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An internet of things-based medication validity monitoring system

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ABSTRACT

Medicine is critical to our everyday lives and to the well-being of individuals of all ages and backgrounds. With the beginning of the Corona pandemic and a rise in Corona virus infection cases, the use of medications to prevent and recover from infection has increased, as well as to treat illness consequences, has grown. The effectiveness of medicines is greatly influenced by the expiration date. In this paper, a system for pharmacy or medical store's information storage system was developed and enhanced by automatically monitoring the validity of medications on a periodic basis and sending expiry reports to medicine authorities through e-mail to warn them that a medicine is approaching expiration. The system was also enhanced with internet of thing (IoT) for fast and secure delivery of the medicine validity report.

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1. INTRODUCTION

In response to the growth in work-related stress and the loss of personal time, there has been an increase in the dependency on medicines and other drugs in recent years. Medications and medicine are the most essential sources of assistance when a patient's life is in urgent danger [1]. The progress of medicine has made it feasible for people of all ages and backgrounds to live their daily lives and maintain their health. The efficacy of medicines is impacted by the date on which they were manufactured. The great majority of people require medical treatment at some point in their lives. The effectiveness of therapeutic treatments is dependent on the validity of the medications used. As a result, the efficacy of these medications must be monitored on a frequent basis. For this paper, we developed a software system that allows pharmacists to track the validity of drugs that are kept on hand at their establishments [2], [3]. Developing software to track the expiration dates of prescription drugs at a pharmacy is the focus of this article. To ensure effective operation, the system must be compatible with a wide range of computer PC devices that are commonly found in pharmacy environments. When a medication's expiration date has passed, the system notifies the pharmacy manager by sending an alert to his or her phone. When it comes to sending out warnings about expired drugs, a notification system and email are also employed. The proposed system's objectives are as follows: create a database for each medicine in the pharmacy that contains the necessary information (name, quantity, expiration date, price, and so on); Provide a database for each medicine in the pharmacy that contains the necessary information (name, quantity, expiration date, price, and so on); Ensure that each drug

in the pharmacy has a database that has all of the necessary information (such as the name of the medicine, the amount, the expiration date, and the price); Set up an expiry alert so that you can know which items are going to expire through the system and take action before they do (before one week before the expiration date), by avoiding the need to search for drugs, you may save time and effort. It entails sending out e-mail notifications when drug expiration dates are approaching. As a result of the rapid development and implementation of smart and internet of things (IoT)-based technologies, the door has been opened to a plethora of new possibilities in technological advancements for a number of different aspects of human existence, such as health, education, and transportation, among other things. According to recent reports, the world is on its way to seeing a massive rush toward current technology, which would fundamentally change the way people live their lives by linking all of the gadgets that we may possibly utilize to one massive global network known as the internet [4], [5].

The internet of things technology is used to develop a medication validity monitoring system, which is described in this study. According to the journal aging in America, Vinjumur *et al*. [6] demonstrated in 2010 how a web-based caregiver module streamlines and simplifies the process of monitoring medicine consumption for health-related concerns in older individuals who live alone, and this was published in the journal aging. We also offer an approach that is both energy-efficient and effective, based on a network of sensor devices that, when necessary, perform in-network data fusion [6]. For many decades, it has been difficult to monitor and track genuine drugs in the hospital setting. In order to make it more convenient, Alam *et* al. [7] and colleagues devised a way in 2021 that made it practicable. In the absence of a solid trust system in place, it is easy for syndicates to simply produce counterfeit medicines. As a result of the shift in emphasis away from life-saving therapy and toward non-life-saving treatment, substandard medicine has risen to the level of an emergency situation. Because counterfeit medication is extremely hazardous and has the potential to cause significant injury, it should be avoided at all costs. Our plan includes a drug monitoring system based on block chain technology, which would help in the identification of bogus pharmaceuticals and other substances. A system that we have created can detect inferior drugs from the producer all the way through to the patient is now available. Consumers may also check for defective or outdated medications using quick response (QR) codes on their cellphones, thanks to the capacity to scan them. This has the potential to increase the system's transparency and dependability by enhancing its dependability, which is beneficial for all stakeholders. It is intended to make use of block chain technology in several aspects of the study, including guaranteeing high-quality medicine manufacture while simultaneously maintaining transaction security and data privacy [7]. In the remaining section of this article, you will find the following organization: Sectioon 2 related work, section 3 the proposed system, and section 4 the system's results. Section 5 the conclusion and recommendations for future work are presented.

2. RELATED WORK

According to Alshamrani [8] an investigation of the most important health internet of things (H-IoT) applications made possible by smart city infrastructure is presented in this article, with a particular emphasis on health information exchange. An evaluation of appropriate technologies and systems for RHM services is also given, as is the identification of the most important monitoring applications based on a wide number of models outfitted with a variety of complementing IoT-based sensors. The study also adds to scientific knowledge by highlighting the main limitations of the issue and suggesting potential future directions for this research area. According to Paganelli *et al*. [9], this research proposes a concept architecture based on the internet of things for remote health monitoring of COVID-19 patients in hospitals and at home. We included a permission control module into our architecture to ensure data security and transparency. Additionally, the paper explores how to integrate a flexible and adaptive scoring system onto wearable devices in order to increase the usefulness and flexibility of early warning systems (EWS) experts. The authors Kashani *et al*. [10] with the use of 146 papers published between 2015 and 2020, this study seeks to discover, evaluate, and categorize current research in healthcare IoT systems. A complete taxonomy of the internet of things is presented on this page, with articles grouped into five categories: sensors; resources; communication; applications and security.

In addition, the article examines the benefits and drawbacks of the methods that were selected, as well as how they compare in terms of assessment procedures, tools, and measurements. In the future of the tactile Internet, social networks, big data analytics, software defined networking/network functions virtualization (SDN/NFV), internet of nano things, and block chain, to mention a few areas, interoperability and scalability will be major issues [10]-[14]. According to Alamri [11] this study offers a semantic middleware that makes use of ontology to facilitate the semantic integration and functional collaboration between the Internet of Things healthcare information systems and electronic health record systems (EHR systems) [15]-[18]. According to Zainol *et al*. [12] this research proposes a novel method for monitoring and controlling users' vital health information while simultaneously transmitting it to their physicians [19]-[22]. The idea makes use

of radio-frequency identification (RFID) and internet of things technology in order to maintain track of the drugs and medicines available in the store [1]. With the help of this system, the pharmacy or hospital will have access to information on the medicines and pharmaceuticals that are available, their quality, their location, and their safety [23]-[27].

3. RESULTS AND DISCUSSION

This section describes the concept and implementation approach of the proposed system, as well as an example of how it accomplishes its objectives by using a computer system to check the authenticity of pharmaceutical desktop application interfaces to achieve its aims. This is an illustration of how the system is supposed to work, as seen in Figure 1. The proposed system model is currently in the process of being developed. Using graphical control, a splash screen, which is a window that displays an image, the business logo, and the current version of the application in use, is shown in Figure 2.

When a splash screen is shown, it may take up the whole of the screen's available real estate. When you initially start an operating system or a program, the splash screens that emerge are great instances of this. When a piece of software is meant to be used in full-screen mode, it is common for it to take up the whole of the screen. A "username" and a matching "password" are often used as the user credentials, and the credentials themselves are referred to as "login," "sign-in," or "sign-in credentials," depending on the situation (or "logon," "sign-in, or "on"). Additional to this, the system includes a medication section that contains all of the necessary information about a medication, such as the medication's name and price, the number of medications currently in stock, and when the medication will expire, and the application uses this information to determine how much time a medication has left on its shelf life.

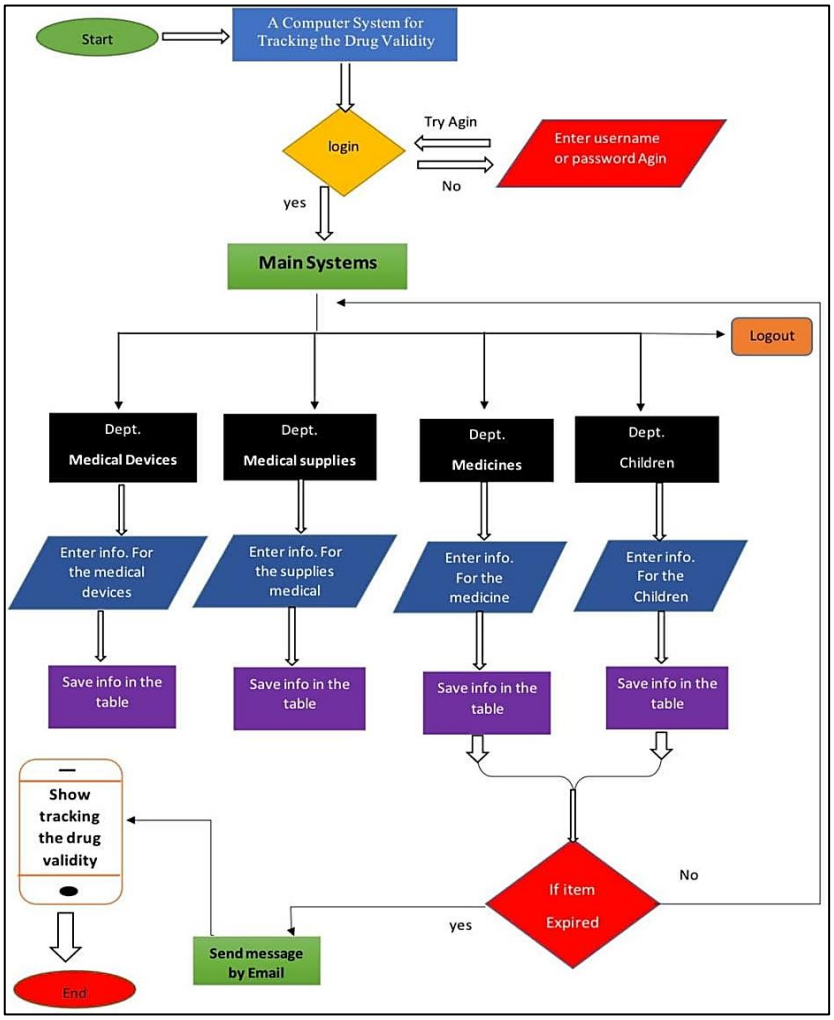

Figure 1. The general flowchart diagram of the system

Figure 2. Splash screen

An additional feature is the availability of a database that tracks all medical devices in the pharmacy or medical stock, allowing you to see what type of device is in stock, how much it costs, and the total number of gadgets available on the premises. The system provides the option to either add or remove an item from the system's database that includes related information, depending on your preferences. We utilize a binary search algorithm to quickly locate an item in a database. This method operates on the divide-and-conquer principle and is often regarded as the best searching algorithm due to its rapid search speed (provided the data is in sorted form). A binary search is sometimes referred to as a logarithmic search or a half-interval search. As show in in Figure 3.

Figure 3. Database of medicines asserted with searching algorithm

4. SYSTEM RESULT

The pharmacy and medical supply management system was developed based on IoT technology. When any drug or item has expired, the system sends a notification. E-mail to alert the user via phone, tablet, and computer to the owner. Figure 4 depicts the email message. Additionally, a Twilio IoT application is utilized to notify the owner by SMS when the medicines are about to expire, allowing him to check his email, as shows in Figure 5.

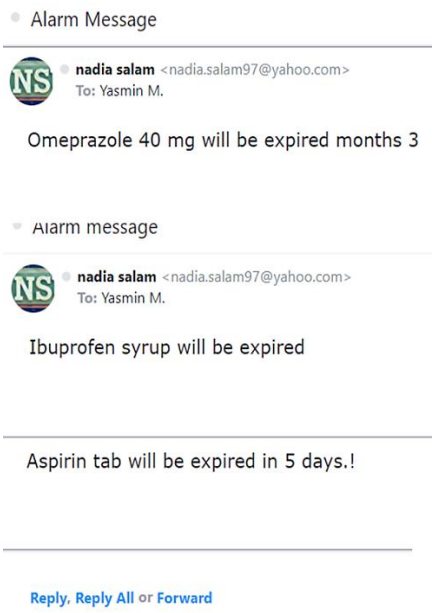

Figure 4. Email alarm message

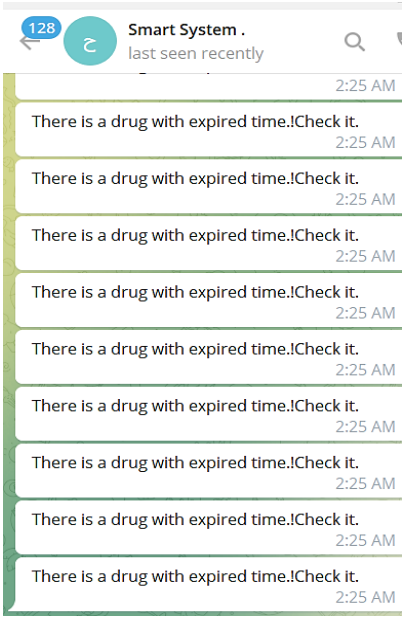

Figure 5. SMS alarm message

5. CONCLUSION AND FUTURE WORKS

It has straightforward and manageable graphical interfaces that do not need the user to have prior understanding of high-level activities in order to work properly. Checking for medicines that have expired or are soon to expire is the most crucial step of the system for the end user. It is the focus of this article to discuss alert messages in the system that are shown as part of a notification about the system's interior, and also alert messages sent via email that may be accessed from any place. Additional to this, an SMS message is delivered to the owner, notifying him or her of the medication's expiration date without the requirement for him or her to be connected to the Internet. This is due in part to the code reuse that is characteristic of object-oriented programming (OOP). It is well-built, and it can be simply and rapidly updated and extended with new features, thanks to the usage of OOP. One of the features that may be added to the system in the future is a QR code scanner, which would enable users to get information about medicines such as their price and brand name, as well as their expiry date and other data. Pharmacy humidity and temperature sensors for Arduino may be placed in order to monitor the presence of moisture and temperature in the pharmacy environment. Making certain that medicines remain effective for as long as they should and notifying relevant authorities if their shelf life has been reached or exceeded is a major responsibility.

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