

Intelligent Laboratory Management System Based on Internet of Things: A Study

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Abstract - For the purpose of replacing error-prone laboratory management system with optimized laboratory management, a set of intelligent laboratory management system based on Internet of things and Machine Learning is discussed in this paper. The hardware platform of this system is STM32 microcontroller, RFID RC 522 card reader, using Android/Java language to develop raspberry 3. When the students get to the laboratory and put their student cards on, the system would read the student information in the cloud database and find the students course information, recorded in the STM32 micro-controller and display the information on the raspberry3. According to the information, the system would sign the data in the cloud database. The another important phase of our work is to assess and analyze the performance of students on such platforms using machine learning. This shall help the student to self-assess themselves. It will also aid the teacher to evaluate the progress of their students and suggest necessary measure to improve the grades as well as understanding of student in subject domain. This achieved an efficient laboratory intelligent information management system based on Internet of things and Machine learning.

Key Words: STM32 micro-controller, RFID RC 522 card reader, raspberry 3, Cloud database, Machine Learning.

I. INTRODUCTION

Now a days laboratory management is human based system. This system is vulnerable to lot of human errors and threats. Internet of Things is a platform which emphasis smarter and intelligent processing of every day devices. The communication between devices become informative. For the transformation and gradual progress of the learner, the laboratory construction, maintenance and application management put forward higher and higher requirements, which urgently need to use advanced technology to standardize and strengthen the laboratory management. Necessity of an open intelligent laboratory management software in organizations is increased significantly in order to cope these requirements. To this end, we are designing and developing an intelligent laboratory management system based on the Internet of Things and Machine Learning technology. The system will be designed to integrate the computer technology, database technology and Internet technology including RFID technology and sensing technology, Machine Learning making laboratory management more standardized, efficient and helping teachers to manage the laboratory easily and increase

student performance. With the rapid development of the Internet technology in recent decades, all walks of life have been inseparable from the application of the Internet. The Internet helps people improve the quality of life and work efficiency. Internet of Things has a lot to improve the work life and quality of living of people. Our everyday system has become more reliable on IoT. Thus, study on development of IoT application, web and mobile has increased. Th system purposed will effectively reduce load of educator by managing the attendance and performance analysis. The attendance of the student will be marked by using cloud database technology, RFID and sensing technology. The scanner will be mounted on the entrance of laboratory. A scanner will be needed which will scan the IDs of students. The ID card of the student will be scanned using the RFID scanner. Depending upon the current system time the course of student will be displayed. The students will be able to see their upcoming work and pending work related to labs. Cloud storage will be needed to store the information of students so that it can be retrieved whenever needed. Predicting the academic performance of student has always been a keen area of interest of many researches. Predicting the performance by establishing a relation between the academic potential and factors affecting it. This study will enhance our teaching methodologies, making it more effective for learner. The overall drop-out rate can be reduced for young learners. By conducting regular online test on the system and then analysing the result of learner can acknowledge the educator to take necessary measure to improve the grades of learner as well as knowledge about domain. Machine learning algorithms such as XGBoost and Random Forest.

II. PROPOSED ARCHITECTURE

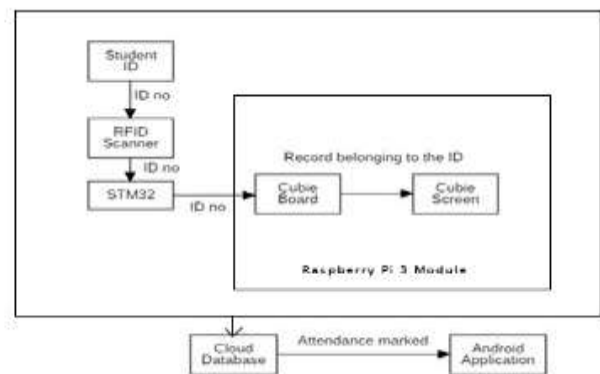


Fig. 1. System Architecture.

The figure above shows the proposed IoT based laboratory management system. The attendance system can be divided into three parts: STM32 Microcontroller, Raspberry Pi 3 with display module and the cloud database. STM32 is responsible for the storage and the transmission of most of the data which it generates whenever an ID card is scanned. Raspberry Pi 3 is mainly responsible for displaying information of the student on board. The cloud database is responsible for storing of large amounts of data uploaded which is mainly signing the attendance of the students and retrieving the course information.

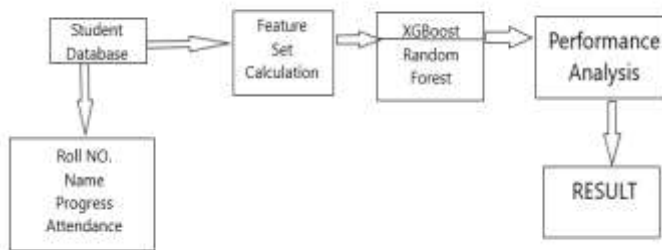


Fig. 2. Performance Prediction

Our aim was to predict the academic performance of students and analyze the impact factor of various attributes that influence this academic performance. This helps the educator to analyze the progress of student and suggest the necessary measure to improve and evolve the learner to new heights. The student database consists of academic information such as Roll Number, Name, Academic Progress and Attendance.

Database consist of following attribute which are taken consider consideration in analysis phase

Dataset	Attribute	Description
Student	StudID	Unique ID for Student
	Name	Name of Student
	Progress	Academic Progress of Individual
	Attendance	Attendance
Progress	Assignment	Assignment assigned to Student
	Due Date	Due Date for Assignment
	Academic Test	Test on Designated Topic
	Marks Scored	Marks obtained in Test

Table -1: Table of Student Database

A. SUPERVISED LEARNING

In this system, we are implementing supervised machine learning algorithms. Supervised learning is where you have input variables (x) and an output variable (Y) and you use an

algorithm to learn the mapping function from the input to the output.

$$Y=f(x)$$

The main goal is to have a mapping function so well that when you have new input x it can predict appropriate output Y. It is called supervised learning because the process of an algorithm learning from the training dataset can be thought of as a teacher supervising the learning process. We know the correct answers, the algorithm iteratively makes predictions on the training data and is corrected by the teacher. Learning stops when the algorithm achieves an acceptable level of performance.

XGBoost Algorithm: XGBoost is a classification technique, based on the original framework called Extreme Gradient Boosting. XGBoost can be used for tree ensemble learning or linear gradient learning and be used to perform various objective functions such as binary classification, regression, and multi-class classification. The algorithm was developed to efficiently reduce computing time and allocate an optimal usage of memory resources. Important features of implementation include handling of missing value.



Fig. 3. XGBoost [9]

III. RELATED WORK

A. Medha Sagar, Arushi Gupta, Rishabh Kaushal: Performance Prediction and Behavioral Analysis of Student Programming Ability

Performance prediction of students is done by creating a machine learning model based on the hackerearth datasets.

B. Yichen Ma, Fuyao Wang, Zhuo Zheng Wang: Intelligent Laboratory Management System Based on Internet of Things, the 12th International Conference for Internet Technology and Secured Transactions (ICITST-2017)

An intelligent system based on IoT is developed to manage the laboratories. For implementation different hardware devices like STM32 Microcontroller, RC522CardReaderandRaspberrypi are used.

C. Nareshkumar R.M., Apoorva Kamat, Dnyaneshvari Shinde: Smart Door Security Control System Using Raspberry Pi, International Journal of Innovations Advancement in Computer Science Volume 6, 11 November 2017.

Develop Door Automation application using Rasp- berry Pi and GSM. Raspberry Pi operates and controls motion detector and cameras for remote sensing, surveillance capture the image of the intruder and sends it to the mobile phone of the owner and finally alerts the user about the intruder.

D. Shivayogi Hiremath, Geng Yang, Kunal Mankodiya: Wearable Internet of Things: Concept, Architectural Components and Promises for Person-Centered Healthcare, International Conference on Wireless Mobile Communication and Healthcare.

A concept of WIoT that identifies its architectural components including wearable sensors, internet connected gateways and cloud and big data support to monitor human health and behaviors unobtrusively is presented.

IV. CONCLUSION

The system is based on the principle of Internet of Things and Machine Learning. The use of STM32 microcontroller, RFID-RC522 card reader, raspberrypi 3 is to achieve efficiency in attendance management of the laboratory. Machine learning algorithms are used for performance prediction of an individual which results in improving teaching methodologies. It also largely benefits in improving student grades by suggesting measure and terminology. In the future development, the system could be developed with more features, such as student course information analysis, intelligent switch computer and other functions. The overall practicality, reliability of this system will be great and it also has a great development prospect. Smart sign-in system will become the new style of teaching in the future.

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