

Development of Mobile Inventory App for Science Lab of High School

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Abstract

In homes, universities, and school labs, chemical compounds are used often. Numerous combinations can expose human beings to risk their fitness and protection. Skin contact, inhalation, or oral ingestion can all cause exposure. The control of dangerous chemical compounds, such as purchase, usage and disposal, must be accomplished through a department's laboratory inventory program. Safe chemical handling, storage, transportation, and disposal are components of an efficient chemical management program. This research aims to create lab inventory, a mobile android app for handling the high school's inventory system. This app can save inventory information, maintain inventory levels, replace inventory relying on income information, and offer income and inventory reviews on a day-by-day basis. The research adheres to mixed research methods that were used for this paper to gather qualitative and quantitative data from the topic. Participants' data revealed that laboratory chemicals could be extremely dangerous if not properly handled and maintained. This research developed a mobile inventory application that is specifically designed for high school science labs, offering inventories and science labs a safe, secure and efficient way of tracking and managing inventory. The development of this application helps to eliminate paper-based systems and reduces manual processes enabling a streamlined workflow.

Keywords: *Inventory management system, mobile application, science lab.*

1 Introduction

Chemicals are extensively utilized; they may be observed everywhere, including in homes, businesses, and educational institutions. Numerous chemical substances are exposed with the aid of human beings, posing risks to their physical and mental fitness. The majority of laboratories within the natural sciences regularly use chemical substances of diverse kinds and hazard levels. Similarly, chemicals are used extensively and frequently within the science classes for experiments and laboratory lessons. These materials may be solid, liquid, or gaseous and are inorganic and organic. These materials can be toxic to people, corrosive, explosive, quick oxidizing, flammable, polluting, irritating, radioactive, or each. Accidents with laboratory chemical substances are pretty likely to arise. At the same time, inexperienced people and college students study without being knowledgeable of the hazards and risks involved with most of the chemical substances within the lab.[1] The chemicals used in a professional chemistry lab and those used in a high school chemistry lab are incredibly similar. The persons employing the substances, the processes, the rate of usage, and the environment are the main factors at play. Proper protocols, safety measures, and disposal are crucial for chemical research. As a result, there may be a willingness for an effective usage of chemical substances in several establishments and organizations, including schools. Chemical management is tremendous as it lets companies achieve regulatory compliances, enhance worker protection and fitness, and decrease terrible environmental consequences.[2] Science labs in many high schools around the nation utilize and store dangerous substances that might threaten teachers and students. Many of these items have been sitting unused and uncoiling in drawers and shelves for years. As a result, chemicals are supplied to newly hired instructors in their original bottles or containers with labels that have faded or been removed. Some containers experience corrosion and leaking due to poor storage practices and the passage of time. Some containers have been tampered with. Around the margins of some of them, crystals are growing. These problems with chemical management are made worse by the corroded metal clips or dried-out plastic clips of chemical shelves. This paper offers management recommendations for efficiently storing chemicals in scientific labs. Science labs must keep track of all the tools and substances. Record-keeping should be methodical to increase productivity and maintain track of laboratory supplies and chemicals. Experimental activities, teaching, and research become effective with structured laboratory administration [3]. In the similar way, the author, after working in one of the high schools, observed the manual management of chemicals within labs. In this thesis the author intends to create an android mobile application which helps to organize and keep the track of high school lab inventory. Further investigation of the literature entered this thesis revealed that there is currently no suitable mobile application in the market to solve such problems in the science lab. As a result, it was determined that the



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need for such an application is tremendous and has the potential to revolutionize the traditional inventory systems used in science labs of high schools.

2 Related Work

According to Foster [4], the management of hazardous chemicals from the moment they are purchased through their proper disposal as chemical waste is an essential component of a department's laboratory safety program. An effective chemical management program comprises safe chemical handling, storing, and transporting, as well as proper chemical waste disposal. In the laboratories of schools and other institutions a chemical inventory is an important part of chemical management. It's vital to keep track of the quantity of potentially dangerous compounds in the lab on a frequent basis. It should be done once a year at the very least, or whenever the Chemical Hygiene Officer demands it. A complete inventory can help you get rid of chemicals that are no longer needed or used, as well as make the most of your lab's storage space. According to Hashim & Arafin [5], several forms must be filled throughout the inventory step. Many improvements have been made to the organizing and upkeep of chemical inventory products. The authors' goal was to create a system for tracking lab inventory at the Faculty of Electronics and Computer Engineering. The system was created to maintain and update data. It also includes a report that describes the present performance of each piece of laboratory equipment and component. Similarly, this approach was created using forms that technicians and laborers had previously used. It also kept a database collecting all information related to land application procedures. The RAD technique was used to create their project; it was created due to an examination of the Laboratory Inventory System. The data show that the primary goal of building working software fulfills all criteria that were met.

3 Methods

The research was conducted using a mixed research methodology approach. This methodology efficiently gathers both qualitative and quantitative data from the participants. In this context, the data collected from the participant was based on the management process of laboratory chemicals at Paragon International School. The data collection method that was utilized is a survey. Questionnaires were the data collection tool that will be utilized. The sample size of the proposed study was 30 participants. These participants represent the population (science department or people involved in the process) in high school. The participants were grouped into different categories: lab assistants, science teachers, administrators, and heads of departments. The data was collected into stages: before deployment of the app and after implementation; this is to facilitate data collection regarding problems experienced by the participants while managing chemicals and efficiency of the developed system, respectively.

4 Findings

4.1 Results from Data Collections

The data collected from the participants indicated that chemicals used in high school lacked a systematic way of management, moreover there was evidence they needed a decent way of ensuring that they controlled the management of chemicals in a way that the lab technician or science teacher can easily locate the chemicals. Additionally, when chemicals are used by many users/teachers or lab technicians, it becomes difficult to know if there is sufficient stock and who handled which chemicals. They needed a notification system which could alert them when the stock is short or about to expire.

How do you know how much of the certain chemical is left in the inventory

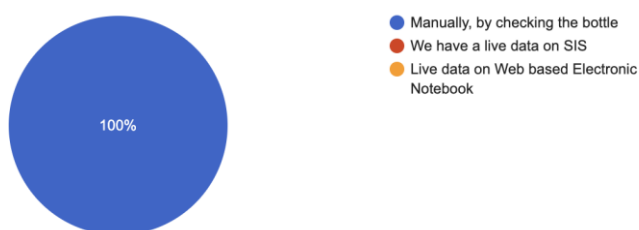


Figure 4.1 sample from data collected by google forms from participants

Does your institution have a method of notifying if the chemicals are about to run out

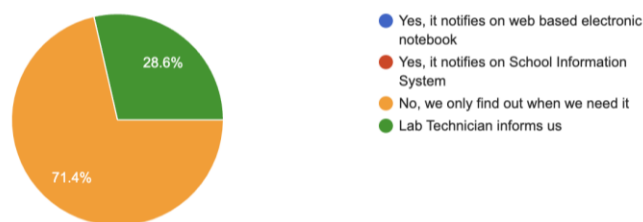


Figure 4.2 sample from data collected by google forms from participants

The data collected from the participants resulted in the identification of chemical management problems that required immediate intervention using the software. This thesis hence facilitates an application that can help science teachers and lab technicians within a school to manage stock, easily locate where the chemicals are stored, identify expired chemicals, and know who was the last person to use a specific chemical. Based on the identified problems, the following designs were implemented:

Which features you would like to see on the lab inventory mobile app? (tick features you would like to see)

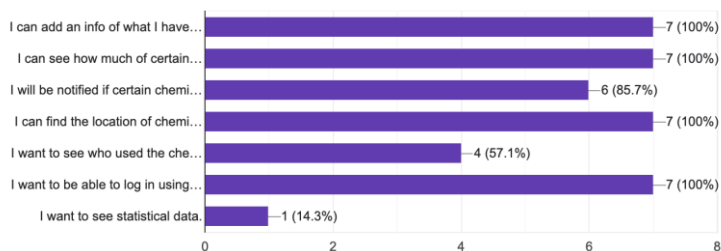


Figure 4.3 Data Collected from participants suggesting what features they would like to see.

What other features do you like to see on a lab inventory mobile app

Receiving messages about run out.

Gallery photos

There can be "add experiment and reired materials" feature for examinations or taught curriculum. It can be stored for future use and it will be easier to see remained amount of specific elements and materials needed for the stored experiment/s.

May be classification by subjects (phy/bio/chem)

- 1.Description of chemicals with symbols of poisonous, hazardous, flammable etc
- 2.Expiration dates
- 3.Storage conditions required

1) The expiry dates of chemicals which are about to pass. 2) The search tab, where I can easily find all possible ions.(I.e. if I type in the word bromide, all possible bromide compounds would be listed)

Gallery

Figure 4.4 Data Collected from participants suggesting what features they would like to see.

4.2 Design Based on the Problems Identified

The data collected from the participants resulted in the identification of chemical management problems that required immediate intervention using the software. This project hence facilitates an application that can help science teachers and lab technicians within a school to manage stock, easily locate where the chemicals are stored, identify expired chemicals, and know who was the last person to use a specific chemical. Based on the identified problems, the following designs were implemented:

i Controlled Access to the system

The below Registration, Login, and Change Password screenshot illustrate that the system developed is password controlled, and no authorized personnel can access it. This is important in promoting accountability within the science department.

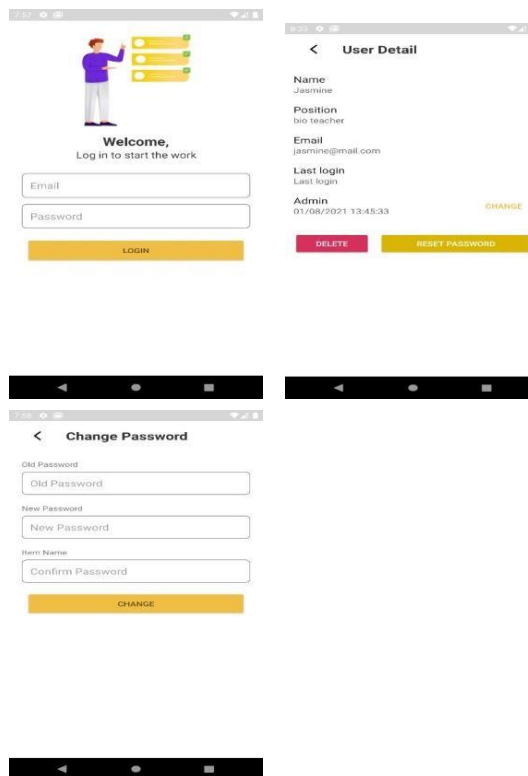


Figure 2, 3, and 4: Registration, Login, and Change Password, respectively.

ii Manage User

Not everyone is allowed to login into the system; therefore, the system allows user management. The supreme user (admin) can view the number of users registered to the system. The system allows the change of user roles, for instance, from Admin to Teacher and vice versa.

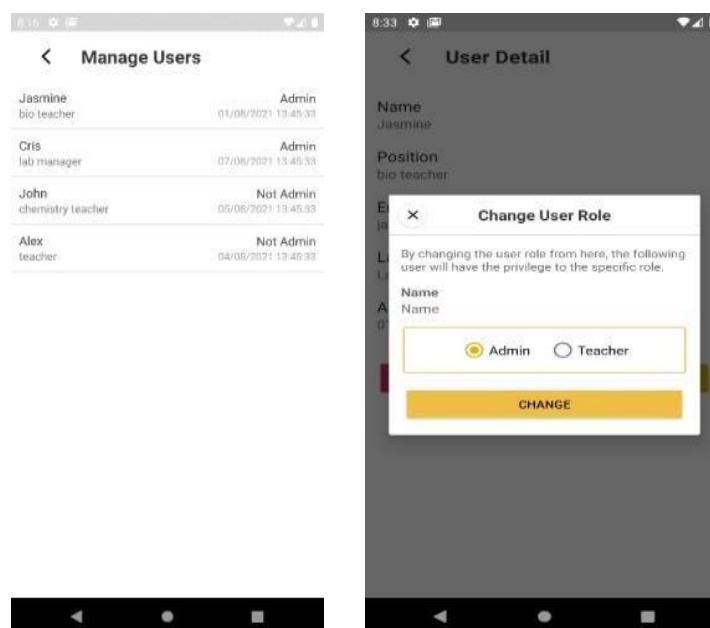


Figure 5 and 6: Manage User and Change User Role Pages, respectively.

iii Stock Management

Under Stock management, the authorized system users can add a new item that indicates what it is used for, and the system will display the added items according to the location of storage, stock number, usage, and name. Therefore, it becomes easier for the user to manage a specific chemical. The locations, quantity, and usage are added to the item page.

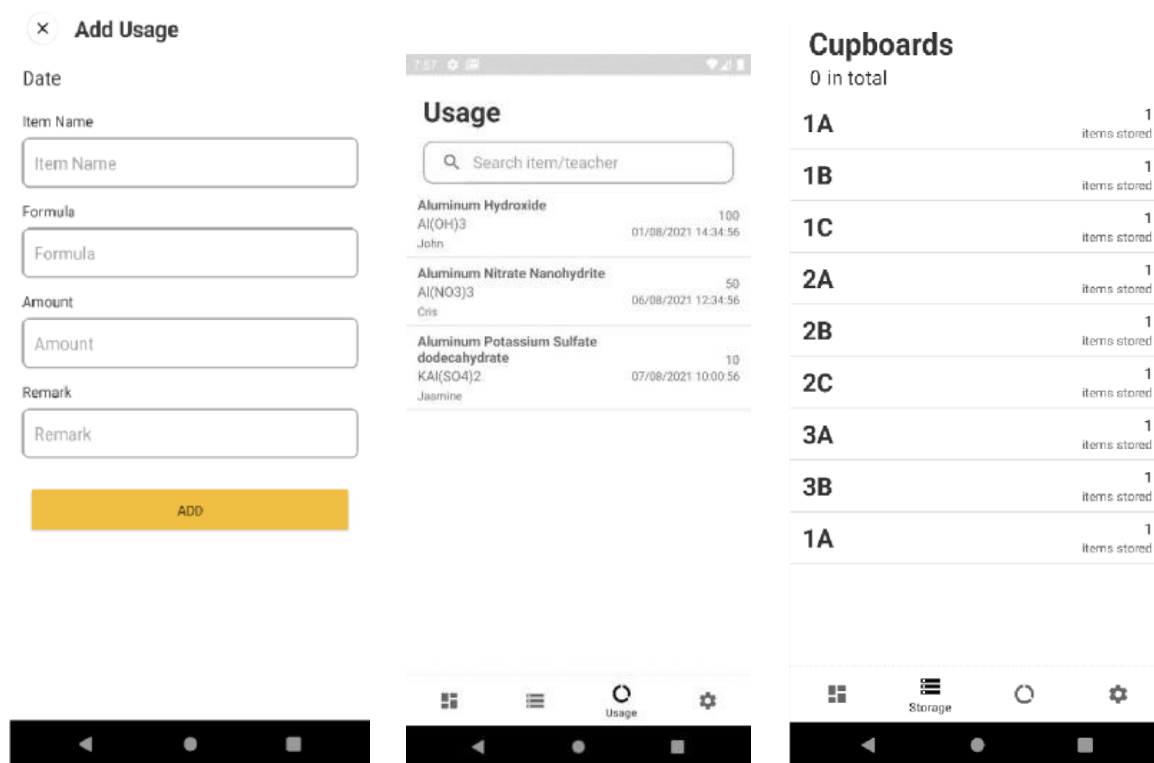


Figure 7, 8, 9, and 10: Add Item, Add Usage, Usage, and Cupboards Pages, respectively.

iv Notification and Settings

All the system's notifications are controlled at the notification tab located in settings. The notification may be as a result of the system upgrade, stock depletion, expiry dates for the chemicals, among others. The setting tab holds the system settings features such as password modification, to buy list, notification, managing users, and logout.

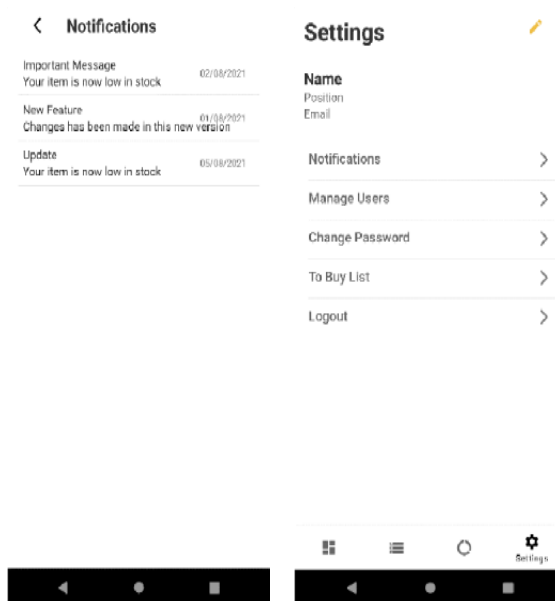


Figure 11 and 12: Notification and setting Pages, respectively.

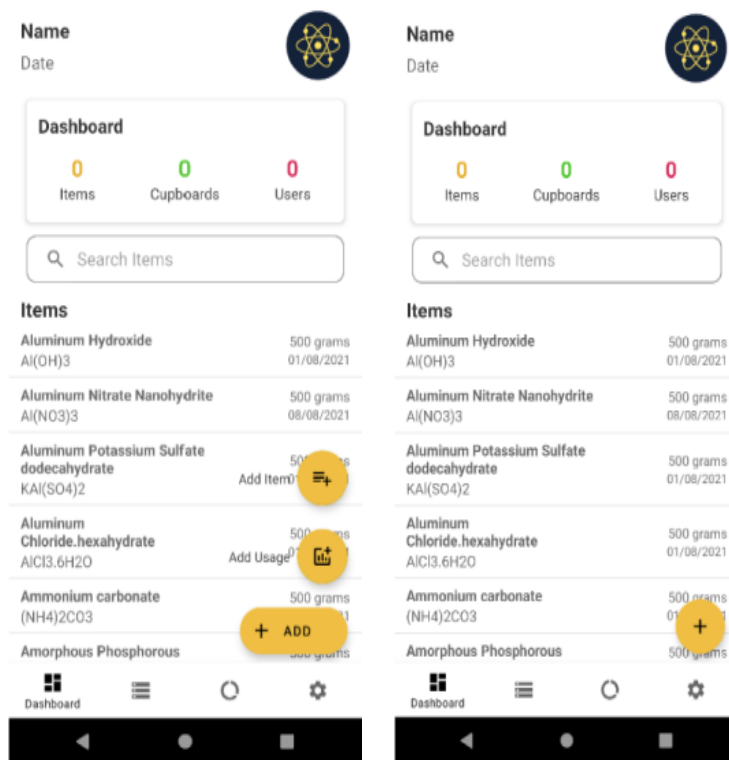


Figure 13 and 14: Dashboard Page

v Dashboard

The system has a dashboard page that appears after the user is logged in to the system. The dashboard has a search bar that allows the user to search a chemical with efficiency. There are other features such as adding an item on the same page; this makes it easier for the users to navigate through the system.

4.3 User Feedback

After the project's development, the testing of the system was done by the science teachers. Based on the problems identified, the teachers evaluated the mobile application in accordance with the ISO9126 standards, which is an international standard for evaluating software quality. In the list of observed quality standards, the following was included: functionality, reliability, usability, time efficiency and portability. A survey on google forms was designed on earlier mentioned standards. The survey was based on a 5-score scale, with 5 being Excellent, 4-Very Good, 3-Good, 2-Fair, 1-Poor. The table 6.1 shows the summary of the survey.

Standard	User Rating
Functionality	4.3
Reliability	4.5
Usability	4.7
Time Efficiency	4.7
Portability	4.6

4.4 Implementation

Lab management Application is currently being used by science teachers of the institution and proven to be efficient, reliable, and easy to navigate. The management issues, stock problems, confusion, and misplacement of chemicals were reduced. However, their findings indicated that the teachers need training since the system comes along with technical changes, and some of the science teachers may have little computer literacy.

5 Limitations

The development of the mobile inventory app for the high school's science lab has had a considerable effect in many areas. The lab application was designed to improve our lab facility by providing easy access to lab inventory information, allowing us to better track and manage our resources. It is currently being used by science teachers of the institution and proven to be efficient, reliable, and easy to navigate. The management issues, stock problems, confusion, and misplacement and expiring issues of chemicals were reduced. Now science teachers are also able to access the list of chemicals they have any time and from anywhere, they are no longer spending time sorting through cluttered shelves to find items. Teachers reported an increased ability to plan and execute their science lessons and felt relieved at the elimination of many of the time-consuming tasks away from actual teaching, moreover students were able to engage more with the coursework due to improved efficiency, and their understanding of the content increased due to a perceived increased convenience of the materials available. The lab technicians now have more time to focus on other tasks due to the inventory app, leading to an overall increase in efficiency. Additionally, the app has curtailed problems associated with chemical expiration and budget waste. Essential chemicals are automatically tracked, and the lab is notified when chemicals are running low, enabling lab technicians to purchase new supplies in a time efficient manner. This, in turn, saves the school significant amounts of money due to the avoidance of expired chemicals and excess waste. The faculty also have the relief of a burden being lifted from them as they had to carry papers, do manual updates on a paper, and the on the google sheet material. Science classes have vastly improved in terms of effectiveness. However, their findings indicated that the teachers need training since the system comes along with technical changes, and some of the science teachers may have little computer literacy. This issue is possible to overcome in a short period of time with proper training of the app. Overall, the development of the mobile inventory app for the high school's science lab has proven to be a worthwhile endeavor. The increased efficiency and convenience has created a beneficial environment for all involved, from lab technicians to administrators, and especially for the teachers who can better engage with the work due to the overall improvement in organization and convenience.

6 Conclusion

This research is based on the problems caused by the inadequate management of lab chemicals and seeks to develop a better, more practical solution. Those in charge of laboratory substances have faced great difficulty due to out-of-date chemicals or low stocks which have resulted in the cancellation of lab demos or practical sessions, proving to be a challenge in teaching. Additionally, manually managing them has been both laborious and time-consuming. Furthermore, the untracked expiration of items frequently leads to a waste of financial funds. The thesis attempted to address these issues by introducing a chemical management solution that would handle stock, location, users, expiry, and accountability. In conclusion the development of the mobile inventory app for high school has provided a valuable solution to the management of laboratory chemicals. The app is a practical approach that can be applied to various laboratories with great success. The app is user friendly and can be used without much training. This research study has highlighted the importance of proper inventory management, to save cost and resources. It also provided an organized system to track the materials and decrease errors. In the long run, this organizational approach will pay off in terms of cost saving and improved laboratory experience. The development of mobile inventory application promises to be an innovative, efficient and sustainable approach in managing laboratory inventory.

7 Publisher's Note

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How to Cite

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