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Automatic Medicine Dispenser Using QR Code

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Abstract

The "Automatic Medicine Dispenser Using QR Code" revolutionizes healthcare by minimizing queue-related inconveniences through automated medicine dispensing. It integrates software for QR-based prescription management and hardware components like Arduino Mega 2560, IR sensors, and motors for precise dispensing. Additionally, it ensures real-time doctor notifications for medicine unavailability, enabling timely alternatives and uninterrupted patient care. The study comprises two teams, each dedicated to software and hardware development. On the software front, one system manages the Medicine Vending Machine (MVM) while the other generates doctor prescribed QR codes. Hardware components include Arduino Mega 2560, motors, IR sensors, Bluetooth modules, and more, facilitating precise medicine dispensing. Beyond conventional automation, the study tackles medicine unavailability. When a prescribed medicine is unavailable, the system immediately notifies the doctor, enabling swift action to prevent treatment delays. This real-time communication allows doctors to prescribe alternative medications or issue new prescriptions, ensuring patients receive timely and uninterrupted care. Key challenges include managing a diverse range of medicines, suggesting suitable generic substitutes, maintaining an optimized inventory, and seamlessly onboarding doctors into the system. By integrating automation, real-time updates, and efficient inventory management, the study represents a transformative shift in healthcare, enhancing accessibility, accuracy, and patient-centric service while significantly improving the overall efficiency of the medical dispensing process.

Keywords: Arduino mega, IOT, vending machines, QR code, smart health technology, wireless

INTRODUCTION

Healthcare services must change in the fast-paced world of today to satisfy the increasing need for accessibility, accuracy, and efficiency. Long wait times, incorrect prescriptions, and unavailable medications are common problems in traditional pharmacy systems, which pose serious difficulties for both patients and medical professionals. To improve medication dispensing systems, creative ideas are needed considering automation and digital technology breakthroughs [1]. The "Automatic Medicine Dispenser Using QR Code" is designed to streamline the process of dispensing prescribed medications, reducing human intervention while ensuring accuracy and efficiency (Figure 1). By integrating software and hardware components, the system automates medicine retrieval through QR code authentication, minimizing errors associated with manual prescriptions. This digital approach enhances security and convenience, benefiting both patients and medical professionals. Inefficiencies in the delivery of conventional medications, such as improper stock management, medication mistakes, and patient annoyance, necessitate the use of such a system. By facilitating automatic drug retrieval and real-time prescription validation, smart dispensing equipment removes these problems and guarantees that patients get the correct medication on schedule. The system also addresses the issue of medicine

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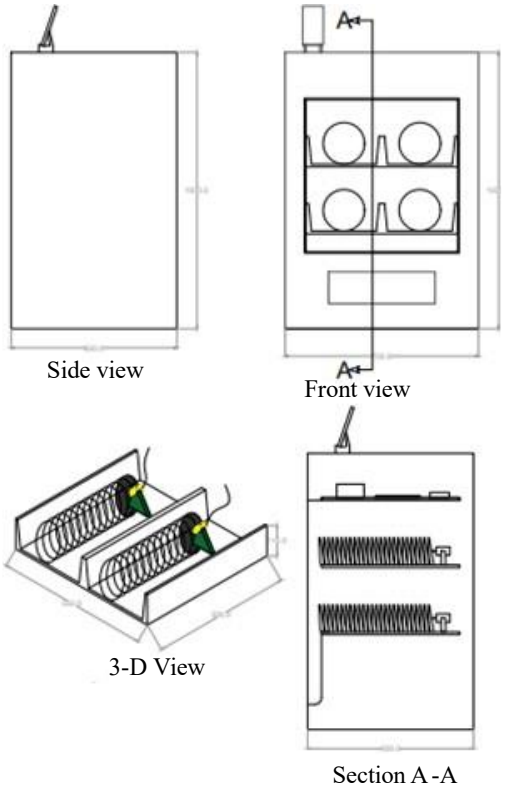

Figure 1. Layout of the proposed system.

unavailability by promptly alerting physicians when prescription medication is unavailable, enabling them to promptly recommend substitutes. The benefits of this system are vast: it enhances efficiency in healthcare facilities, reduces patient wait times, prevents prescription errors, and ensures seamless inventory management [2]. By combining automation, real-time updates, and intelligent inventory tracking, the Automatic Medicine Dispenser Using QR Code represents a transformative leap in modern healthcare, making medical services more accessible, reliable, and patient-centric. The efficacy and efficiency of pharmaceutical distribution are impacted by several issues facing the contemporary healthcare sector. Long lines, manual prescription handling, poor stock management, and human error are all part of traditional pharmacy operations, and they can cause delays in patient care. Healthcare systems must use more intelligent and effective strategies to enhance service delivery considering growing patient loads. A technical solution created to solve these issues, the "Automatic Medicine Dispenser Using QR Code" guarantees accuracy, automation, and accessibility while delivering medications.

In response to the evolving healthcare and technology landscape, our study introduces a smart vending machine utilizing QR code technology for efficient medicine dispensing. The system is powered by an Arduino Mega 2560 and integrates key components such as a DC gear motor, L298N motor driver, infrared sensor, HC-05 Bluetooth module, and a 12 V power supply to facilitate precise drug delivery [3].

The design incorporates a spring mechanism and a motor-mounted wheel to ensure accurate and reliable dispensing. Additionally, the integration of infrared sensors enhances user safety by detecting potential issues during the dispensing process. To initiate automatic medicine retrieval, users simply scan the QR code linked to their prescribed medication, streamlining the entire process. Therefore, this study details the design, implementation, and potential impact of our innovative system in improving medication management and clinical efficiency. The primary objective of this study is to eliminate long and stressful queues in hospitals and pharmacies, ultimately enhancing patient experience and healthcare accessibility. Figure 2 represents the circuit diagram of the system. However, Figures 3 and 4 describe about the software which could be further useful for the implementation of medical dispenser.

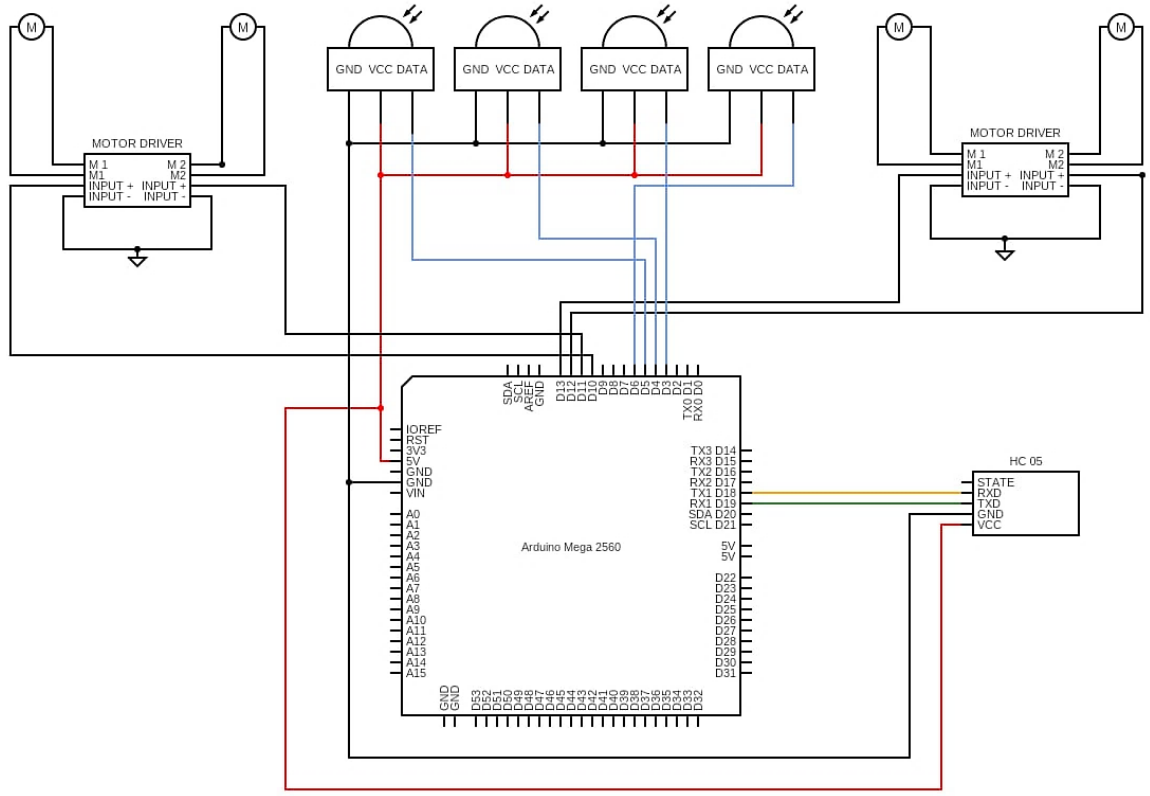

Figure 2. Circuit diagram.

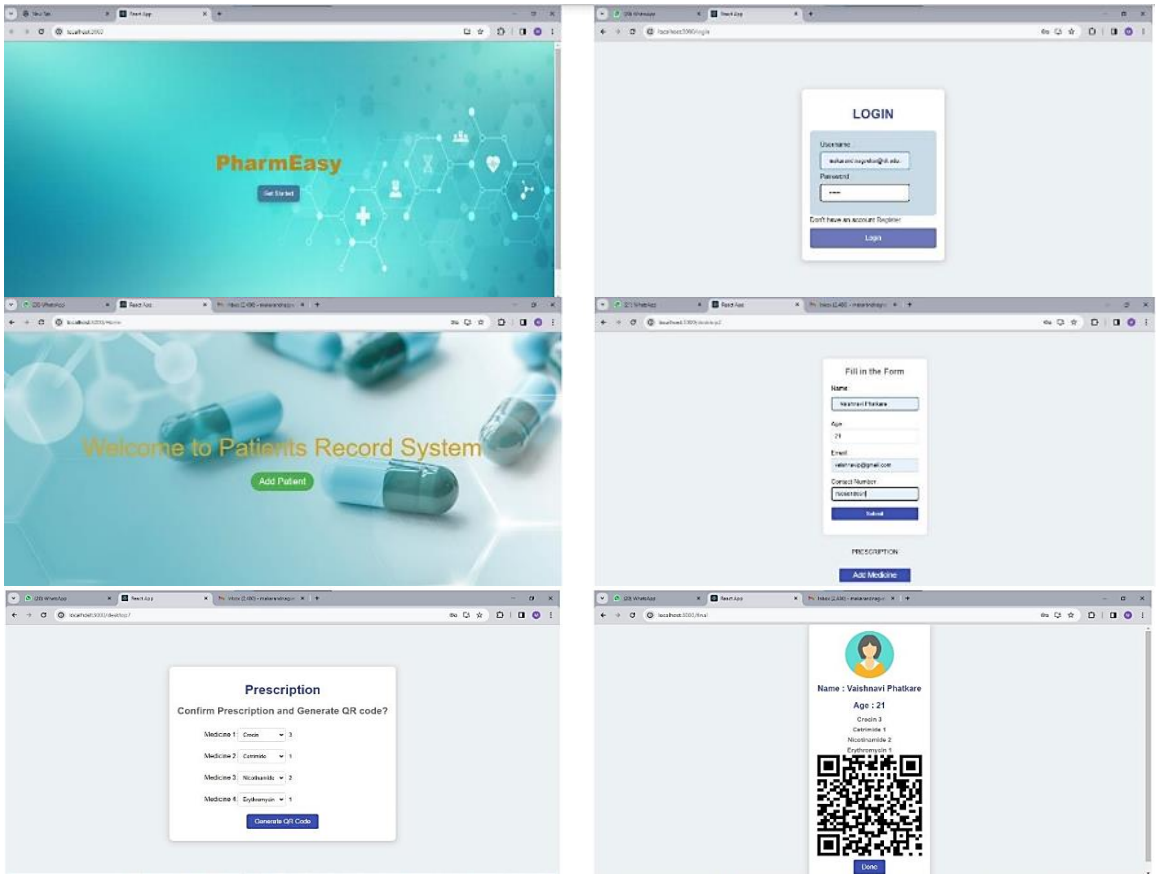

Figure 3. Software implementation.

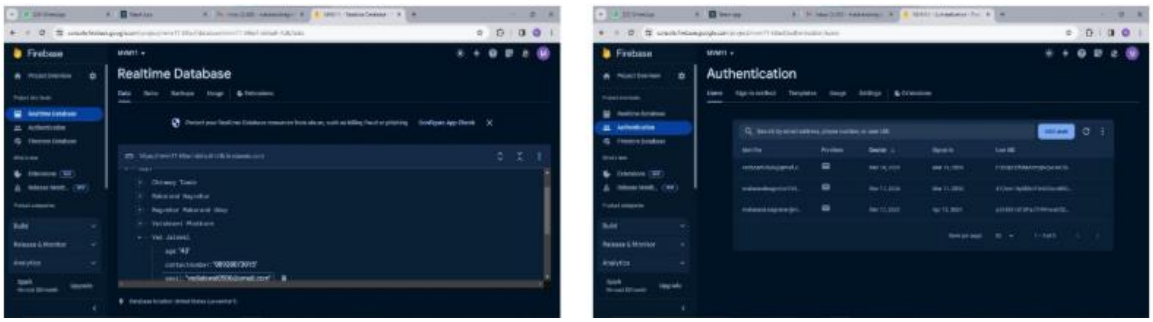

Figure 4. Real-time database.

COMPONENTS REQUIRED FOR THE IMPLEMENTATION OF AUTOMATIC MEDICINE DISPENSER

The Arduino Mega 2560 (Figure 5): A potent microcontroller board that is based on the ATmega2560, is an ideal choice for a QR code-based automatic prescription drugs dispenser. This microprocessor acts as the central processing unit, regulating several hardware elements to guarantee accuracy and successful medication distribution. To read patient prescriptions and comprehend crucial information such medicine kind, dose, and timing, one of its primary functions is to interface with a QR code scanner. After processing this information, the Arduino Mega initiates the necessary operations to deliver the prescribed medication [4].

A critical function of the Arduino Mega 2560 in this system is controlling motors, such as servo motors or stepper motors, that operate the dispensing mechanism. These motors are responsible for selecting the correct compartment and releasing the required medicine dosage. Additionally, the microcontroller works in synchronization with a Real-Time Clock (RTC) module, like the DS3231, to ensure medicines are dispensed at the prescribed time intervals. To enhance user interaction, the Arduino can be connected to an LCD or OLED display, showing essential details such as the patient's name, medication schedule, and dosage instructions. Furthermore, buzzer and LED indicators can be integrated to alert the patient when it is time to take their medicine or in case of errors, such as an incorrect selection [5].

The L298N Motor Driver (Figure 6): is a crucial component in an Automatic Medicine Dispenser Using QR Code, as it facilitates precise control of the motors responsible for dispensing medication. The L298N is a dual H-Bridge motor driver module that can control the direction and speed of DC motors and stepper motors, making it an ideal choice for managing the movement of medicine compartments or dispensing mechanisms. In the context of an automatic medicine dispenser, the L298N motor driver is used to control servo motors, DC motors, or stepper motors that operate the medicine storage system. When a QR code scanner reads the prescription data, the microcontroller (such as Arduino Mega 2560) processes the information and sends signals to the L298N module [6]. The module then regulates the voltage and current supplied to the motors, ensuring that the correct compartment is accessed, and the required dose of medication is dispensed. The bidirectional motor control feature of the L298N allows the motors to move forward and backward, enabling precise positioning of medicine trays or containers. One of the key advantages of using the L298N motor driver in this system is its ability to handle multiple motors simultaneously. Many medicine dispensers use rotating trays, conveyor belts, or robotic arms to retrieve and dispense medication, all of which require motorized movement. The L298N module provides independent control of two motors, which can be useful for dual-motor mechanisms or for controlling different sections of the dispenser. Additionally, the pulse-width modulation (PWM) capability allows for speed control, ensuring smooth and accurate dispensing of medication without sudden or jerky movements [7].

HC-05 Bluetooth Module (Figure 7): An automatic medicine dispenser that uses a QR code must have the HC-05 Bluetooth Module in order to communicate wirelessly with external devices like computers, tablets, and smartphones. This module is perfect for remote monitoring and control of the medication

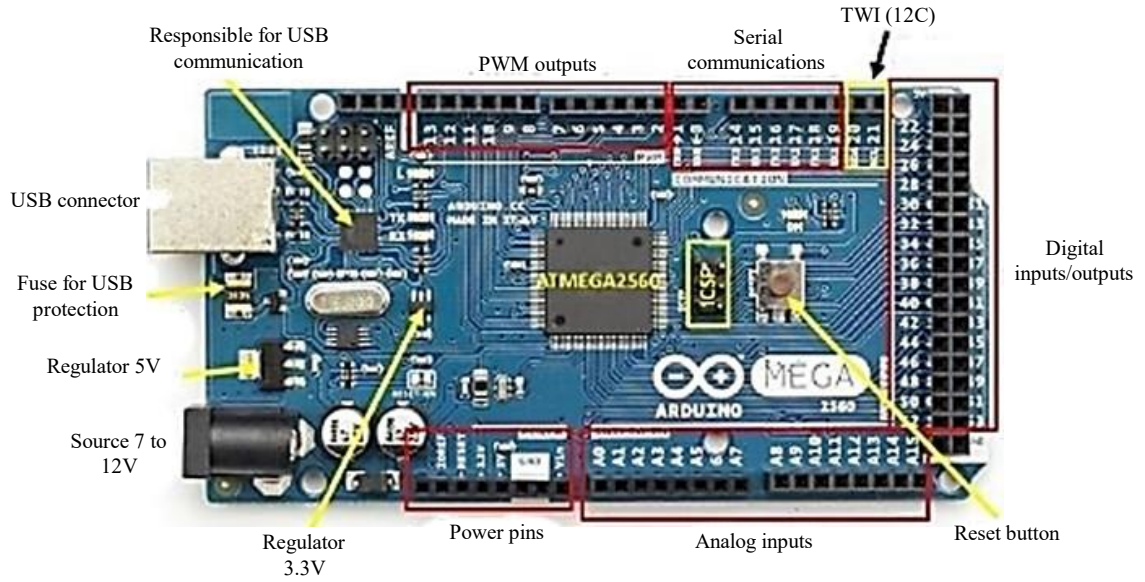

Figure 5. The Arduino Mega 2560.

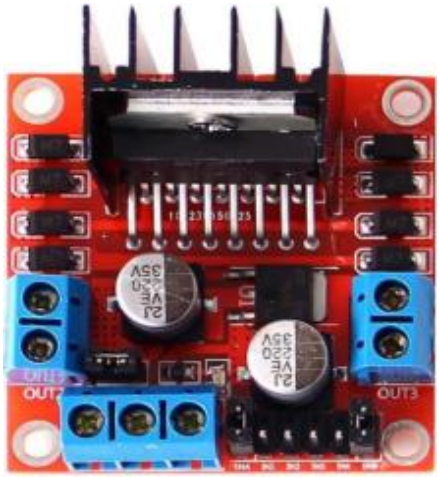

Figure 6. The L298N Motor Driver [8].

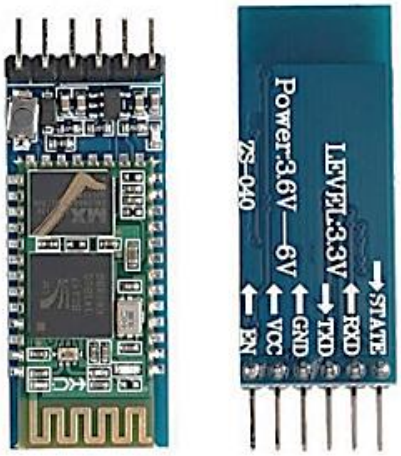

Figure 7. HC-05 Bluetooth Module.

delivery system since it uses Bluetooth 2.0 technology, which enables smooth data transfer over short distances. In the context of an automatic medicine dispenser, the HC-05 module can be used to establish a Bluetooth connection between the dispenser and a mobile application or computer system [8]. When a QR code scanner reads the prescription data, the information can be transmitted wirelessly to a caregiver's or patient's smartphone. This allows users to receive real-time notifications, reminders, or alerts regarding their medication schedule. Moreover, caregivers or healthcare professionals can remotely monitor the medicine intake records and ensure adherence to prescribed dosages [9–11].

METHODOLOGY

Step 1: Prescription Generation

1. *Doctor generates prescription:* The process begins when a doctor generates a prescription for a patient using specialized software. This prescription includes essential patient information, medical instructions, and details of the required medications.

Step 2: Prescription QR Code

1. *QR code generation:* The software generates a unique QR code based on the information within the prescription. This QR code acts as a digital representation of the prescription.

Step 3: Scanning the Prescription

1. The patient approaches the Automatic Medicine Vending Machine (MVM), which is equipped with a scanner and a user interface.
2. *QR code scanning:* The patient scans the QR code using the Medicine Vending Machine 's scanning interface.

Step 4: *Data Processing*

1. *QR code interpretation:* The Medicine Vending Machine 's software processes the scanned QR code, extracting all the data encoded within it.
2. *Medication identification:* The software identifies the medications prescribed, their quantities, and any specific instructions.

Step 5: Medicine Selection

1. *User interaction:* The Medicine Vending Machine 's user interface prompts the patient to confirm the selection. The patient verifies the list of medications to be dispensed.
2. *Confirmation and dispensing:* Once the patient confirms, the Medicine Vending Machine software activates the dispensing process.

Step 6: Dispensing Medications

1. The Medicine Vending Machine's hardware components, including motors and sensors, are engaged.
2. *Medication rotation:* The motors rotate a spiral mechanism that holds the medications. The rotation of the spiral dispenses the required medications into a collection area.

Step 7: Medication Collection

1. *Collection point:* The dispensed medications are collected by the patient from a designated collection point within the Medicine Vending Machine.

Step 8: Completion

1. *Notification:* The Medicine Vending Machine's software sends a completion notification to the patient and records the transaction.

Step 9: Inventory Management

1. *Inventory tracking:* The system updates the inventory of available medications to maintain stock levels.

WORKING

The study’s workflow begins when a user scans the QR code associated with a specific drug on the vending machine. The QR code triggers the Arduino Mega 2560, which acts as the system's brain. The Arduino processes the information and activates the DC gear motor, controlled by the L298N motor driver, to initiate the dispensing mechanism.

As the motor starts, the integrated infrared sensors play a crucial role in ensuring the safe and reliable delivery of the medication. These sensors constantly monitor the dispensing process, detecting any anomalies or issues, thereby enhancing user safety. If a problem is detected, the system can halt the process and alert users or administrators. The dispensing mechanism relies on a spring and a motor-mounted wheel, providing accuracy and reliability in delivering the prescribed medication. The HC05 Bluetooth module facilitates communication and connectivity, allowing for seamless interaction between the user's scanning action and the dispensing process. The entire system is powered by a 12 V power supply, ensuring sufficient energy to drive the components effectively. The first step in designing a website interface is creating a digital prototype, often done using Figma. Figma enables the translation of concepts into interactive prototypes, allowing the structuring of screens, adding design elements, and simulating user interactions. For the front end, essential technologies include HTML for structure, CSS

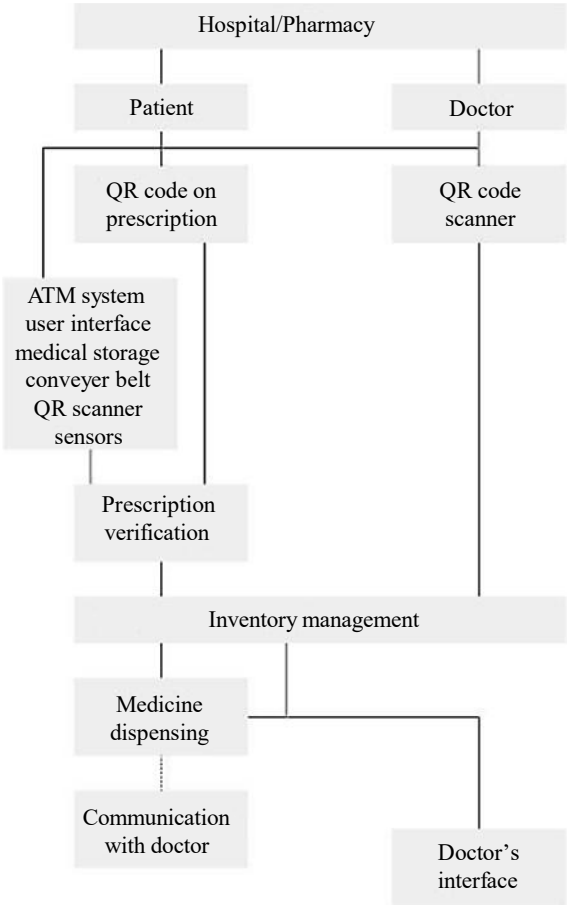

Figure 8. Flowchart of the proposed system.

for presentation and layout, and JavaScript for interactivity. This innovative solution aims to streamline medication dispensing, reduce queues and enhancing clinical efficiency for a user-friendly healthcare experience. Figure 8 represents the flowchart of proposed system.

CONCLUSION

In conclusion, our QR code-enabled medication dispensing system, powered by Arduino Mega 2560, represents a significant leap forward in healthcare technology. By seamlessly integrating components such as DC gear motor, L298N motor driver, infrared sensors, and HC05 Bluetooth module. It is an efficient and user-friendly solution to alleviate the challenges of long queues in hospitals and pharmacies. The design's reliance on a spring and motor-mounted wheel ensures precise and reliable medication delivery, while the integration of infrared sensors enhances user safety by promptly detecting and addressing any issues during the dispensing process. However, this system can show the following limitations such as:

- *Technical issues and reliability:* Software or hardware malfunctions could disrupt service.
- *Network dependence:* Requires stable internet connectivity, which might not be available in all areas.
- *QR code scanning issues:* Poor QR code quality or scanner malfunction can prevent dispensing.
- *Security and privacy concerns data breaches:* Digital prescriptions and personal health information could be vulnerable to hacking.
- *Misuse of information:* Unauthorized access to sensitive patient data.
- *Accessibility issues:*
  - *Elderly and technologically challenged users:* Some patients might struggle with using QR codes and digital interfaces.
  - *Physical accessibility:* Machines may not be accessible to individuals with disabilities.

Therefore, more detailed investigations are required to design a better and more effective Automatic Medicine Dispenser Using QR Code.

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