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**A Synopsis on**  
**IOT BASED CIRCUIT BREAKER**

*Submitted by*

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**2022 – 2023**

## **IOT BASED CIRCUIT BREAKER**

### **AIM**

**To design and implement an IOT based monitoring & control of circuit breaker.**

### **INTRODUCTION: -**

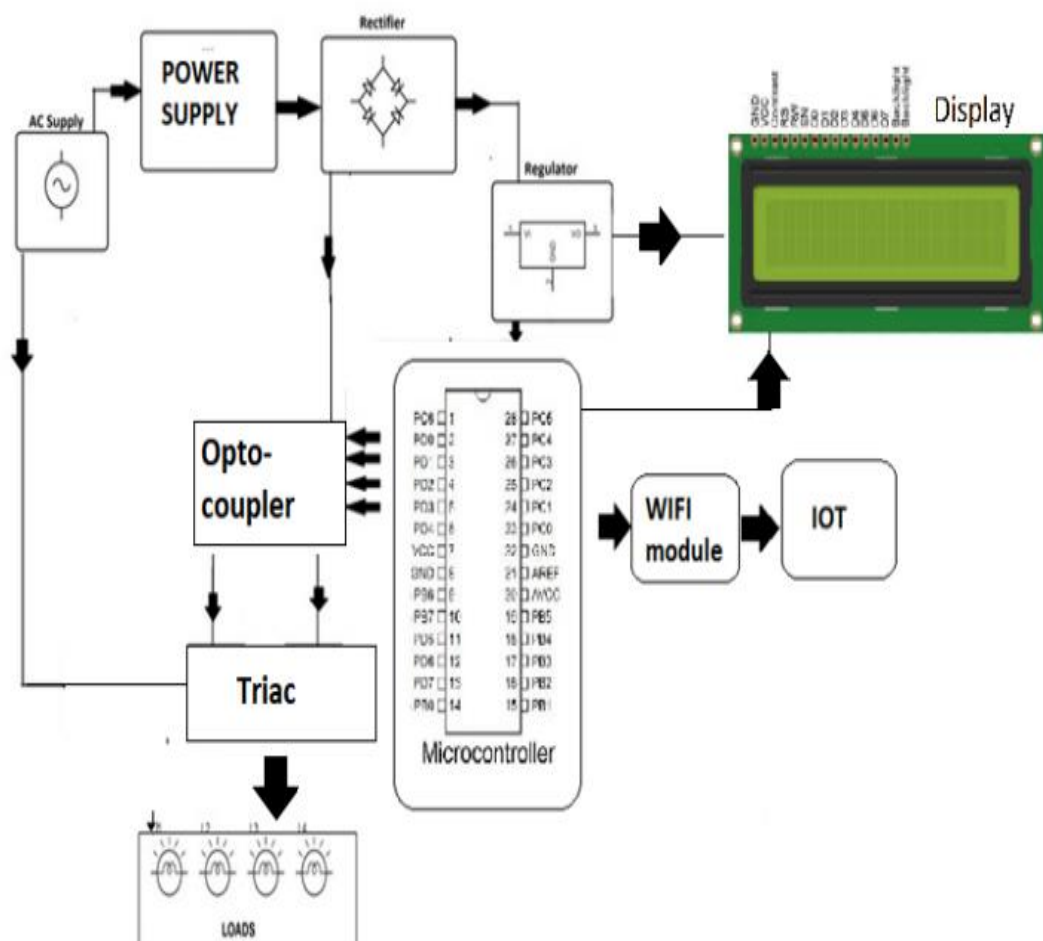
We propose our mini project on the Internet of Thing (I.O.T) based monitoring & control of circuit breaker. Circuit breaker is an important component of Industrial Electrical Systems. It is used for protection & switching. Hence, reliable and timely operation of circuit breaker is essential.

This project provides a password-based circuit breaker system using IOT. Quite a lot of fatal accidents happen with linemen due to electric shocks. It is a result of miscoordination or miscommunication between linemen and substations. The project aims to solve this issue by making use of IOT. The IoT based Circuit Breaker is a system with fast response time, which uses the interconnection network (internet) to control electrical loads. This system uses a wi-fi module paired with Atmega328p microcontroller locally on the circuit breaker side to connect to the internet. It is also equipped with an LCD display which shows the state of each load connected to the system, either ON or OFF.

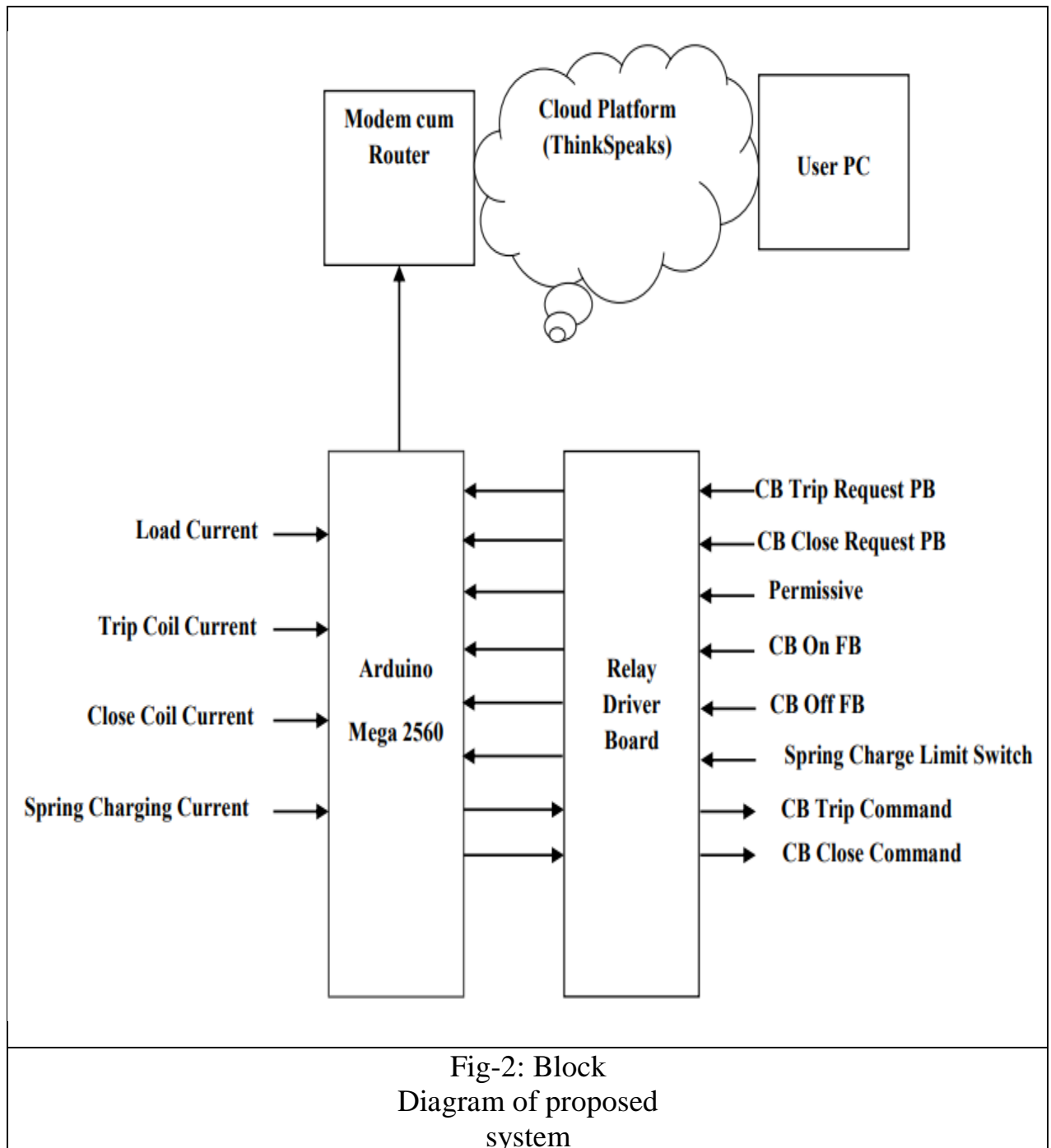
The concept of electronic circuit breaker came into focus realizing that the conventional circuit breakers such as Miniature Circuit Breakers [MCB] take longer time to trip on occurrence of fault condition. Therefore, for sensitive loads, it is very important to activate a tripping mechanism in the shortest possible time, preferably instantaneously.

The proposed electronic circuit breaker is based on the voltage drop across a series element proportional to the load current, typically a low-value resistor. This voltage is sensed and rectified to DC, and then is compared with a preset voltage by a level comparator to generate an output that drives a relay through the MOSFET transistor to trip the load. The relay is used in place of a semiconductor switch because such solid-state switches would invariably fail in case of accidental short circuits. A circuit breaker is an automatic operated switch designed to shut down the power supply when overloaded. The tripping depends on the current passing through the CTs which is connected in series with load.

## BLOCK DIAGRAM



**Fig-1: Circuit Diagram**



## DETAILED DESIGN BASIS OF THE PROJECT: -

### 1 Need of the proposed system: -

Circuit breakers are used for protection & switching & an important component of industrial electrical system. In order to ascertain reliability of circuit breaker & at the same time to reduce the downtime due to time based preventive maintenance, online monitoring of circuit breaker health parameter is needed. Deployment of software-based control instead of hardwired control reduces the size of control & metering cabinet. Integration of Internet of Things make the circuit breaker health data available on the fly for effective decision-making regarding maintenance of circuit breaker.

The proposed system facilitates automated circuit breaker monitoring & control that diagnose the electrical and mechanical health of circuit breaker in real time. This is a shift in the maintenance paradigm *from time-based maintenance to as-needed maintenance*. This shift comes with the benefit of maintaining adequate circuit breaker performance while reducing overall maintenance costs & unnecessary additional downtime.

### 2 Objectives: -

- a) The main objective of this paper is to use open-source platform to continuously monitor and control the circuit breaker.
- b) There is a shift in the maintenance paradigm from time-based maintenance to as-needed maintenance. This shift comes with the benefit of maintaining adequate circuit breaker performance while reducing overall maintenance costs & unnecessary downtime.

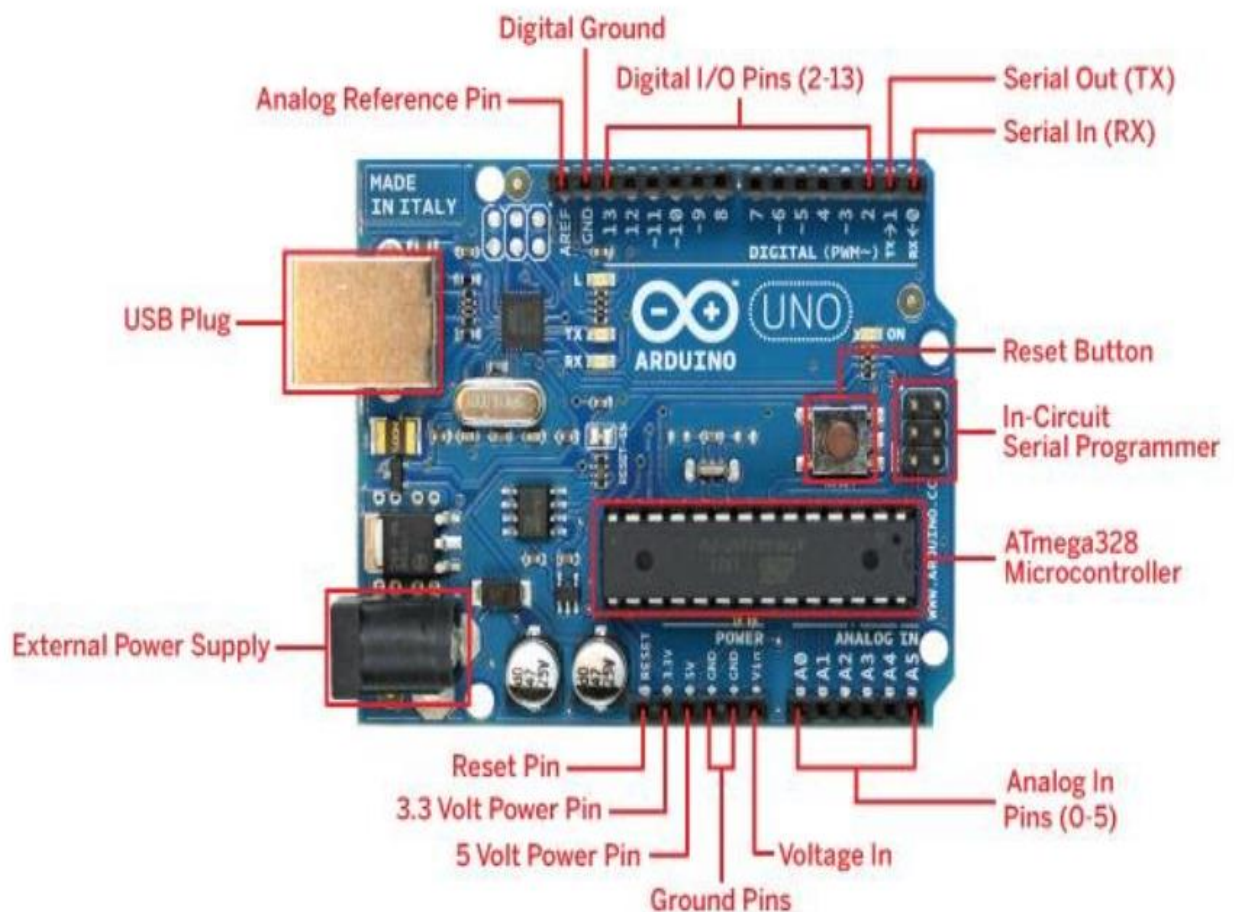
### 3 Hardware Requirements: -

The system Consist of the following parts: -

- 3.1 Arduino Uno (ATMEGA 328P microcontroller)
- 3.2 GSM Module
- 3.3 Relay
- 3.4 LCD 16 X 2
- 3.5 Adapter
- 3.6 Relay Driver Board

### 3.1 Arduino Uno (ATMEGA 3280 Microcontroller): -

Microcontroller acts as the engine of the system and determines the circuit breaker operation. We will use Arduino Uno microcontroller in our project. The Arduino Uno is an open-source microcontroller board based totally on the Microchip ATmega328P microcontroller and developed by Arduino.cc (Figure1). The board has units of digital and analog input/output (I/O) pins that can be interfaced to various enlargement boards and other circuits. The board has fourteen Digital input/output pins (out of which six can be used as PWM outputs), six Analog enter pins, and programmable with the Arduino IDE (Integrated Development Environment) by way of a kind B USB cable.



**Figure: 1**

### 3.2 GSM Module: -

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator-demodulator) is a critical part here.

These modules consist of a GSM module or GPRS modem powered by a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for computer. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities.



**Figure: 2**



### 3.3 Relay: -

2-Channel 5V Relay Module is a relay interface board, it can be controlled directly by a wide range of microcontrollers such as Arduino, AVR, PIC, ARM and so on. It uses a low-level triggered control signal (3.3-5VDC) to control the relay. Triggering the relay operates the NORMALLY OPEN [NO] or NORMALLY CLOSED [NC] contacts. It is frequently used in an automatic control circuit. To put it simply, it is an automatic switch to control a high-current circuit with a low-current signal. 5V relay signal input voltage range, 0-5V. VCC power to the system. JD-VCC relay in the power supply. JD-VCC and VCC can be a shorted.

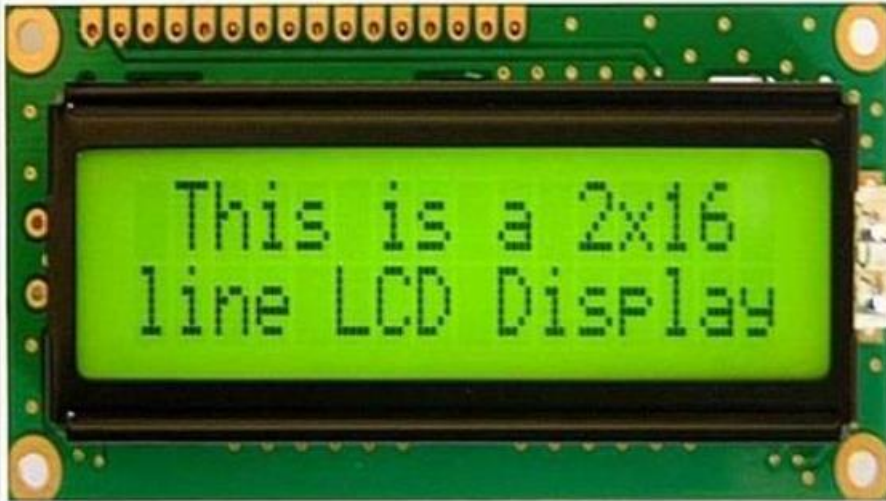


**Figure: 3**

### 3.4 LCD 16 X 2: -

LCD displays everywhere around us. Computers, calculators, television sets, mobile phones, digital watches use some kind of display to display the time. An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates to a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7 pixel matrix.





**Figure: 4**

### **3.5 Adapter: -**

All of the power supplies we sell are 12V DC. They take any input from 100V up to 220V AC, which is what comes out of your wall socket, and output 12V DC. This is what most digital devices such as LCD screens, DVD players, Hard Drives, Audio Gear, and most other digital devices use. We only carry 12V DC power supplies, so if your unit is not 12 Volt, you will not find the correct adapter here.

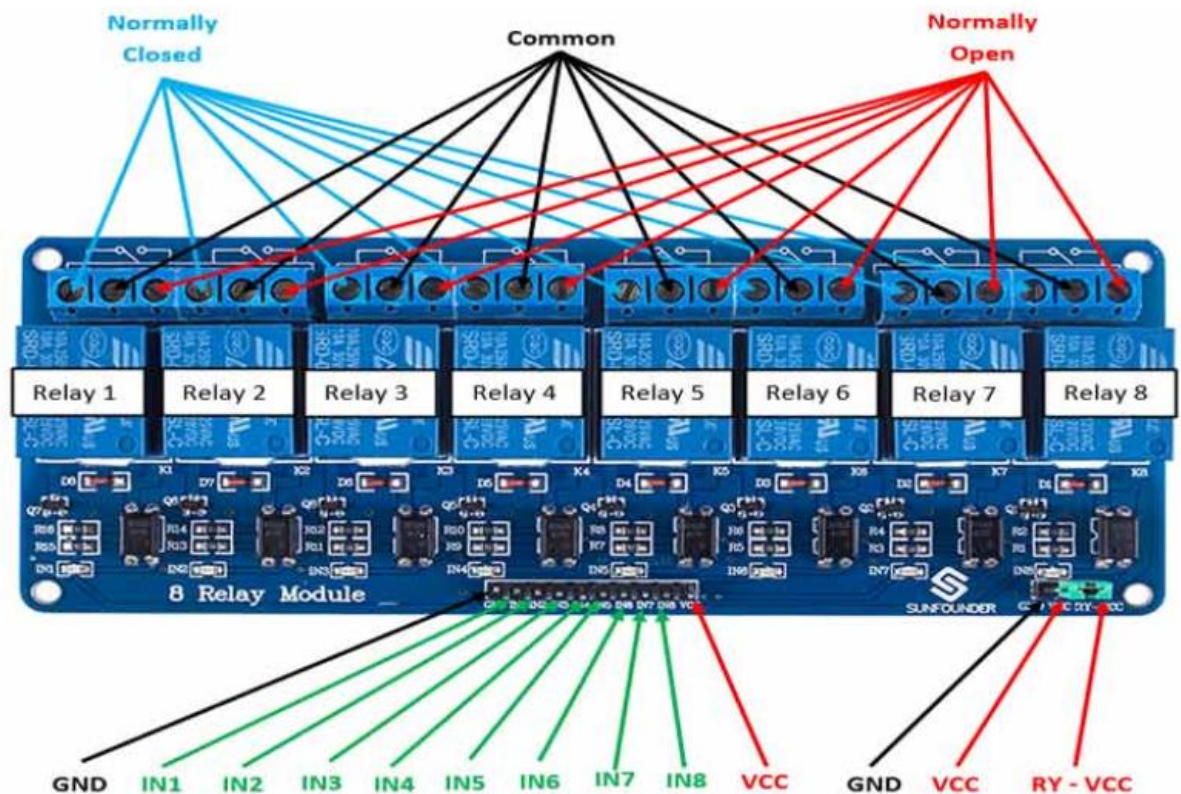
**Figure: 5**



### 3.6 Relay Driver Board: -

Relay boards are **computer boards with an array of relays and switches**. They have input and output terminals and are designed to control the voltage supply. Relay boards provide independently programmable, real-time control for each of several onboard relay channels.

#### ❖ 8 - Channel Relay driver board: -



- ✓ 8 Channel Relay Board is a simple and convenient way to interface 8 relays for switching application in your project. Input voltage level support TTL (Transistor – Transistor Logic) as well as CMOS (Complementary Metal Oxide Semiconductor). Easy interface with Microcontrollers based projects and analog circuits.
- **CB trip request PB:** - A circuit breaker (CB) “trips” (shuts off the electrical flow) in order to protect the circuit from overheating. It's a safeguard that helps prevent damage and electrical fires. Push bottom (PB) is pressed, the trip circuit supervision network is completed and lamp glows indicating that the breaker is ready for tripping.
- **CB close request PB:** - The supervision while circuit breaker is closed. This scheme is called post close supervision.
- **Permissive:** - A Permissive is something that must take place BEFORE another action or sequence of actions can be undertaken.

- **Spring charge limit switch:** - Limit switches are used to detect the presence or absence of an object.
- ✓ We are access the data like load current, trip coil current, load status and this data is given to the Arduino mega 2560 and this is connected to the relay driver board which is directly connected to the circuit breaker. Data from the Arduino can be access by the relay coil and according to that data relay coil can make and break the contact with the circuit breaker. And as there is two-way communication between the relay and the Arduino the data from the relay coil and circuit breaker can be displays on the computer or PC through the modem with the help of the cloud and internet system.

#### 4 Software Requirement: -

The software used here is Arduino (Version 1.8.9). Arduino software is employed to place the instruction of whole functions of this system to the microcontroller. The program for executing this project has been written in C language. In this we will be also use **Think-Speak** software in our mini-project. Thing-Speak is an open-source software written in **Ruby** which allows users to communicate with internet enabled device. It facilitates data access, retrieval and logging of data by providing an APPLICATION PROGRAMMING INTERFACE [API] to both the devices and social network websites. Thing-Speak was originally launched by **ioBridge** in 2010 as a service in support of IOT application.

We will be use Arduino IDE version 1.8.9 for writing program for Arduino. There are two steps of the programming. First set up section, we define all the variables in this section. Second loop part where the program runs continuously.

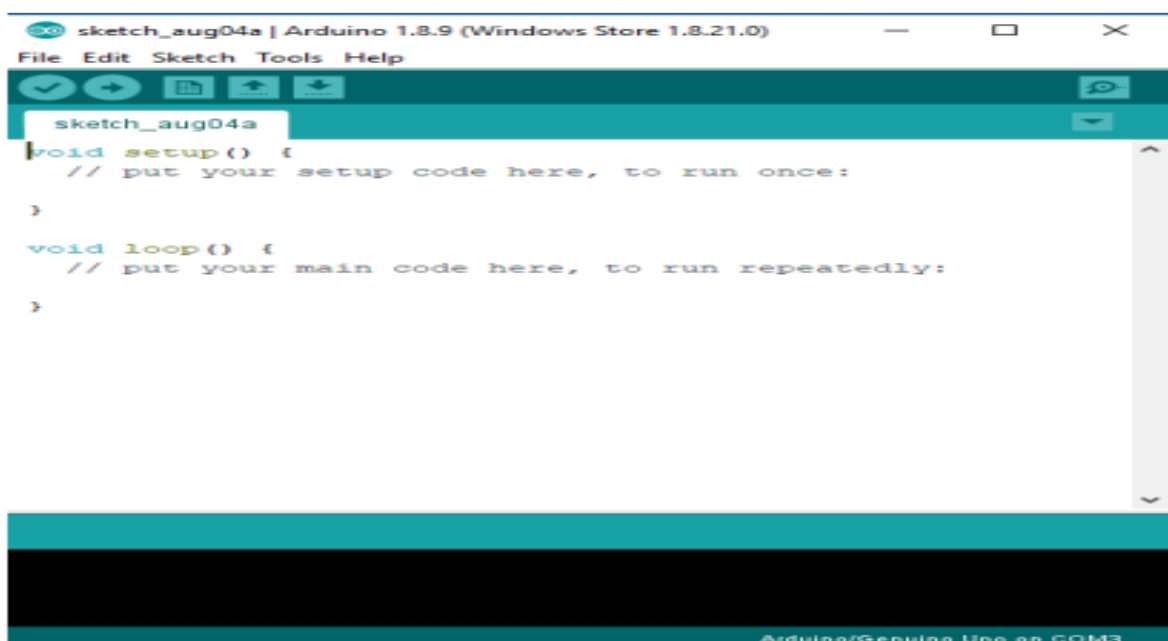


Figure: 5

## **5 Application and Advantages: -**

- Circuit breaker current status & health can be accessed from anywhere in the world.
- Efficient and low-cost design.
- Supports Real time monitoring and timely response action to fault or overcurrent occurrence.
- Improves circuit breaker reliability and minimizes downtime through *as-needed maintenance* approach.
- Minimize condition monitoring costs through unified monitoring of various parameters for the entire circuit breaker.
- Integrate with your facility's computerized maintenance management software (CMMS).

**6 Expected Outcome:** - In this way we are going to make circuit breaker smart and making its operation very reliable and makes its data available for all the users by using the internet of things, also maintenance time and downtime of the system reduces and also security of the system get increase. By using the smart electronic components data can be available in Operators hand so he can make changes according to the requirements of the system.

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