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IoT Based Fast Acting Electronic Circuit Breaker

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Abstract: Electronic circuit breaker is designed to cut off the power supply whenever overload or short circuit occurs. This paper proposes an IoT based Electronic Circuit Breaker (ECB) designed using high sensitive current transformers, programming controller and triac. Circuit breaker designed using these high sensitive components trips the power supply instantaneously in overload conditions or short circuit conditions. Traditional circuit breaker like miniature circuit breaker is based on thermal bimetal lever trip mechanism. MCB is very slow and the trip time varies according to the Percentage of overload and surrounding temperature. Microcontroller continuous monitor the CT value and preset value, if it is above preset then send signal to Triac for cut power supply to load. This system is cost effective and has less wear and tear. Also we can adjust preset current rating according to load and its tripping not depends on surrounding temperature.

Keywords: ECB, IoT, MCB, Current Transformer, Wi-Fi.

I. INTRODUCTION

Miniature Circuit Breaker (MCB) is mostly used solution now days. MCB detect the over current and after detection of over/fault current it operates and trips the electric circuit, so current flow is stop to appliances or instruments and are protected from overload condition. The MCB contain bimetallic strip due to which wearing of this strip is to be happen and this leads to slow response when electric circuit is overloaded. That mean it takes more time to trip the circuit when over load condition occur. This Miniature Circuit Breaker (MCB) is capable of handling 10000 amps current but when current rating is exceeded by 1000 amps then MCB is not economical to use. MCB operate on temperature when overload occurs current Flowing through bimetallic strip increases then heat is also increases which cause the deformation of bimetallic strip and open circuit is to be happen in this way it protect the circuit but change in temperature reduces current capacity of circuit breaker .

II. LITERATURE SURVEY

Miniature Circuit Breaker (MCB) is mostly used solution now days. MCB detect the over current and after detection of over/fault current it operates and trips the electric circuit, so current flow is stop to appliances or instruments and are protected from overload condition [1]. The MCB contain bimetallic strip due to which wearing of this strip is to be happen and this leads to slow response when electric circuit is overloaded.

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These disadvantages of Miniature Circuit Breaker (MCB) can be eliminated by proposed Electronic Circuit Breaker (ECB). This paper proposed one fast acting mechanism of electronic circuit breaker. The current passing through a series element is sensed and the resultant voltage and a preset voltage are compared using a level comparator to generate an output for the load to trip. The voltage drop occurs in the series element is proportional to the current value in load side normally a resistor with low value. The sensed voltage is converted to DC voltage and is set to a value through a level comparator whose output is given to a relay using MOSFET for activating tripping mechanism. In contradiction with other circuit breakers like MCB, Electronic Circuit Breakers has

A. Fast tripping mechanism in overloading
B. Less maintenance cost
C. Manufactured using few electronic inexpensive components.

Preferably, the damage occurs for sensitive loads can be overcome by installing circuit breakers with instant response.

III.SYSTEM OVERVIEW

In this project current is sensed by current transformer and then compared with a preset value present in microcontroller to generate an output for MOC3041 driver that drives a triac to trip the load within microsecond. Tripping is extremely fast and overcomes the limitation of the thermal type in overload condition.

It is the switch which automatically turns off when current flowing through it passes the maximum preset limit. This is mainly design to protect against over current and over temperature. Whenever the over current is drawn by the load the circuit will be tripped. To trip the circuit we are using TRIAC which will be controlled through microcontroller. For the protection from over current condition first we have to measuring the total load current. For measuring the total load current the output of Current Transformer is used. The inbuilt ADC converts analog output of Current Transformer into digital data. When current rating increases beyond threshold limit, then controller trip the load by using triac.

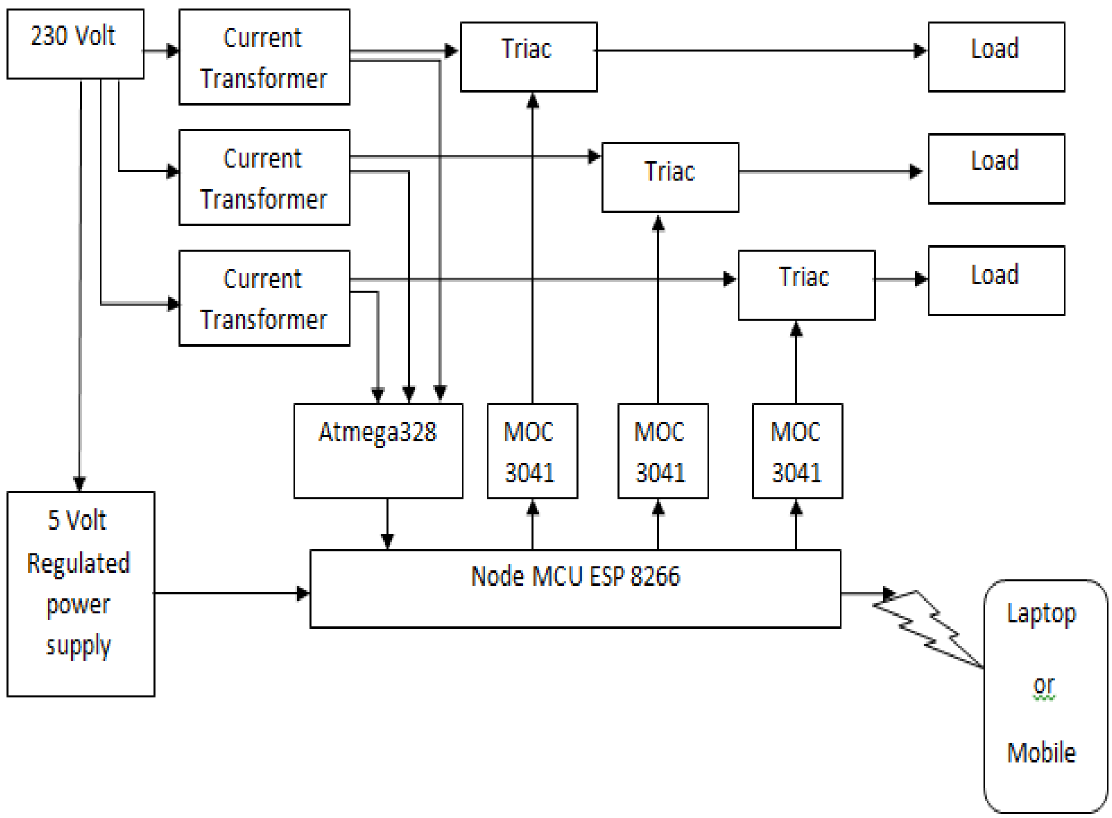

Fig.1 Block diagram of Iot based electronic circuit breaker

As mentioned above the traditional MCB comes with fixed rating and user can't change it. So in such case user needs to change the MCB. This problem is overcome in our system. there will be provision for setting current limit of MCB. We can configure the current limit of circuit breaker from any mobile or laptop by connecting to network. For networking we will use NodeMCU a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability produced by Espressif Systems. The ESP8285 is an ESP8266 with 1 MB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

A. Hardware details

1) Current Transformer (1:1000) up to 10 amp
2) Arduino nano Controller board
3) ESP 8266 WiFi module
4) MOC 3041 Driver for Triac
5) Triac BT136
6) 5v ultra compact power module HLK-PM01

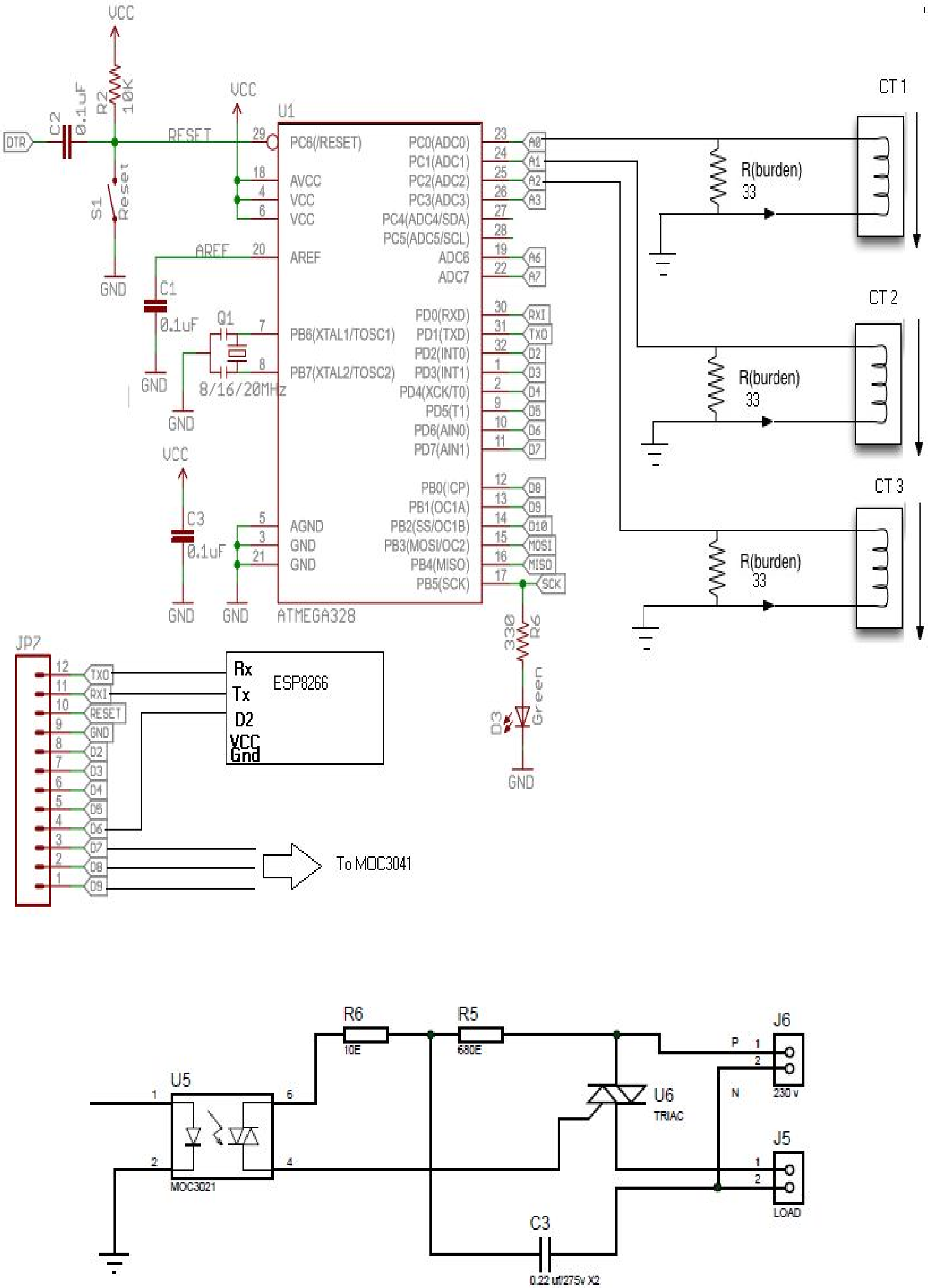

Fig. 2 Overall Circuit wiring diagram

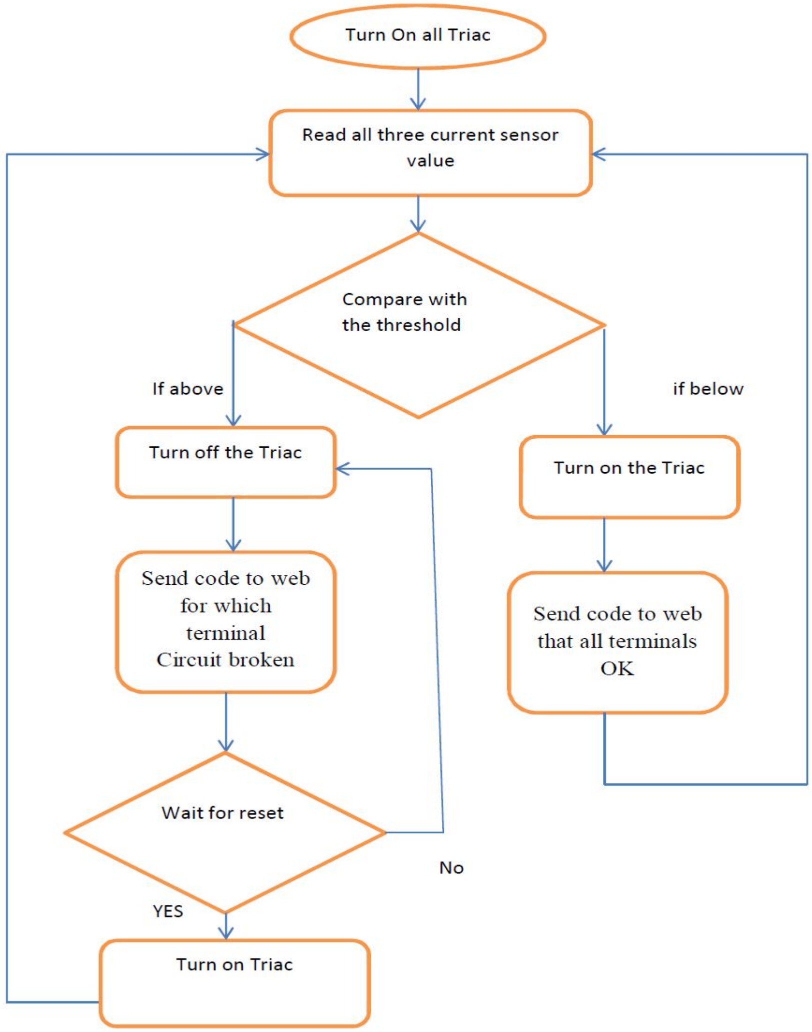

Fig.3 System Flow chart

IV. RESULTS

For the demo experimentation purpose we tested the hardware by applying electrical bulb load of different watts. As per design and code the three terminal blocks works for different ratings. The limit for the first block is 40 mA current. Second terminal block 180 mA and third is 450 mA rating. These rating are set in code so that we can take the readings on low watt loads i.e. bulbs.

As shown in figure 4 connected our develop hardware with load and supply and turned it on. A 9w LED bulb is connected as load in terminal block 2 and observed the result it remains on as it consumes current less than ratings of middle terminal block i. e 180mA.

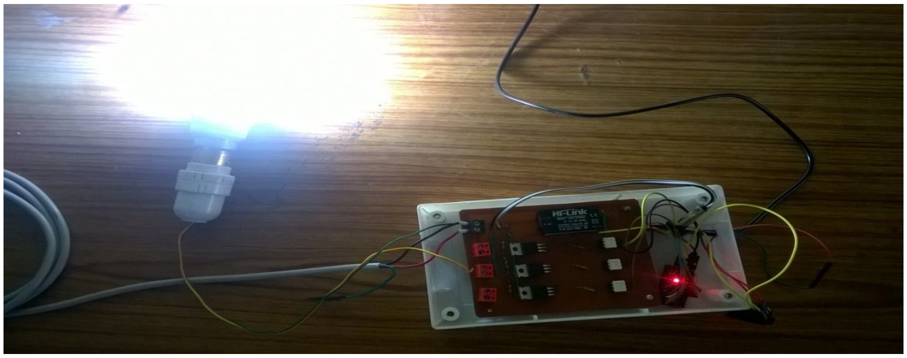

Fig.4 Photograph showing 9w LED bulb remains on when connected to second terminal.

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With the above load observed the IoT cloud , it is showing everything is ok the screenshot is as shown in figure 5. Only thing is required is proper internet connectivity if our hardware is not connected to cloud then the downward thumb will appear in upper corner on status. As we can see B1, B2 and B3 are the status of circuit breaker and reset button is provided to reset the circuit breaker.

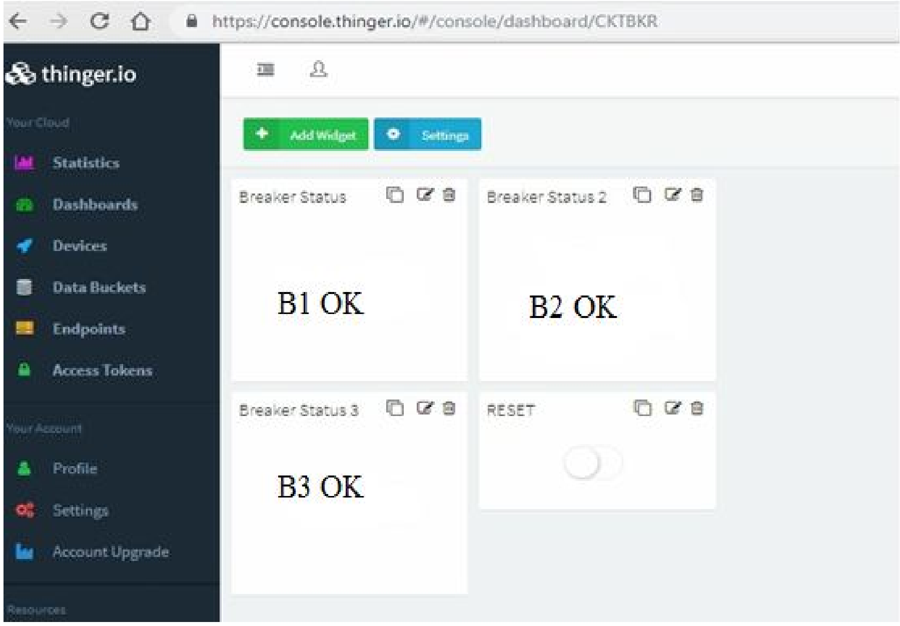

Fig. 5 Screenshot of result obtained on cloud when current is in limit.

Now we connected 200w bulb to same terminal and observed the system as shown in figure 6

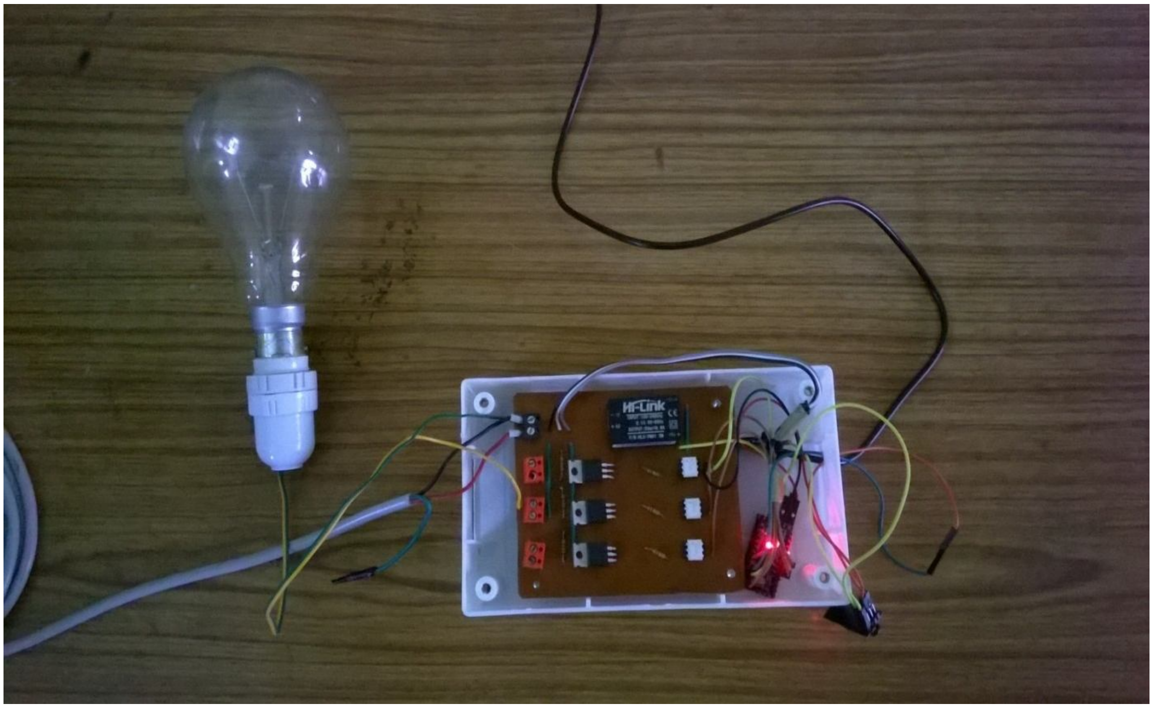

Fig. 6 Photograph showing 200w LED bulb remains on when connected to second terminal.

As we turned on the power supply bulb glow for moment and turned off. Hence system works ok for higher rating above the limit circuit breaker breaks the circuit. Same is appeared on IoT cloud as shown in figure 7. Here in figure B2 shows braked. Now reset applied without disconnecting the load but again it is switched off.

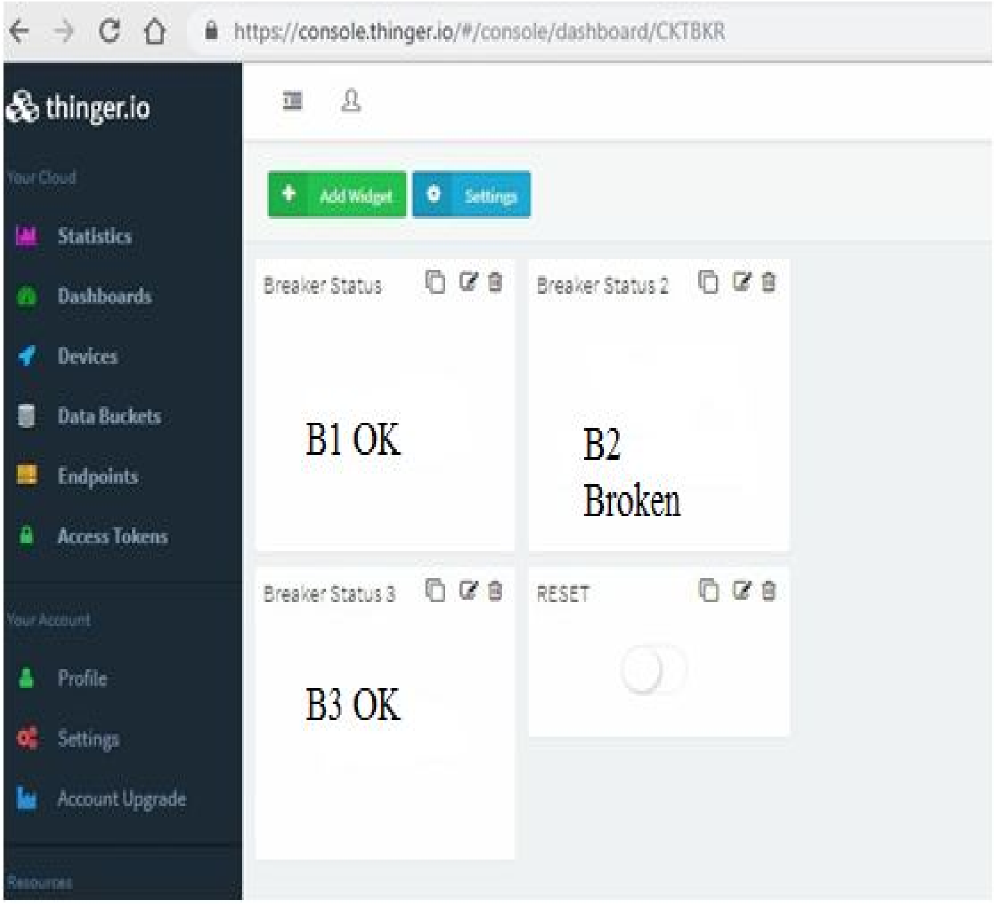

Fig.7 Screenshot of result obtained on cloud when current is above limit for second terminal.

Table 1 Result obtained by varying rheostat pot

Sr. No.	Load (watt)	Max current through load	Breaker Status
1	Open circuit(no load)	0.0000	All ok.
2	3W	0.0130	All ok
3	5W	0.0228	All ok
4	10w	0.0445	P1 -broken, P2- ok,P3-ok
5	20w	0.0880	P1 -broken, P2- ok,P3-ok
6	40W	0.1750	P1 -broken, P2- ok,P3-ok
7	60w	0.2620	P1 -broken, P2- broken,P3-ok
8	100w	0.4360	P1 -broken, P2- broken,P3-ok
9	150w	0.6530	P1 -broken, P2- broken,P3-ok
10	200W	0.8705	P1 -broken, P2- broken,P3-broken

V. CONCLUSIONS

To avoid electrical damages we use the fast responding circuit breaker because of its great sensitivity and accuracy. This system is designed for instantaneous breaking if any fault occurs in electrical system due to load variation or any abnormal causes. This system has more scope compare to MCB with longer breaking time... In the case of a breaker, report will offer more detailed message whether the breaker failure logic worked out properly and finally disconnected faulted section. This kind of analysis enables tracking of every CB operation allowing reconstruction of an entire sequence of operations. In our project we studied designed to attain real time control &monitoring of Circuit Breaker. Measure and record loading of your output of C.B and prevent overloading & increasing whole system life.

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