



An Advanced IoT Based Frame Work to Save Electrical power in an Organization

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Abstract—The growing global demand for power supply is likely to exhaust available resources soon. It is advisable to avoid wastage of electricity as it may overburden consumer adversely. In the present study, we propose an IoT based solution to reduce electric power wastage in organizations. As the organizations are generally divided into sub sections or departments, a frame work can be proposed which allows the managers and supervisors to keep an online track of the ON/OFF status of appliances in their respective departments/sectors. The access to appliances can be provided with a Secure Shell connection through a dedicated server which keeps monitoring all the appliances in the whole organization continuously. Each manager and in-charge along with other officials can be provided with a user ID and password to login with. Each of them is likely to entertain with different level of rights to control various gadgets of the department. This frame work can prove itself to be useful in reducing the problem of various appliances ON in an organization. The frame work has provision for further improvements such that with slight modification it can be implemented for controlling and monitoring a weather station situated in the remote places.

Keywords— RPi (Raspberry Pi), Arduino UNO, SSH, GSM

I. INTRODUCTION

In this study, we proposed an idea to use IoT to control/monitor the electricity usage in an organization. IoT is a network of inter-linked items that has provision for connection to the computation devices. The system can be connected to a relatively bigger network. The IoT is important for making smart homes and organizations as well as public places. The framework proposed is a step towards exploiting IoT to make smart appliances. The proposed IoT can be used to save power consumption. Arduino UNO has been used to control appliances and can send status over the network using GSM module. Using Raspberry Pi whole system can be monitored using SSH without using Arduino. An Arduino, when connected to a PC, can replace Raspberry Pi. If somebody forgets to turn OFF the lights while leaving the office or home, he can turn OFF the lights from somewhere else. The higher authority can also check the status of appliances (power connection) which are left ON at various places in his department. The proposed system can also be used for educational institutes like universities and colleges etc. Unlike earlier methods where SMS over GSM had been used, the proposed strategy uses SSH[1][2]. In earlier proposed methods one cannot prevent perceiving irrelevant messages from unknown numbers/senders. The

SSH makes it more secure and versatile. SSH is easily available for almost every platform whether it is Windows, Linux or Android etc. Hence it becomes easier for the user to control this system from any platform. On the negative note, requirement of switching relays for all devices increases as the system grows which is definitely a limitation of the system.

The paper contains three sections viz. introduction, methodology, and conclusion. In the first section, the problem and its solution are introduced. Then in the next section complete methodology is discussed in detail. After that, in the last section, the paper is concluded with a brief discussion of possible future prospects.

II. METHODOLOGY

Proposed operative model

In the proposed scheme the model involves a power saving strategy in an organization. Each room of the institute/organization would be under surveillance and monitored by the head of department or section. The various sections will, in turn, looked after by the main supervisor or manager .

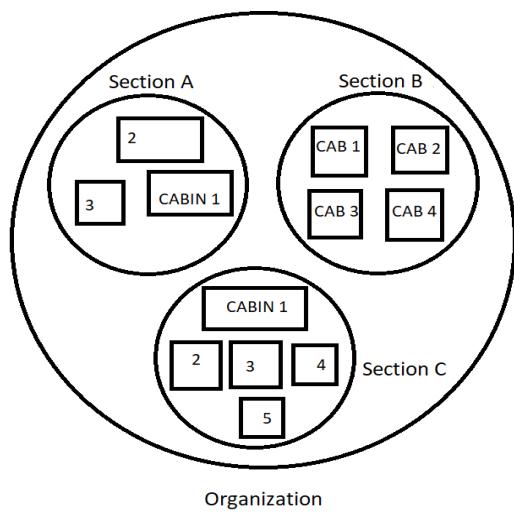


Figure 1. Representation of an organization.

As mentioned earlier, this system is specifically for an organization where many users utilize electric appliances. The main supervisor enjoys most of the rights. This system allows individual office-bearers to control or manage their office or cabin. They cannot change or modify the status of other cabins or sections. The section in-charge can override the rights bestowed upon the members of his section only and cannot interrupt the other sections. The main supervisor, in turn, can override the in-charge of various sections. The distribution of privileges in this system is represented by following Venn diagram.

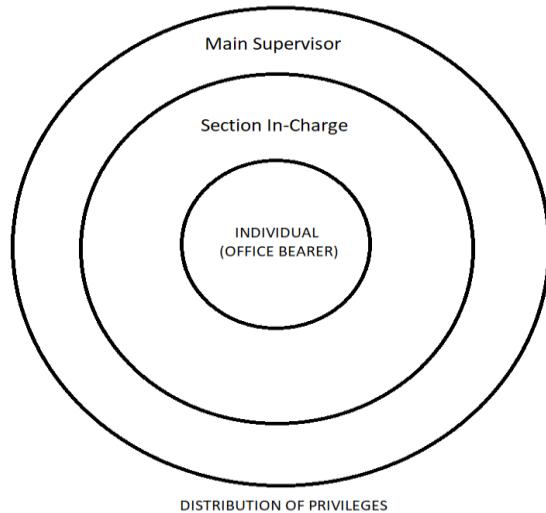


Figure 2 Distribution of power among various posts within an organization.

The main head/supervisor can access the system by using a login ID and a password. When he logs into the system he finds a list of sections or departments under his supervision. He can switch power ON or OFF of any section. On the same pattern, section in-charge can login and change the state of power of various cabins/offices in the section.

Hardware

Raspberry is the most efficient and user-friendly computer device however not preferred because of its cost. Next choice is Arduino that can be programmed to control relays connected to various appliances. Arduino UNO can be connected to nearly 10 relays. We can also read back the status of the relays. A PC is also needed to provide internet connectivity to the Arduino. An old computer can be used for this purpose. The system should also be able to check the presence of a person in the office. This is done by attaching a switch to the lock of the entrance. The Arduino will check the state of the switch and monitor the physical presence of individual inside the office. If any person is inside the office then the section in-charge of the concerned section and main supervisor will lose the rights to switch OFF the appliances.

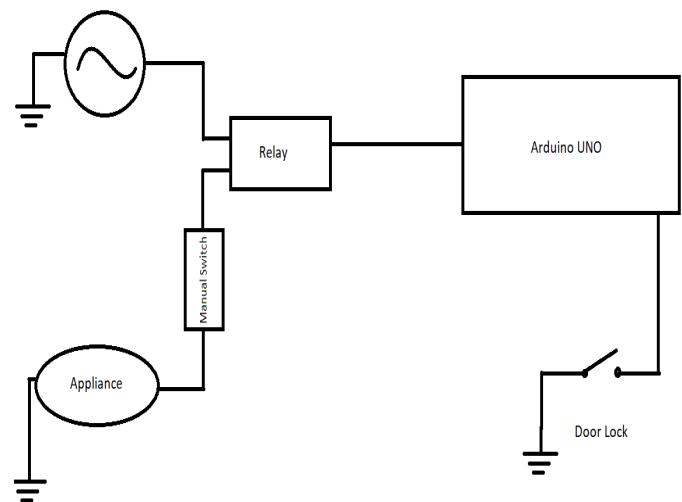


Figure 3 Circuit block diagram for connecting relay, lock
SWITCH AND APPLIANCE.

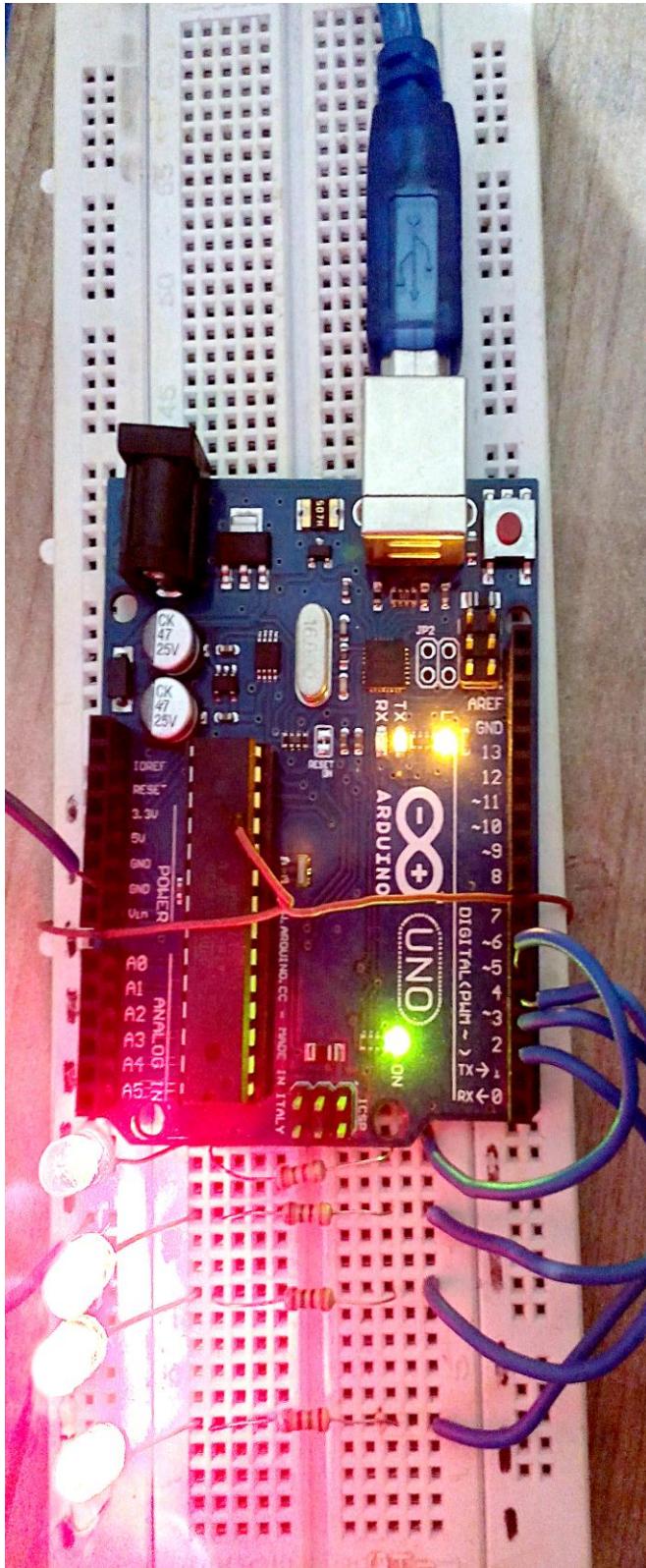


Figure 4. LEDs are representing relays.

Connectivity

Raspberry Pi can be connected directly to the network either by using Ethernet jack or by wireless network. Whereas an Arduino will require either a GSM module or a PC connected to the network. In the second case, we will need another program on the PC which is connected to the Arduino. Each Arduino unit will send data to a central system which will work as a server. This will analyze the whole system state and will also provide an interface to the various users. Hence the server will work as a bridge between user and hardware. This feature of the system can be introduced as a cloud operating system. The hardware of any cabin is not directly controlled by the local software. But to change the state of an appliance which is available locally, the user will have to make a request to the server. Then server will analyze the situation. It will check the door locks and the appliances. And then complete the request made by the user.

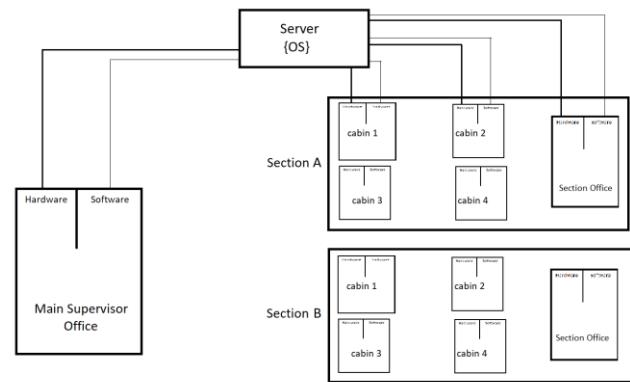


Figure 5. The flow of control from various offices to the server.

Software

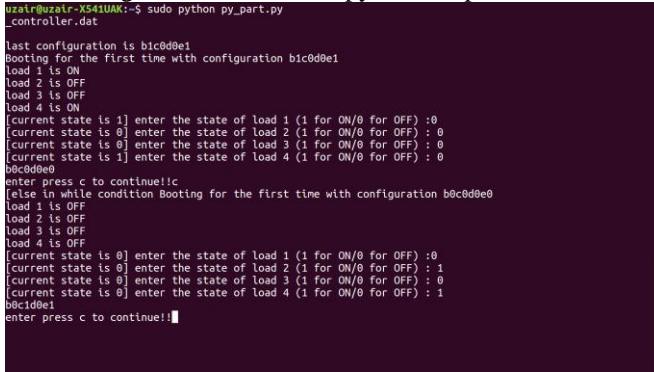
Arduino is programmed by using a c++ code. It will check the state of the pins (digital pins) which are connected to the appliances. It will also change the state of these if required. The program will correspond the data with the PC over USB or GSM module. Then on the PC side, we will need a python script to interact with Arduino and send/upload data to the server. Then we need a script on server to process data, make decisions and send it back to the Arduino. Then Arduino will switch ON/OFF the devices accordingly. Some screenshots of the interface in Linux (Ubuntu 16.04 Distro) are given below.



```
uzair@uzair-X541UAK:~$ sudo python py_part.py
_controller.dat
last configuration is b1c0d0e1
Booting for the first time with configuration b1c0d0e1
load 1 is ON
load 2 is OFF
load 3 is OFF
load 4 is ON
[current state is 1] enter the state of load 1 (1 for ON/0 for OFF) : 0

```

Figure 6. Execution of python script on PC.



```
uzair@uzair-X541UAK:~$ sudo python py_part.py
_controller.dat
last configuration is b1c0d0e1
Booting for the first time with configuration b1c0d0e1
load 1 is ON
load 2 is OFF
load 3 is OFF
load 4 is OFF
[current state is 1] enter the state of load 1 (1 for ON/0 for OFF) : 0
[current state is 0] enter the state of load 2 (1 for ON/0 for OFF) : 0
[current state is 0] enter the state of load 3 (1 for ON/0 for OFF) : 0
[current state is 1] enter the state of load 4 (1 for ON/0 for OFF) : 0
b0c0d0e0
enter press c to continue!:
[else in while condition Booting for the first time with configuration b0c0d0e0
load 1 is ON
load 2 is OFF
load 3 is OFF
load 4 is OFF
[current state is 0] enter the state of load 1 (1 for ON/0 for OFF) : 0
[current state is 0] enter the state of load 2 (1 for ON/0 for OFF) : 1
[current state is 0] enter the state of load 3 (1 for ON/0 for OFF) : 0
[current state is 0] enter the state of load 4 (1 for ON/0 for OFF) : 1
b0c1d0e1
enter press c to continue!:
```

Figure 7. Execution of python script on PC.

Authors Profile

She is working as Assistant Professor at Computer Science Department, Aligarh Muslim University, Aligarh. Her research interest mainly focuses on Immuno-informatics, nano-informatics, MIS, Data mining, Big data Analytics, and IoT. She has several publications in peer-reviewed reputed International journals.

Mr. Uzair Aalam pursued Bachelor of Science (Hons) physics, from Aligarh Muslim University, Aligarh, India in 2016 and Master of Science (Physics) from the same university in the year 2018. He is currently pursuing M.Tech. His area of interest and work include IoT, sensors, microelectronics, communication and hardware programming.

III. CONCLUSION AND FUTURE SCOPE

An IoT based frame work for controlling and monitoring the electrical appliances used in an organization has been proposed. The scheme can find wide users and can be implemented in any organization or institute to monitor and control the power wastage. The important feature of this is the use of IoT to make organization a "smart organization". The connection is secured through SSH (Secure Shell) which improves safety and protection. The use of the Arduino UNO, which is available in the market at a reasonable price, makes it cheaper and cost-effective. The provision for entrance lock switches to check the presence of a person inside the cabin is an advancement over the existing "smart home" systems. A little amendment can make the proposed approach more useful in other firms and buildings. Besides, there is a stipulation to upgrade the system in future because of the fact that only server has to be updated.

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