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Monitoring and Protection of Electrical Load using 'IOT'

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Abstract: This paper proposes monitoring and protection of electrical load system designed to be integrated in domestic or industrial premises based on Internet-of-Things technologies. The proposed system enhances electrical safety by fast disconnection of the power supply in case of fault events like leakage current, overcurrent or overvoltage. The system also enables real-time monitoring and notification events through an advanced communication interface using mobiles phones, laptop by accessing the website. In the Energy Management system, the main constraints are accurate metering, energy monitoring and implementation of visual data for consumer load profile. This Project is intended in designing a system at home or industry which monitors the energy consumption of each device, which is designed to calculate the total energy consumption. A server will be created with appropriate channels to monitor the energy consumption from each of the devices respectively. These data will be uploaded to the server at the monitoring end. Considering all these data individual energy load profile for each of the devices is displayed on the web-page. Accordingly, the analysis can be made for the precise usage or energy consumption of each device in order to further reduce the usage of the device which is drawing the maximum amount of energy. These monitoring reports can be remotely accessed and would help consumers to take the required action in order to improvise the energy usage.

Keywords: IOT, Node MCU, Arduino, Cloud server

I. INTRODUCTION

The Internet of Things (IOT) is becoming more widely used technology nowadays. It is often used to refer to the growing network for connected devices, or "things", that are capable of exchange data over on a low bandwidth network. IOT is being used in various areas, such as automotive industry, logistics, healthcare, smart grid and smart cities. The power consumption is the main part of the electrical equipment used in home or industry. This project aim is to monitor individual power consumption by the load or devices which will be online using "IOT". It will help to monitor and analyse the performance of the device and if any load is consuming more power than that device require maintenance. This will help to improve the device life as well as it will save money as energy billing is maintained. We are building the wireless sensor network based current and temperature monitoring node for each load which will send data to the cloud server that we can monitor online.

II. OBJECTIVES

1) To design the power and temperature monitoring system using IOT for individual appliances of home or industry.
2) To protect the appliance or device from over current consumption & from damage as well as from over temperature
3) To monitor and receive current system information of parameters using IOT.
4) Automatic switching off of faulty devices.

III. PROJECT METHODOLOGY

In the Energy Management system, the main constraints are power reading, energy monitoring and implementation of visual data online. This Project is intended in designing a system at home or industry which monitors the energy consumption and temperature of each device, and displaying the usage online. Live energy consumption & temperature reading from each wireless sensor node is sent to the web server periodically and details are updated in a central database. The web server is created and an interface is created for the users to track the performance of each appliance in the continuously from anywhere and anytime.

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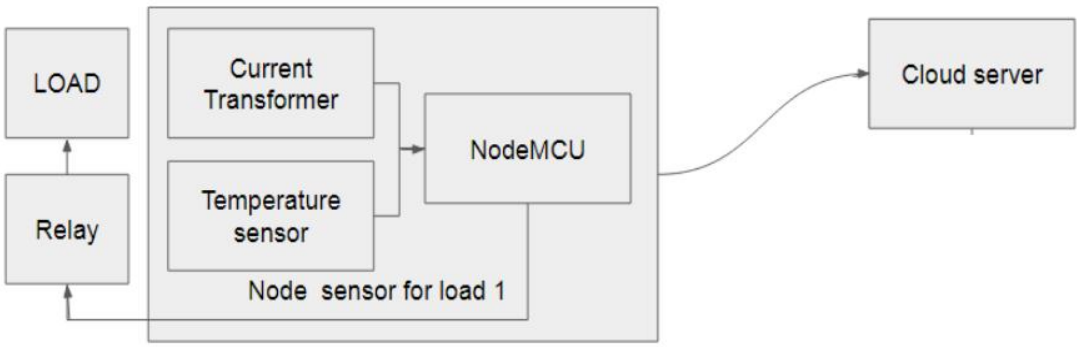

Fig.1 Block Diagram of Monitoring And Protection of Electrical Load Using IOT

To measure the power and energy so we need to measure the current and voltage from the mains supply as well as temperature. For this we are using NodeMCU ESP controller which is an open-source electronics platform based on easy-to-use hardware and software with inbuilt Wi-Fi module called ESP12. It senses the environment by receiving inputs from sensors. NodeMCU is a microcontroller board based on the ESP12 with 3.3v supply, 8 bit, 4kb of memory and 16 MHz clock frequency. The software coding is done in Arduino programming language and using the provided Arduino Integrated development environment.

The current sensors are used to give the accurate current consumption values of each load connected. The current sensor used is Current Transformer. It provides economical and precise solutions for AC current sensing. The power calculation is done using the current and voltage values obtained from the supply and also the energy consumption for each of the devices. The temperature sensor we are using is MAX6675 which is digital sensor and can be programmed on digital pin of the controller. As shown in the diagram, we are monitoring a load - Current and temperature. For the load we are connecting the node and it is connected to a Wi-Fi network so we called it a wireless sensor network. The relay is used to switch OFF the load if it is consuming more power or high temperature to protect it from damage.

IV. WORKING OPERATION

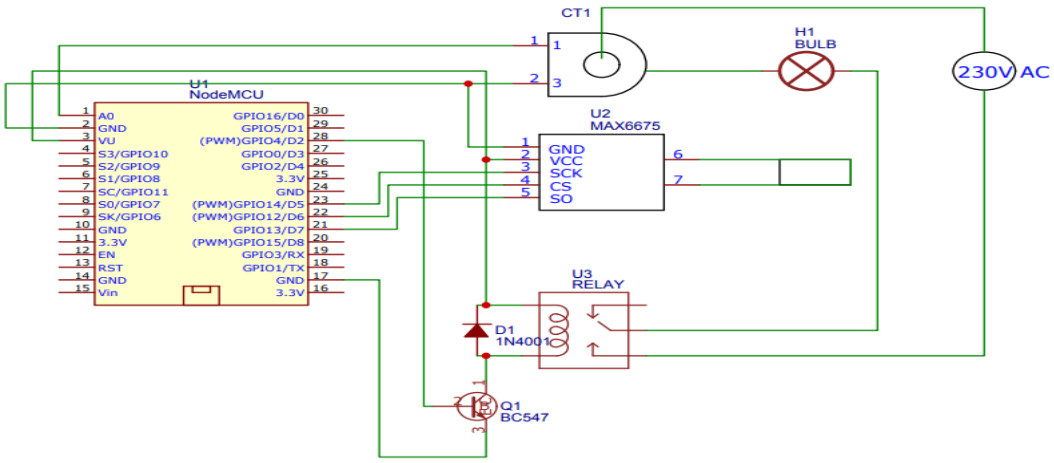

Fig.2 Circuit diagram of monitoring and protection of electrical load using IoT

The temperature sensor amplifier max6675 is connected to D5,D6,D7 of Node MCU, current transformer is connected to A0, relay is Triggered by transistor BC547, the base of transistor is connected to D4 of nodeMCU, the load phase wire is paas through the current transformer, the system is powered by the transformer 12V AC output is converted into 12V DC by bridge rectifier then capacitor filter to give pure DC voltage, this 12V is then converted into 5V 7805IC which is Voltage regulator ic to provide supply to the NodeMCU.

V. SOFTWARE USE

The hardware programming is done on Arduino Compiler software. The flow of data is passed through the layers built upon of TCP/IP stack following a machine-to-machine (M2M) or Internet of Things connectivity protocol. The live data from the sensors through the Wi-Fi module is sent over to the database for storage. The Server is built so as to

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monitor the data and visualize these load graphs online. The server is Thingspeak or cloud server with MySQL database and web server to show our website called the Apache HTTP Server, The MySQL relational database management system (RDBMS), and The PHP programming language. The flow of data to the web server, its connection to the database etc. is done using the php scripts. One php script is responsible for connecting to the database. It contains the configuration settings for the database. If we want to see the data from the database all we have to do is to visit the table file from a browser. The php script will connect to database and it will ask the database to return all the stored data. Then it will display all the data in an HTML table. The data analytics is done so as to compare and notify the users that which appliances are consuming the maximum power and which has max temperature.

Cloud Server

Cloud storage is a model of computer data storage in which the digital data is stored in logical pools. The physical storage spans multiple servers (sometimes in multiple locations), and the physical environment is typically owned and managed by a hosting company. These cloud storage providers are responsible for keeping the data available and accessible, and the physical environment protected and running. People and organizations buy or lease storage capacity from the providers to store user, organization, or application data. Cloud storage services may be accessed through a collocated cloud computing service, a web service application programming interface (API) or by applications that utilize the API, such as cloud desktop storage, a cloud storage gateway or Web-based content management systems. Cloud storage is based on highly virtualized infrastructure and is like broader cloud computing in terms of accessible interfaces, near-instant elasticity and scalability, multi-tenancy, and metered resources. Cloud storage services can be utilized from an off-premises service (Amazon S3) or deployed on-premises (ViON Capacity Services). Cloud storage typically refers to a hosted object storage service, but the term has broadened to include other types of data storage that are now available as a service, like block storage. Object storage services like Amazon S3, Oracle Cloud Storage and Microsoft Azure Storage, object storage software like Openstack Swift, object storage systems like EMC Atmos, EMC ECS and Hitachi Content Platform, and distributed storage research projects like OceanStore and VISION Cloud are all examples of storage that can be hosted and deployed with cloud storage characteristics.

VI. EXPERIMENTAL RESULT

We are going to demonstrate experimental results and show in the website. And reading like in format of column like date, temperature and current shows in the given below.

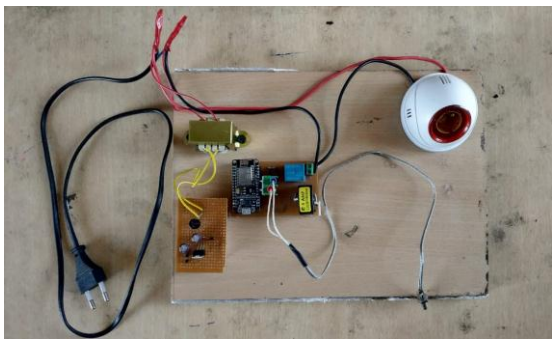

Fig.3 Complete Project Hardware

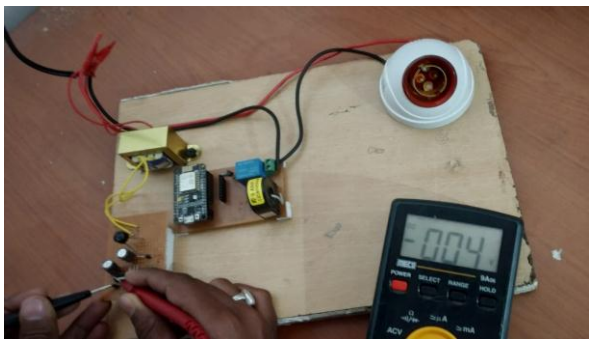

Fig.4 voltage regulators convert about 5volts

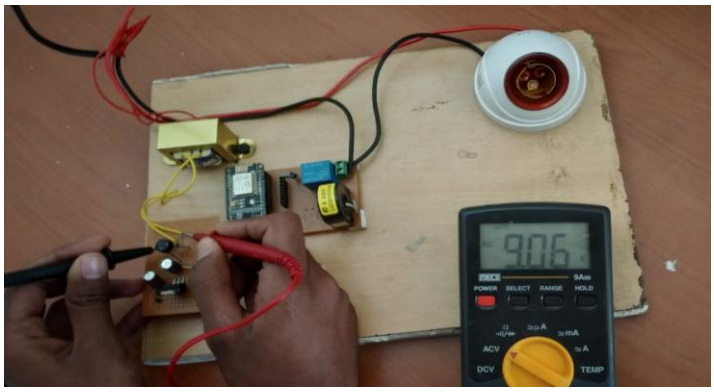

Fig.5 Input Voltage is 230v When We Connect 9v transformer the voltage get step down

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Time	TEMP	Current
2020-01-07 05:41:04	77	3
2020-01-07 05:45:26	57	2
2020-01-07 06:14:59	23	2
2020-01-07 06:15:39	23	2
2020-01-07 06:16:02	22	2
2020-01-07 06:16:25	23	2
2020-01-07 06:16:48	24	2
2020-01-07 06:17:10	25	2
2020-01-07 06:17:33	25	2
2020-01-07 06:17:56	25	2
2020-01-07 06:18:18	24	2
2020-01-07 06:18:41	24	2
2020-01-07 06:19:04	24	2
2020-01-07 06:19:27	24	2
2020-01-07 06:19:50	24	2
2020-01-07 06:20:13	24	2
2020-01-07 06:20:36	23	2
2020-01-07 06:21:02	24	2
2020-01-07 06:21:25	24	2
2020-01-07 06:21:47	24	2
2020-01-07 06:22:10	24	2
2020-01-07 06:22:33	24	2
2020-01-07 06:22:56	24	2
2020-01-07 06:23:19	24	2
2020-01-07 06:23:41	23	2
2020-01-07 06:24:04	23	2
2020-01-07 06:24:26	23	2
2020-01-07 06:24:49	24	2

Fig.6 Final result shows in website (time, temperature, current)

VII. CONCLUSION

The design of a low-cost IOT load monitoring and protection system is presented. This proposed system is suitable for monitoring and protection of electrical load and it has been successfully tested and give a required output result.

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