

# SECURITY SYSTEM FOR LABORATORY EQUIPMENTS

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## ABSTRACT

*This paper describes and discusses on the development of data management system of laboratory equipments using IoT technology. The system was developed to assist staff in managing the status of the laboratory equipments i.e. to tell whether the equipments are damaged, working, issued or free to use. The data related to the students and the equipment is recorded and stored automatically and in a systematic manner. With the help of new information and network technology, management methods have become convenient and effective. New challenges and chances keep cropping up according to the need. Any laboratory in colleges and universities serves as a multifunctional base for activities like training, teaching, scientific research and application and so on so forth. However, a few problems have arisen during the process of managing a lab, such as, easy to use and sufficient number of lab manuals, need of a lab assistant for small works, management of quantity and quality of lab equipment, slow query speed on experimental programs, attendance issues, power management.*

**Keywords:-** *Laboratory management, Network technology, Systematic analysis, Automation, Intelligent services, IoT network, GUI, Wireless communications.*

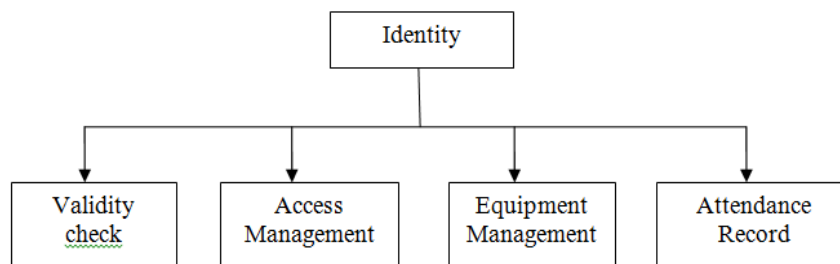
## 1. INTRODUCTION

With the demand for university teaching and teaching reform, establishment of open laboratories have been taken up by many colleges, teaching requirements preclude new teaching methods courses take reasonable real integration, project and so that the theory teaching is done in lab, students learn by doing. Management of laboratory is still done in traditional way, students have to enter the laboratory experimental projects operating practice, which makes the students' ability cannot be fully exercise, while the lab is a large waste of resources. As students on the use of experimental equipment cannot track record, equipments can be damaged or lost, and unable to be held responsible. Therefore, intelligent design to introduce automation in the lab management process has become essential.

Networking is the core of a new generation of information technology, it is the integration of various technologies from the new technology system, it will be based on the Internet any time, any place of communication and connection between people, extended to any time and any place and objects, object interaction and connections between things. Use of networking technology can be used to provide intelligent services, identification, location tracking, on-line monitoring, remote control and other functions. The plan for this project is to implement IoT in the Instrumentation Lab of Electronics Department of RCOEM. The idea is to develop a laboratory where attendance, access of the lab and instruments and the equipment safety will be managed with the help of IoT.

## 2. ANALYSIS ON THE CONCEPT

This system contains Personnel authentication, access management, student attendance records management and laboratory Instruments management, as shown in Figure 1 [1].



**Fig-1 Block diagram of laboratory instruments management system**

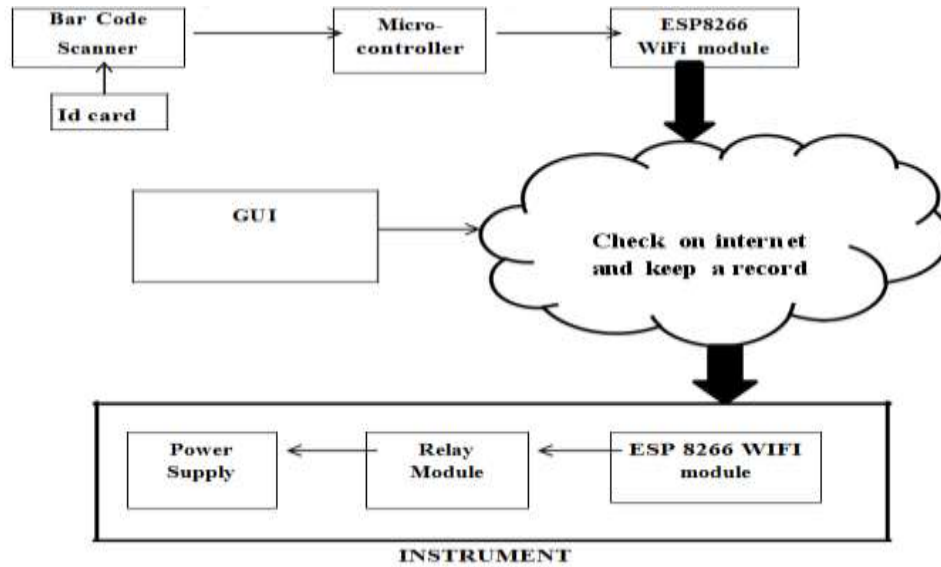
Connection of various sensors and Internet, forms the IoT network, which could manage and process the monitoring data. A usual system is the sensor collects the data from the monitoring devices, and then transfers the data to the central servers. A group of sensor devices or physical instruments is combined by IoT and passes to a specific kind of application software.

The IoT network is formed by the connection of various kinds of sensors and Internet, which could manage and process the data intelligently. A usual system is the sensor collects the data from the monitoring devices, and then transfers the data to the central servers. A group of sensor devices or physical instruments is combined by IoT and passes to a specific kind of application software.

The data collected by the sensors is input to the IoT. Some modules can be used to display the monitored data after processing. Standard interface, such as Web Service, can be used to access the processed data. We develop the IoT unified GUI to realize the mentioned functions, which could display different kinds of monitoring data on the unified panel. The GUI analyzes the IoT description file, and dynamically loads the calculation module to acquire the monitoring data and system information. It can form the IoT based on the file and display the data. Another important thing to solve is how to provide wireless communication capabilities to the various devices used and also the energy consumption for the communications, etc. Primary pillars of the IoT is to identify an object. A key problem is how to separate device's Location and Identification. The IoT is expected to provide a resource fabric interfacing the physical world by means of a usually deployed substrate of embedded networked devices. [3] The collected record data from scanner is stored in database server and the user can monitor the related information of specific laboratory equipment by information displayed on a computer screen. Presently, the users record the information manually in the log book to borrow the laboratory equipments. GUI will have the information about the equipment such as the name of the user, the item they borrowed, the time and date. Each tag has its own unique ID. [4]

### 3. THE ESTABLISHMENT OF THE HARDWARE MODEL

In order to make the laboratory automated, we are using the concept of Internet of Things (IoT). IoT is basically communication between two or more machines without human intervention via internet. So our project will also be based on access management of the laboratory with least human intervention. In order to make this project more feasible and cost effective, we will be making the use of identity cards which already have bar codes encrypted on them. Every student wishing to access the equipment in the laboratory must have their identity cards with them. Those cards will be scanned and only the students having valid identity cards registered with the institute can access the equipment. At the same time, record of duration for which the device was used and the person using it will be sent on the cloud. The block diagram shown below will give a brief overview of the system.

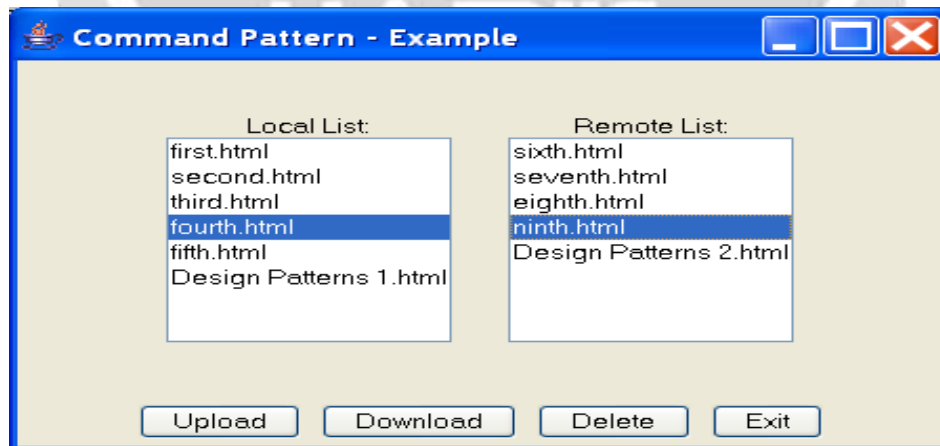


**Fig-2 Block diagram for access management**

Barcode scanner ( Pegasus PS1010 1D laser ) is used at the first level as detection module for the ID cards and give activation signal and detected information to the microcontroller(here Arduino nano) . The Wifi module (ESP8266 ) is used for the wireless communication between microcontroller and the switching device which is based on relay switch. The wifi module authenticates the user and stores the required information on the cloud or on the server. Relay is between the concerned component and the AC power supply. The selection of the device is done through GUI which is connected to the wifi module. This stores the information about the component on the server and links it to the user.

**4. SOFTWARE MODEL ANALYSIS AND FUNCTION IMPLEMENTATION**

First of all need to consider the selection of design platform designed in this paper using Eric (GNU General Public License) as the software design.



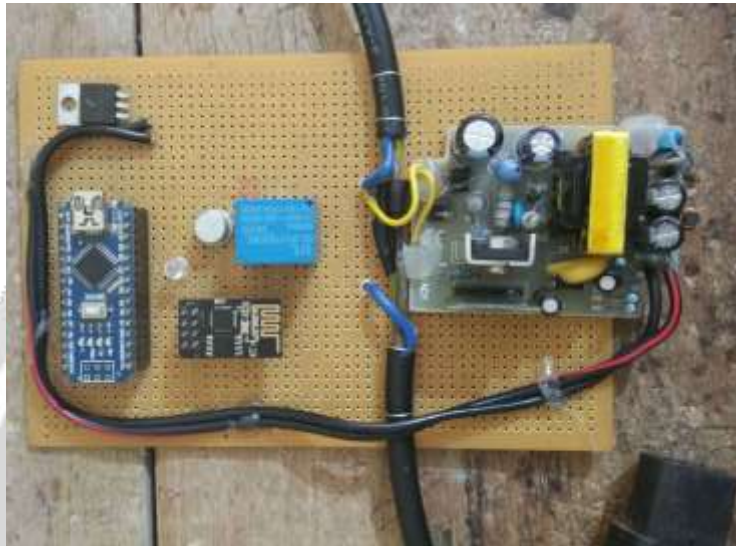
**Fig-3 An example of Graphical User Interface (GUI)**

The name of the instruments available in the laboratory will be available on an electronic board which is basically a Graphical User Interface (GUI). A user can communicate with computer application (or computer operating system), which in turn controls the computer hardware, using graphical symbols in the GUI rather than typing the

instructions or commands. GUIs let you work with picture-like items (icons and arrows for example) to tell the computer what you want from it.

This GUI will have the complete list of the practicals, easy to read lab manual and description of the instruments used in the lab. It will be used to turn on the electronic component for the selected practical.

## 5. ACTUAL HARDWARE



**Fig-4 Hardware for controlling use of equipment**

## 6. ADVANTAGES

Storing data with the help of IoT will make a lab supervisor life easier. There will be no need of log book for student to login, an automatic access will be there. Data i.e. a persons' information can be automatically stored with the help of WiFi and GUI. Safety of lab equipment will be monitored. Person responsible for the damage will be easily traceable. It will be more efficient.

## 7. THE MAIN TECHNICAL DIFFICULTIES AND SOLUTIONS OF THE SYSTEM

The main difficulty was to realize the stable wireless connection over a long distance. To monitor data transmission is the main difficulty in the project. This problem will be reduced through WiFi network or local area network (LAN), using the TELNET protocol to send test data to a server, the server monitoring software based on the analysis of different address to upload data and document analysis, the advantage is the use of mature network, which is not restricted by distance, realize the stability of the signal data transmission.

The other difficulty is to maintain the stability of large number of instruments, their status and equipment monitoring.

System need to monitor the working condition of all the instruments for a long time and also their availability, store large amount of data, real-time multitasking and processing, will be to consider the problems in the process of software development. This solution will monitor software based on GUI development platform, which is versatile, and use the built-in database module development corresponding database software, the software adopts modular programming method, easy to maintain and upgrade.



Security and maintenance of the central computer and power back up at all time. This will be done by providing separate power for the central PC and a UPS dedicated only for it. Considering the stable operation of the system, will use a high performance server as a system of PC, all data storage and analysis, enough to cope with the stable operation of the system.

## 8. RESULT

- Effective lab management system, - using Arduino pro mini board (microcontroller board used - control of voltage, various components like ESP 8266 WiFi Module and barcode scanner.)
- ESP 8266 WiFi Module - connect and control the devices and data over the internet.
- Barcode scanner - scan the code on the unique identity card – user data will automatically be uploaded.
- Relay module - control the opening and closing of the circuit – providing accessibility to registered users.
- GUI - graphically allow the access and control the basic functions of lab.

## 9. CONCLUSION

- Effective lab management system can be made.
- Allows the user to access the lab irrespective of the existing traditional lab timings.
- Automate the lab and save time of lab attendant and teachers from continuously keeping a track of the students and instruments.
- Control the accessibility of the lab.
- Ensure protection of the lab instruments. Record the usability of the same.
- GUI - Friendly access of the lab and instruments - saves a lot of time.

## 10. REFERENCES

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