevMicros=micros();
 }
 }
 bit_peak2peak = bit_Vmax-bit_Vmin;
 result = bit_peak2peak
}
```

After the sine wave's peak-to-peak value is determined, data is retrieved to obtain a Vrms equation ($\mathbf{V_{rms}}$ = f (bit peak to peak value)). The $\mathbf{V_{rms}}$ data measurement in this study utilized the Fluke 17B+ Digital Multimeter. In addition, the peak to peak method is also used on the ACS712 current sensor to obtain its current value. The value of $\boldsymbol{I_{rms}}$ is obtained by formula (1) and (2), where the "mVperAmp" value is 66 for the ACS712 30A sensor.

$$V_{rms} = \frac{\text{bit\_Vmax} - \text{bit\_Vmin}}{2} * 0.707 \qquad (1)$$

$$I_{rms} = \frac{V_{rms} * 1000}{mVperAmp} \qquad (2)$$

4.4 Telegram Bot

Telegram bot is a bot or robot programmed with various commands to carry out a series of user instructions and operated by software comprising of AI features. In this project, it is used to send commands and received responses from NodeMCU. Therefore, to start using this robot, the user needs to create a bot name using the command "/newbot". After The Bot Username is created, a Token is obtained to access the HTTP API, as shown in figure 4. Then the Token is entered into the sketch to ensure NodeMCU connects to the Telegram Bot.

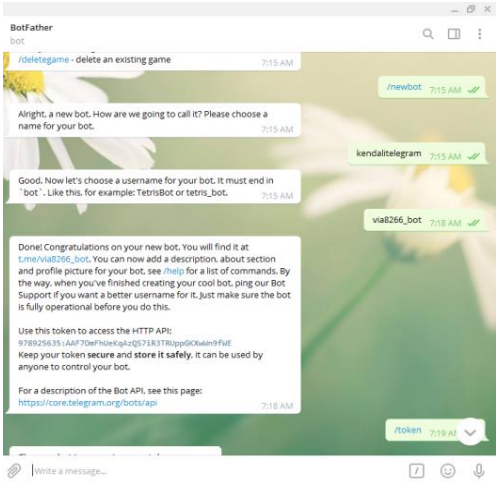

Fig. 4: Bot Name, Bot Username, and Token

6. EXPERIMENTAL RESULTS

The result of this project is a hardware integration that has been equipped with a sketch program written through the Arduino IDE, as shown in figure 5. Furthermore, this project was carried out with 4 loads, namely a phase AC motor load, and 3 group of lighting lamps.

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Fig. 5: Integrated Hardware and Loads

The experimental results are displayed in graphical form through Thingspeak.com and Telegram Bot with the parameters of Current (I), Voltage (V), and power as shown in figures 6 and 7.

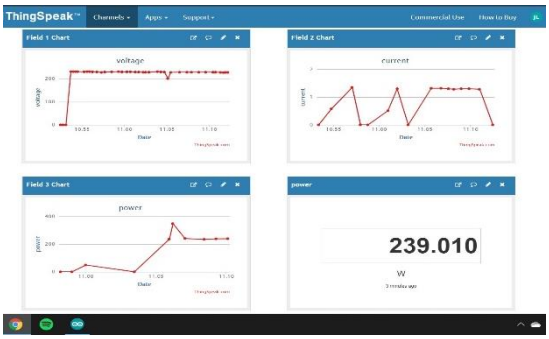

Fig. 6: The display on Thingspeak and Telegram Bot

7. CONCLUSION

The existence of IoT based on Electrical Power distribution is useful for the control and monitor of home, office, and industrial equipment for various purposes. The Multiplexer Circuit (MUX) as an input gate is used to accommodate a maximum of 8 to 16 sensors connected to the system, and for the accessible development opportunities for other applications. In addition, the ZMPT101B voltage sensor and ACS712 Current can be replaced with different types of CT sensor, thereby providing convenience in hardware installation. Therefore, this project can be developed using AI to help users make the right decisions for other future applications.

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