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A Cost effective Campus Automation System Using BOLT-IOT

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Abstract

The tremendous growth of the IoT produces diverse advanced applications to the world. It invents the birth of advanced appliances for day to day life. This paper aims to develop an economical and efficient campus-automation system through Internet of Things (IOT). The proposed campus-automation system uses Bolt-IOT as cloud and Bolt ESP8266 based IoT platform as the Microcontroller and Android mobile application. A Bolt based IOT system has been devised to control and monitor any campus appliances using micro-web server with Internet protocol. The proposed system establishes the IP connection for accessing and controlling devices and appliances remotely using android based smart phone with website interface.

Keywords: *Bolt IOT, Wi-Fi module, relay- module, remote control, Smart Campus*

1. Introduction

The Internet of Things (IOT) is one of the most popular technologies. The IOT has the promising future with other trending technologies such as robotics or nanotechnology. The IOT is not new to this world, it is available with us for longer than 10 years. The WIFI module ESP8266 (new ESP32) have really changing the world of IOT**.** Today automation is the new phenomenon that is becoming popular because of its less expensiveness. Connecting our personal gadgets, entertainment platforms and home appliances to a central automation unit (hub) one can control everything from lights to temperature to music at any time using his smartphone or computer [7].

The Bolt-Cloud platform creates a link between devices, objects, and things inside campus that can connect, and work together for a common objective. The IOT devices, objects and things can improve and automate the college campus. All electronic devices namely projector, speakers, television, fan, light etc. can be connected over the internet and can be operated in virtual manner [1]. Also, we can monitor our devices from anywhere in the world through a simple webpage or a mobile application [7]. For example, if there is an emergency meeting arranged and needs auditorium to be precooled by air conditioner before people reaches auditorium, then the IOT can simply do this by turning the air conditioner ‘on’ via smart mobile phone from any location. Similarly, if someone wants to monitor and control the projector, then it is possible through IOT platform [12].

IoT indeed enables innovation, starting with whiteboards and connected school buses, moving toward smart lighting and security cameras. Thus, it provide real-time data and valuable insights to students, parents, faculty and administration. The most common IoT devices used in the classroom are interactive whiteboards, student ID cards, temperature and environmental sensors, security cameras with computer vision, smart efficient lighting and predictive maintenance for infrastructure, smart automated attendance tracking systems, wireless door locks and lockdown protocols [13, 14].

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In this paper, the proposed work aims to develop and improve the automation of all appliances and gadgets inside the campus via mobile application through bolt IOT. This work does not change the operations of switch boards. Both normal and IOT based switching can be operated in the proposed work. Such that, if either of the two operations are true, then the appliance will operate; if both IOT device trigger and individual switch are false then only appliance will stop the operation [15,16,17]. The Bolt-IOT is an integrated platform that comes with wi-fi chip to connect actuators and sensors to the internet. The proposed campus-automation system is built by gathering and assembling hardware, connecting bolt to the cloud and upload the custom code written by user [10].

The rest of this paper is organized as follows. We described the related studies of campus-automation system in Section 2. The proposed methodology, software, and hardware tools adopted for the proposed campus-automation system is presented in Section 3. The real-time implementation and experimental results and discussions were given in Section 4. We summarized our study and concluded in Section 5.

2. Literature Review

This section studies the recent literature on the automation methods utilized in the campus, classroom, home, etc. using IOT. Pallavi Asthana ,Smitha Mishra (2018) had developed an Bolt-IOT system to monitor the pollutants like carbon dioxide, carbon mono oxide, and particulate matter in campus indoor environment. Their system intended to provide pollution level information and authors have also focused on the measures to improve the quality of air for good health of the students [1].

Abdal Rahman Abuarqoub, Hesham Abusaimeh (2017) had reported a survey paper that analyses usages of the IOT technologies to develop a modular approach to smart campus. Author had specified the development of IOT enabled campus provides a comprehensive view of general types of smart campus applications [2]. Authors Marti Widya Sarii, Prahenusa Wahyu Ciptadi (2017) had developed a smart campus that is connected via online by the outside entity using internet of things. So that the teaching method based on technology can be conducted in real time. This paper had implemented a smart campus system that includes smart education development, smart parking and smart room [3].

Authors AI-ming Yang, Shan-Shan Li (2016) were aimed to achieve the intelligent management and service on campus. This work had analysed the current research status of smart campus and its difficulties. Also challenges of integrating different kinds of service data in smart campus. Their works shows that smart campus can handle perceptual data efficiently, which helps us to create convenient management of campus service [4]. The authors Brayan Sanchez-Torres, Jesus Alberto Rodiguez-Rodriguez (2018) had analysed on how IOT can influence on improve the university processes to contribute decision-making, technical development, and academic learning. Their work can impact and improve the college's procedures to add to dynamic, innovative turn of events, and scholastic learning in all fields [5].

PP Netalkar, Y Kaushal, NSV Shet (2014) had developed a bolt based IOT system to control and monitor any campus appliances using micro-web server with Internet protocol. They worked on various topologies and unique impacts on arranging the parameters are acquired. The remote individual territory and the individuals are permitted to form the system topology for the execution [6]. Authors H Talei, B Zizi, MR Abid, M Essaaidi (2015) had developed campus-automation system through Internet of Things. They used the Microcontroller and Android

mobile application for the implementation. Authors had shown that the proposed system can automate the processes of the campus day to day duties [7].

The remote sensors are organized by the authors NP Sastra, DM Wiharta (2016) though the development of web of things for natural observing application. The system establishes the IP connection in order to access appliances remotely using smart phone and website. The Arduino was utilized for the implementation of the work [8].

3. Materials and methods

The IoT makes the move from usefulness to availability. The IoT is not just a lot of gadgets and sensors associated with one another in a wired or remote system. It is a thick combination of the virtual and present reality. Bolt based IOT system provides connection between daily used objects like smart-phones, projectors, sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people [18]. Through Bolt based IOT system, one can have connectivity for anything inside the campus and this technology can also be applied to create a wide development space for smart indoors to provide intelligence, comfort and to improve the quality of life [9, 10].

In this proposed work, we are planning to create and improve the automation all things in the campus classroom such as lighting ON/OFF. The proposed work doesn't change the activities of switch sheets. Both ordinary and IOT based automation are implemented in the proposed work. When both of the two IOT gadget trigger and individual switch are valid, at that point the apparatus will work. If both IOT gadget trigger and individual switch are bogus, at that point just machine will stop the activity. In the proposed work, Bolt-IOT is a coordinator framework, it manages the equipment, interfaces it to the cloud and transfer the custom code composed by client [10]. Then the developed application get data and control the gadgets from any stage.

3.1. Components of the proposed work

- Bolt Wi-Fi Module: Bolt is an IoT platform that helps the campus appliances to connect with the devices to the internet. Bolt comes with a WiFi/GSM Chip to connect the campus appliances to the Internet [9].
- Relay Module (Generic) : The relay module is a separate hardware device used for remote device switching. It can remotely control devices over a network or the Internet. The devices can be remotely powered on or off with commands from ClockWatch Enterprise delivered over a local or wide area network [10].
- Jumper wires (generic) : Jumper wires are simply wires that have connector pins at each end, allowing the campus appliances to connect points to each other without soldering. Typically, the jumper wires are used with breadboards and other prototyping tools in order to make it easy to change a circuit as required.
- Bulb: The bulb is used to show an electronic device is on with direct traffic and for many other purposes.
- Bulb holder: For wall and ceiling lights with a fixed lamp holder, it is important that the lamp holder should be compatible with the type of bulb that one want to use.
- Bolt Cloud: Bolt's Cloud platform helps to control and monitor campus appliances over the Internet. Using Bolt Cloud platform the personalised

dashboards are created to visualise data, monitor devices, and to send text messages, etc [9, 10, 11, 12].

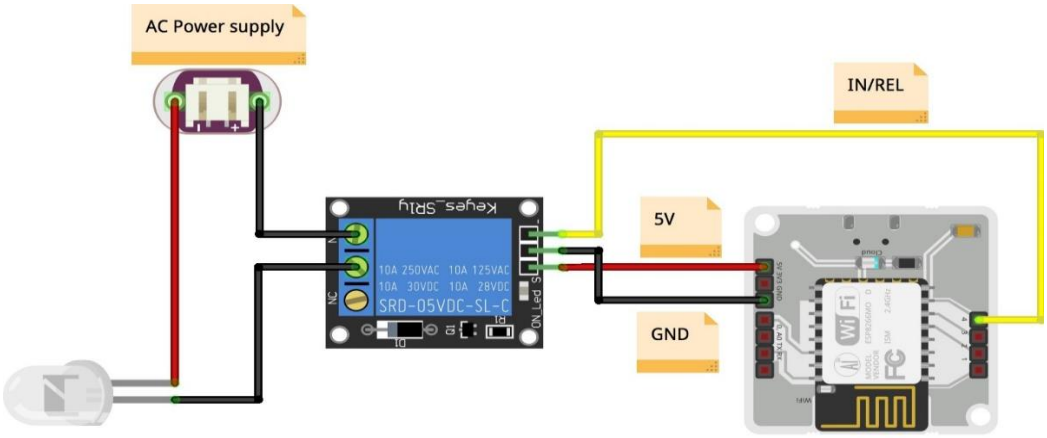

Fig1: Block diagram

The Figure 1, illustrates the block diagram of the hardware setup for the proposed campus automation system. First the 5Volt supply pin and GND of the Bolt-Wi-Fi module is connected with the 5Volt supply and GND pins of the relay-module. Then, any one digital pin (0-4) of the Bolt-Wi-Fi module is connected with to the IN or REL pin of the relay-module. After that, a wire from the bulb holder is connected to the COM-pin of the relay-module [7]. Afterwards, a wire from the NO pin of the relay-module is connected with the 2-pin Socket. Finally, the remaining terminal of the bulb holder is connected with the other terminal of the 2-pin socket. Table.1 summarizes the configuration of devices and other parameters of the proposed system. The Figure2.1, 2.2, 2.3 depicts the adopted Bolt module, Wi-Fi module, and relay module respectively.

Fig2.1: Bolt Module

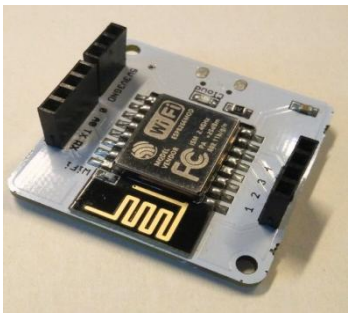

Fig2.2: Wi-Fi Module

Fig2.3: Relay Module

Table.1 Configurations and parameters of the proposed system

Parameter	**Value**
ESP8266 with custom firmware	MCU
32-bit RISC CPU	Ten silica Xtensa LX106
Power	5V/1A DC via Micro-USB port or 5V and GND pins
Operating Voltage	3.3V
CPU Clock Frequency	80 MHz
MCU Internal Memory	64 KB of instruction RAM; 96KB of data RAM
MCU External Memory	4 MB Flash memory [QSPI]
GPIO pins	5 Digital pins [3.3V logic]
ADC	1 pin 10 bit ADC [0-1V input]

PWM	All 5 Digital pins capable of PWM [Software PWM]
Connectivity	Wi-Fi 802.11 b/g/n [7]

4. Real-time implementation of the proposed system

The proposed system is implemented in real-time. The hardware setup of the proposed system is depicted in figure.3. Here the relay module is connected with the Bolt-IoT platform.

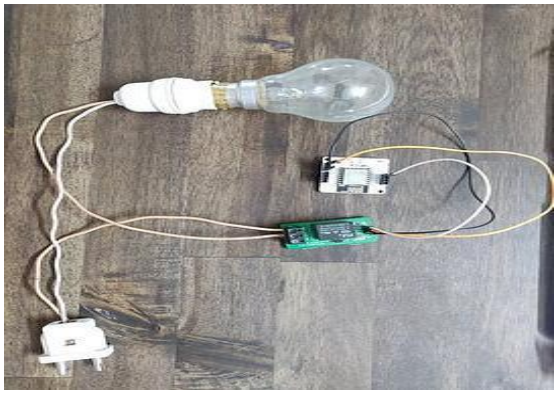

Fig3: Hardware setup of proposed system

For the Bolt IOT based software setup, first devices are added for the Bolt-Wi –Fi module using Wi-Fi Network. The switch of the Bolt device is put into ON state by inserting the Micro USB cable into the USB port provided on the Bolt. The other end of the cable is connected to the Android smart phone to laptop. Secondly, the location service of the smart mobile phone is turned into ON state. It enables the mobile phone to automatically connect with the hotspot of bolt device. Then, the mobile application will send the Wi-Fi credentials to the Bolt Wi-Fi Module.

If the Bolt is connected to the Wi-Fi network it will directly connect to the cloud Bolt's device ID and it will be shown on app. Then the IOT based web dashboard on the PC or mobile phone gives the status of the bolt device. Using the Bolt IOT based web dashboard, the output device and select devices are managed [7]. Afterwards, the proposed system is configured by connecting corresponding digital pins. Finally, the developed java script was loaded into the controlling device. Now the dashboard shows the connected campus appliances in the Bolt IOT based web platform. In the proposed work, the board module was used for the microcontroller development and relay module was used for controlling campus appliances [10].

4.1. Performance analysis

The performance of the proposed campus automation is evaluated by the real time testing. The figure.4 illustrates web controller dashboard of the proposed campus automation system. The figure.5 depicts graphical user interface (GUI) for user to switch ON or OFF campus alliances from anywhere. The coding was developed for the proposed campus automation system given in the figure.4 and deployed.

In the fig.5, controller dashboard is designed with on/off facilities. By clicking the controller tab, two buttons called ON and OFF will be displayed. Now automation system becomes easy by controlling the bulb using the ON/OFF button over the internet [6]. Bolt-API (Application Program Interface) call that turns the state of the digital pin to HIGH or LOW [7]. The state of this pin is further used to switch the relay ON or OFF. And this API call is activated when you press the button on the browser. When the relay is in OFF state it breaks the circuit between

the bulb and the power supply. It results in which the bulb goes off. When the relay is in ON state, it completes the circuit connection between bulb and power supply as a result of which bulb lights up.

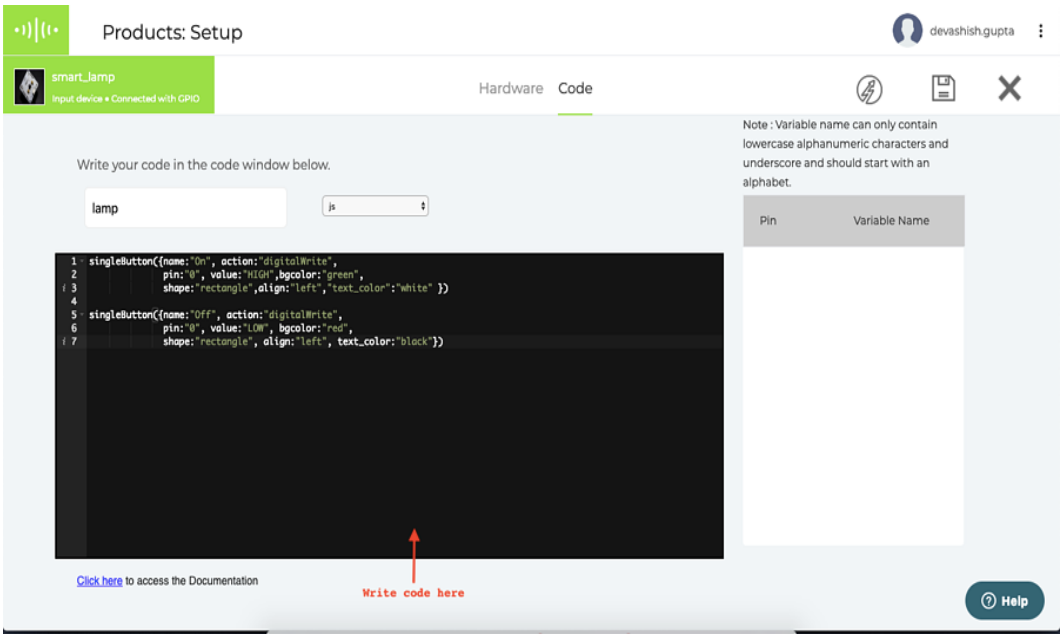

Figure.4 Configuration of the campus automation system

In the proposed campus automation system, the controller is used as the dashboard of cloud Bolt IOT, in which all actions of the hardware was taken. It takes the instructions, processes on it and gives the result of the instructions. When the relay is ON state that means, it will activate the campus appliances and in similar way when the relay is off the controller will deactivate the product.

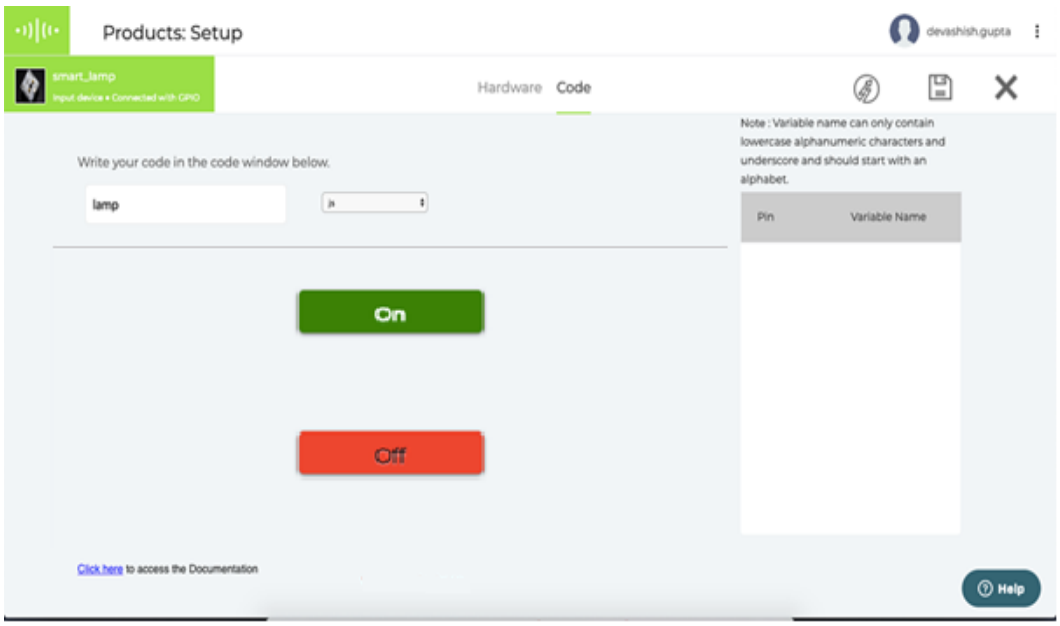

Figure.5 GUI for campus automation system

5. CONCLUSION

The proposed campus automation system using bolt-IOT is perhaps the most useful cost-effective application. Campus Automation improves the campus facilities and make life easy and reduce workloads. Smart campus is an emerging and challenging concept for the technology to bring it in reality. The purpose of this paper is to represent cheapest, secure and efficient Campus Automation using cloud technologies. This work doesn't change the activities of normal working of the switch sheets. The future work is to create IOT platform for implementation on smart education and smart classroom.

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