

Lab Automation System using IoT

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Abstract— Lab automation is building automation for the lab. It involves the control and automation of lighting, heating (such as smart thermostats), ventilation, air conditioning and electricity supply to the computers. Wi-Fi is often used for remote monitoring and control. Lab devices, when remotely monitored and controlled via the Internet, are an important constituent of the Internet of Things. Modern systems generally consist of switches and sensors connected to a central hub sometimes called a "gateway" from which the system is controlled with a user interface that is interacted either with a wall-mounted terminal, mobile phone software, tablet computer or a web interface, often but not always via Internet cloud services. The main purpose is to make the lab automate with the help of IoT concepts. This project will help to reduce the cost and electricity consumption which actually are much high. To get rid of unnecessary usage of the electricity we came to the solution which will help us to overcome this problem.

Keywords: Internet of Things, Lab Automation

I. INTRODUCTION

The Internet of things defines, sensors and actuators embedded in physical objects are linked through wired and wireless network. The term IoT was invented in 1999, initially to promote radio frequency identification technology. The IoT is about to transform the next decade. Literally, everything will be connected to everything. As we know that today's world is progressing very fast, things are becoming easy then before. People are considering the automatic devices instead of manual devices. They just want an easier approach to some device. The field of automation is growing very fast. Internet is the basic part of the world's communication. For the last few decades the use of internet has enormously increased. IoT is a field in which you can share all your required information from your specified file even when you are busy. IoT wants to connect all potential objects to interact each other on the internet to provide secure, comfort life for human. The term Internet of Things (IoT) was first coined by Kevin Ashton in the year 1999 in the background of supply chain management. IoT represents the ability of network devices to sense and gather knowledge from the environment, this knowledge is then shared across the Internet where it can be processed and utilized for an extensive range of applications like healthcare, utilities, home automation, transportation, defense, public safety, wearable and augmented reality (AR). It is expected that IoT devices will rise to 26 billion by the year 2020, which is 30 times the estimated number of devices deployed in the year 2009. With the help of IoT, automation of processes is possible. The smart sensor networks which are connected to a cloud or local system can provide us with better control of the processes. The Internet of Things (IoT) involves continuously connected Internet devices that can be used to simplify activities in many aspects of life [1]. The main purpose of IoT is to

increase various types of functions in any system consist of the Internet and we can make it more useful than the existing system. With help of IoT many users can share various information which is provided by the humans that are contained in the cloud databases and it also contains information provided by the several things in physical world [2]. With help of IoT and recent technologies, we can create a smart ecosystem of computing. IoT has several components and described with including embedded intelligence for different objects those can notice at an early stage and changes in atmospherically physical state.

In the current scenario, there is a lot of unnecessary wastage of electricity in the laboratory. The appliances of the laboratory are left switched on even when not required. This leads to a rise in electricity consumption and hence exorbitant electricity bills.

Our objective is to build a Smart Laboratory which takes into consideration environmental parameters such as temperature and light intensity of the laboratory. With the help of these parameters, the system will analyze and process the information collected and then produce appropriate results. This will help in automation and effective power consumption of the laboratory. The system will be able to adapt to the environment and act accordingly. This means the usage of the appliances will be done only when required. The automation of the laboratory will help in the efficient utilization of the appliances with minimal human assistance.

- To count the number of students in lab and accordingly provide the power supply
- To switch ON the respective computer by tracking the respective location of that particular student
- To solve problem of manual switching on and off the devices.
- To reduce the electricity bill by 10-20%

The next section describes background and related work. Section 3 describes the system design and methodology of proposed IoT based system. Section 4 is results. At last, conclusions are stated in section 5.

II. BACKGROUND AND RELATED WORK

IoT is a combination of computers, sensors, and several objects that are interacting with each other. It may process data automatically without any interfering of humans. IoT is one of the best new technology used in the various system, which is combined with several various information technologies. Internet of Things is connecting with each individual device in the network. In IoT, there are special systems which control software services which act as the brain of this system which helps us to process data. The Internet of Things software system is analysed by using the collected data which is connected by various devices to make important decisions [3].

Now a day, IoT is used in each field.

- Healthcare- Smart bands, Wireless ECG monitor, Smart contact lens, Smart devices helping people to quit smoking, improved care for patients and providers can be facilitated.
- Smart fabrics can communicate with the smartphones to process biometric information such as heart rate, body temperature, breathing patterns, stress levels, hormone levels and the movement of body, with real time feedback.
- IoT in architecture of buildings can help in accelerating development, adding intelligence across building operations, lower operational costs and consolidating workloads to build smarter offices, industries, residents, hotels, hospitals, etc.
- Smart Energy- Economical electricity transmission, Immediate electricity restoration after power disruptions, Decreased operational and management costs, Controlled demand
- Smart Mobility and Transport- The transport with the help of internet connected vehicles is effortless, hassle-free and safer. IoT provides cutting-edge services relating to different modes of transport and enables user to be informed about the environment and make safer and smart decisions and thereby make optimum use of the transportation networks.
- Smart Manufacturing- Digitized manufacturing systems
- Smart Farming- Viable farming, Increased production with much lesser costs, lesser environmental impact.
- A general example of IoT is a smart home, in which users don't need to turn off lights/fans/equipment manually. There are various sensors are integrated with hardware components and it automatically detects any motion with this system. With this system, we can save human efforts and power consumption. In a smart home system, many such functionalities are made available. With help of interconnected devices, it measures the various environmental factors from the sensor nodes. Physical activities are performed by actuators, which converts digital data from the sensor to any physical activity such as switching off lights, fire extinguisher turns on in presence of fire and with these components, we can easily manage any action and it becomes much easier [4].
- In literature, many papers experimented the use of IoT for forest fires. Proposed system using a wireless the sensor network is designed for early forest fire detection. The main aim is quick detection of fire with minimizing the energy consumption of the sensor nodes. The proposed framework is tested using simulators [5]. To predict the forest fire, 24-hour weather data is collected through a rechargeable wireless sensor network. The obtained data is processed using a fuzzy inference system and big data analytics [6]. Early forest fire detection system experiments with a smoke sensor, two gas sensors and microwave sensors. Indoor and outdoor tests are conducted to validate the results [7]. Presented improved MODIS for detection of forest fire by adapting the HJ-infrared sensor [8].

Internet of things (IoT) provides a platform that allows devices to be connected, sensed and controlled remotely across a network infrastructure. Dashboard and

Mobile Application has been developed for interfacing IoT smart hardware kit.

From the results of implementation, it is observed that the appliances in our lab are remotely monitored and controlled, thereby reducing their energy consumption considerably. The proposed work controls and monitors the devices of the IoT lab using the dashboard developed in Node-RED or android studio Mobile Application. Devices in laboratory are connected to IoT smart hardware kit [9]. IoT is a promising technology that has wasted no time spreading across the world and connecting the huge number of individuals with the devices around them. The proposed work mainly intends to provide an easy accessibility of the electrical appliances through an android application. Along with the status and energy consumption of individual devices, temperature and humidity status of the laboratory can also be monitored using sensors [10]. The integration of IoT platforms in modern building has started to offer diverse services for residents comfort and wellbeing. This paper presents the potential gained benefits of such IoT implementation for older homes by proposing an IoT – enabled control mechanism. The savings are in the form of reducing power consumed for lighting while ensuring Visual comfort for the residents [11]. In this paper we presented the a Lab Automation System (LAS) using Nodemcu esp8266 that employs the integration of cloud networking, wireless communication, which provide the user with remote control of lights, fans, and appliances within their lab and storing the data in the cloud. The system will automatically change on the basis of sensors' data. This system is designed with low cost and expanded in lab to control variety of devices [12]. Home automation has become more and more popular in recent years. It aims at helping people manage the home appliances freely and build an autonomous environment in home. The arduino board is specially designed circuit board for programming and prototyping with microcontroller. The aim of this is full security and controlling the home appliances using wireless communication [13].

III. SYSTEM DESIGN AND METHODOLOGY

It was too important to first identify crucial components and then configure those hardware components, some software components to simplify the implementation of the proposed system and for testing of the proposed system. Assembling all required components allows for appropriate planning and system formation.

With the help of IoT concepts we are going to make lab automate. we have divided the lab into quadrants and accordingly we are going to count the no of student present in each quadrant so with respect to the no of students present in the that quadrant fans and light will get switched ON and PC's and if no one is present in the lab then it will cut all the power so it will be on power saver mode.

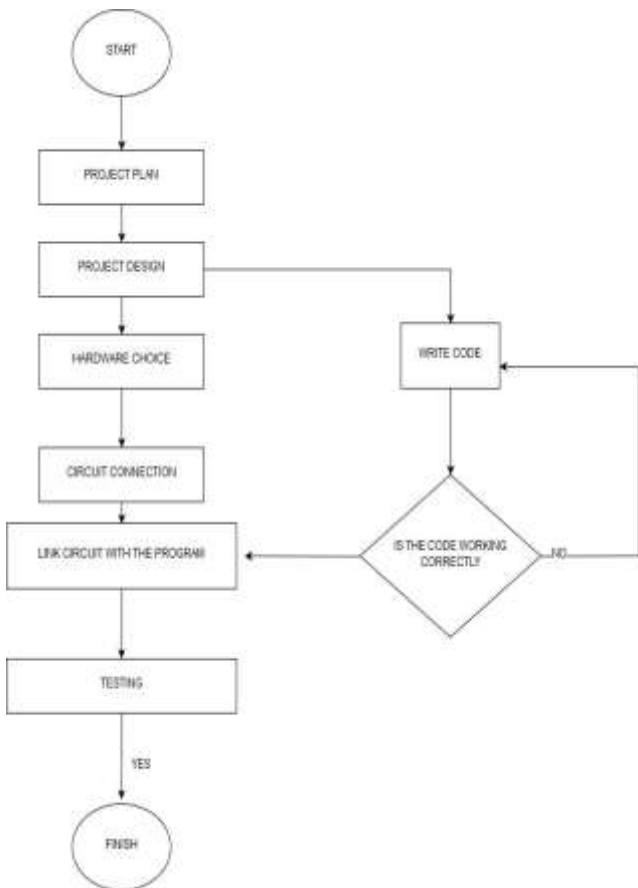


Fig. 1: Flowchart Diagram for the project

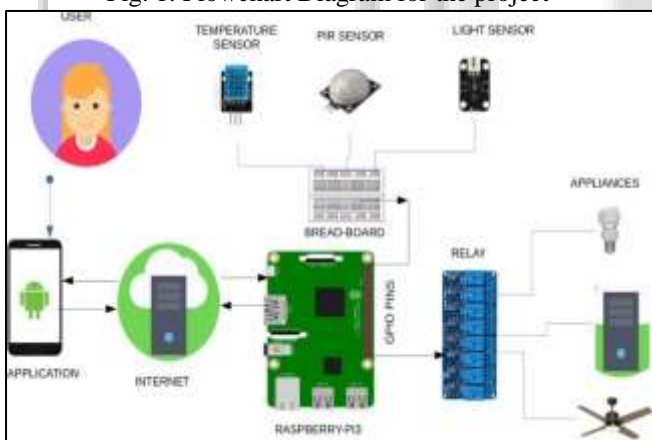


Fig. 2: System design

For proposed work, we are going to make use concept called “Internet of Things” (IoT). So, with the help of arduino, we will make our lab automatic. For this, firstly we will go through some basic maths regarding the dimensions of the lab.

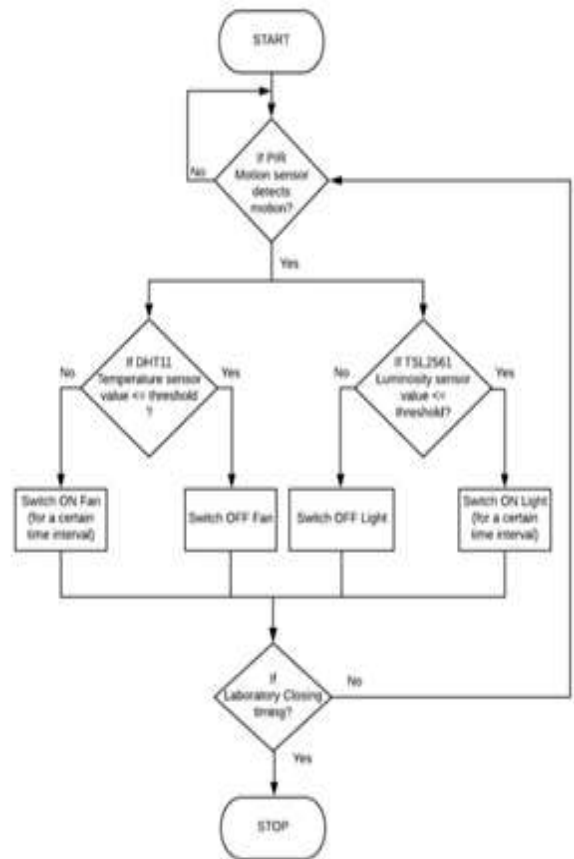


Fig. 3: Activity flowchart

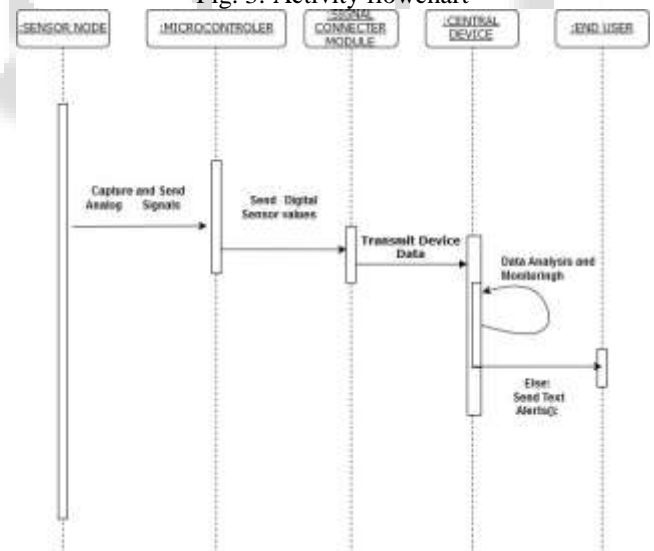


Fig. 4: Sequence diagram

- Firstly, we are going to virtually divide the lab into quadrants. Then the basic idea is to count the total number of students presents in all quadrants respectively.
- We are making use of IR SENSOR, which will be installed at the centre of the lab. Those IR SENSOR will help us to count the no of student present at respective quadrants.
- At main entrance, we are installing pair of 2 IR SENSOR which will guide us to count of total student present in lab. Will also switched on and accordingly the fan and light.

- Working of pair of IR sensor is as follows, If IR sensor no. 1 gets active first with respect to IR sensor no. 2 then the count will get incremented and if IR sensor no. 2 gets active with respect to IR sensor no. 1 then count will get decremented.
- Accordingly the presence respective number of students, power supply will be provided to that particular quadrant that respective number of PC's will be provided the power supply.
- Switching the respective number of computer w.r.t the number of student present in the LAB is an innovative idea which will add cherry on the cake in automation.

IV. RESULTS

It collects the data from the particular field using various sensors and sends it to the microcontroller through a wifi module. To analyse the collected data, it uses cloud service. The user can access the sensor data through Android Smartphone and Web App (Website Application) via cloud service.

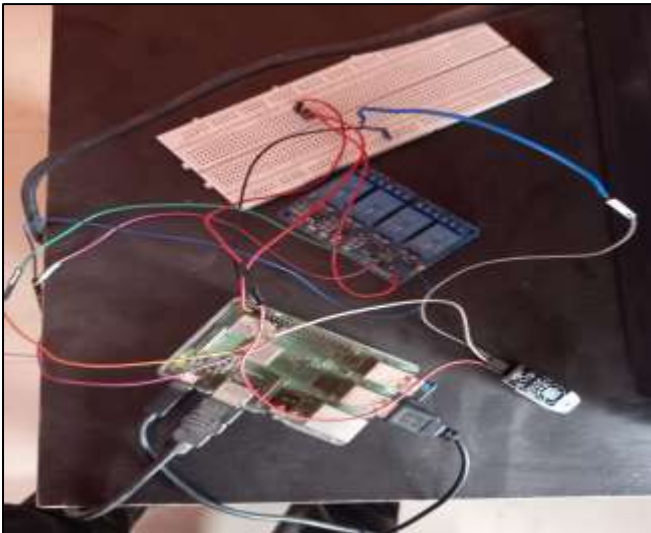


Fig. 5: IoT Connections

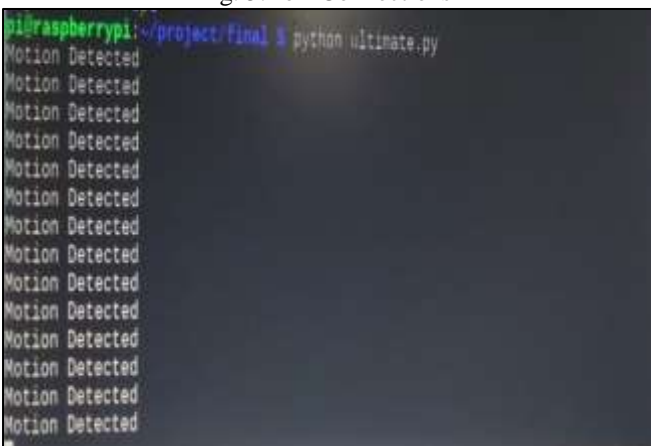


Fig. 6: Results of PIR Sensor for motion detectors

We have used the components like Raspberry Pi, temperature Sensor, light sensor. The Raspberry Pi, Sensors, Relay Board, Android Phone, Computer, etc. are integrated to monitor the plant effectively. Smartphone connected wireless to the Raspberry Pi (RPI) via the Internet. RPI is a small hand-held computer connected to the sensors. An

android app helps to monitor the plant by taking data from various sensors.

Fig. 6 describe the continuous result of PIR circuit connection with raspberry pi when any motion is found which is detected by PIR sensor.

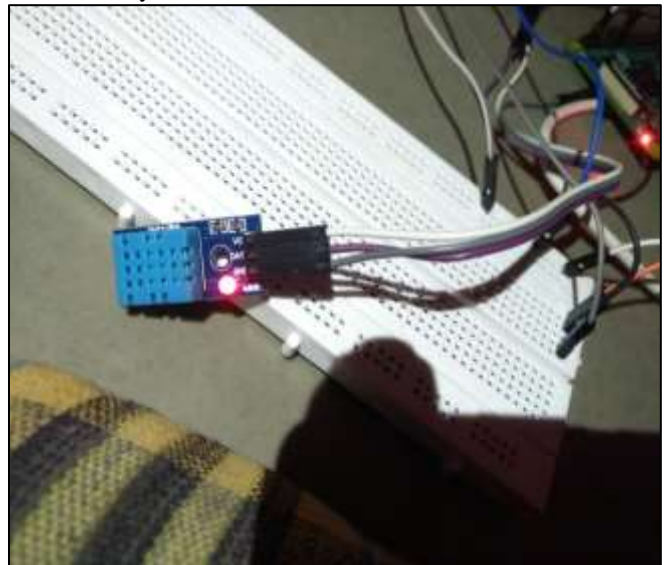


Fig. 7: Sensor for Temp and Humidity

Fig. 7 shows separate sensor circuit connection with raspberry pi and this sensor detect a rise in temperature and a decrease in humidity.



Fig. 8: Mobile Application interface

Lab automation system is a means that allow users to control electric appliances. Labs will become more and more self-controlled and automated due to the comfort it provides, especially when employed in a private lab. Many existing, well established lab automation systems are based on wired communication. In contrast, Wireless systems can be of great help for automation systems. With the wireless technologies such as Wi-Fi, cloud networks in the recent past, wireless systems are used every day and everywhere. Advantages of proposed system are.

- Installation costs are significantly reduced since no cabling is necessary. Wired solutions require cabling, where material as well as the professional laying of cables (e.g. into walls) is expensive.

- With wireless networks, associating mobile devices such as PDAs and Smartphones with the automation system becomes possible everywhere and at any time, as a device's exact physical location is no longer crucial for a connection (as long as the device is in reach of the network). For all these reasons, wireless technology is not only an attractive choice in renovation and refurbishment, but also for new installations.

V. CONCLUSION

Lab automation system using IoT that is capable of controlling and automating most of the appliances through an easy manageable web interface. The proposed system has a great flexibility by using Wi-Fi technology to interconnect its distributed sensors to lab automation server. It has the capability to reduce the excess usage of the power consumption and it will reduce the electricity bill upto 10% to 15% and manual switching of the computer and stuffs. So our project is very effective and eco-friendly.

REFERENCES

- [1] Qian, Z. H., & WANG, Y. J. (2012). IoT technology and application [J]. *Acta Electronica Sinica*, 5, 026.
- [2] Zhong, Y. (2015). I2oT: Advanced Direction of the Internet of Things. *ZTECOMMUNICATIONS*, 3.
- [3] Miller, M. (2015). The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world. Pearson Education.
- [4] http://www.academia.edu/19560667/A_Literature_Review_on_Internet_of_Things_IoT_.
- [5] Xiao, J., Li, J., & Zhang, J. (2009, October). The identification of forest fire based on digital image processing. In *Image and Signal Processing, 2009. CISP'09. 2nd International Congress on* (pp. 1-5). IEEE.
- [6] Asatryan, D., & Hovsepian, S. (2015, September). Method for fire and smoke detection in monitored forest areas. In *2015 Computer Science and Information Technologies (CSIT)* (pp. 77-81). IEEE.
- [7] Morerio, P., Marcenaro, L., Regazzoni, C. S., & Gera, G. (2012, September). Early fire and smoke detection based on colour features and motion analysis. In *Image Processing (ICIP), 2012 19th IEEE International Conference on* (pp. 1041-1044). IEEE.
- [8] Zhang, Q. X., Lin, G. H., Zhang, Y. M., Xu, G., & Wang, J. J. (2018). Wildland Forest Fire Smoke Detection Based on Faster R-CNN using Synthetic Smoke Images. *Procedia engineering*, 211, 441-446.
- [9] M. Poongothai, P. Muthu Subramanian "Design and Implementation of IoT Based Smart Laboratory" at IEEE, 5th International Conference on Industrial Engineering and Applications, 2018.
- [10] A. L. Karupriya, R. Priyadarshani "Implementation of IoT Based SmartLaboratory" International Journal of Computer Application, Vol-182,Sept 2018.
- [11] Naser Hossein Motlagh, Siavash H. Khajavi, Alireza Jaribion, and Jan Holmstrom "An IoT- based Automation System for Older Homes: A Use Case for Lighting System" at IEEE 11th International Conference on Service-Oriented Computing and Applications, 2018
- [12] Nitish Gupta, Shivam Kumar, "IOT Based Lab automation System" at International Journal of Current Engineering and Scientific Research (IJCESR) ISSN: 2393-8374, Volume-4, Issue-6, 2017.
- [13] V. Jyothi, M. Gopi Krishna, B. Raveendranath "IOT Based Smart Home System Technologies" International Journal of Engineering Research and Development, Vol-13, Feb 2017.