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SMART DRUG DISTRIBUTION SYSTEM

DR SUMIT SINGH PHUKELA[1*], Dr Omkar Shetty[2], Dr. Surbhi Priyadarshi[3], Yash Singh[4], Juhi Ruth Sinha[5], Sakshi Gupta[6]

[1]Professor, Department of Prosthodontics, Associate Dean Faculty of Dental Sciences, SGT University, Budhera, Gurugram-Badli Road, Gurugram- 122505, Haryana, India.
E Mail ID: sumit.phukela@sgtuniversity.org
[2]Professor, Department of Prosthodontics, Dean Faculty of Dental Science SGT University, Budhera, Gurugram-Badli Road, Gurugram- 122505, Haryana, India.
E Mail ID: dean.fdsc@sgtuniversity.org
[3]Assistant Professor, Department of Public Health Dentistry, Faculty of Dental Sciences, SGT University, Budhera, Gurugram-Badli Road, Gurugram- 122505, Haryana, India
Email ID: surbhi_fds@sgtuniversity.org
[4]BDS, Final year, Faculty of Dental Sciences, SGT University Budhera, Gurugram-Badli road, Gurugram – 122505, Haryana India.E mail ID: yashsingh0059@gmail.com
[5]BDS, Final year, Faculty of Dental Sciences, SGT University Budhera, Gurugram-Badli road, Gurugram – 122505, Haryana India. E mail ID: juhisinha811@gmail.com
[6]BDS, Final year, Faculty of Dental Sciences, SGT University Budhera, Gurugram-Badli road, Gurugram – 122505, Haryana India. E mail ID: sakshiguptarewari@gmail.com

Corresponding Author: E Mail ID: sumit.phukela@sgtuniversity.org

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ABSTRACT

Currently, there is no fully automated medicine-dispensing machine available in the market, making this innovation the first of its kind. Literature shows that courts have penalized doctors for illegible handwriting on prescriptions. A doctor's prescription is not only a guide for patients but also an instruction manual for family members, a document for chemists to dispense correct medications, and an important medical record for other healthcare providers. Illegible prescriptions can lead to misinterpretation, loss of information, and compromised patient care. The solution lies in digitizing the process of prescription generation and dispensing. The proposed automated medicine-dispensing machine aims to solve these challenges by enabling accurate, secure, and efficient distribution of commonly prescribed medicines in dentistry.

Introduction

A Field of Invention

The proposed system integrates principles of electronics engineering, mechanical engineering, and electrical engineering—collectively known as *Mechatronics*. Vending machines are a well-established category of automated systems designed either for products or services. They offer multiple advantages including time savings, reduced manpower requirements, lower labour costs, and increased profitability.

B Non–IoT Based Vending Machine Technologies

Over the past few years, various prototypes of vending machines have been developed, such as:

- PLC-based change-dispensing machines

- PLC-based automated multi-fluid vending machines
- AVR ATmega8515-based liquid dispensing systems
- Arduino-based reverse vending machines
- Finite State Machine–based vending machines with auto-billing features
- RFID-based ration distribution machines
- Touch-screen-based medical vending systems

These systems fall under non-IoT vending technologies. IoT-based systems, on the other hand, allow suppliers to remotely monitor stock availability.

C Existing IoT-Based Machines

Existing IoT-enabled machines include smart coffee dispensers, cashless snack vending systems, computerized vending units, and automated juice dispensers. Many are built using PIC microcontrollers and RFID-based authentication. Modern vending systems increasingly support cashless payments such as QR code/Barcode payments through virtual wallets.

With the rapid growth of smart manufacturing, there is also a need for cloud platforms that can support both Smart Factory environments and conventional businesses.

Objective of the innovation

- To design a device capable of dispensing commonly prescribed medicines in dentistry.
- To allow doctors to have complete control over what medicine is dispensed to the patient.

A.Hardware Details

Arduino Mega

Featuring the ATmega2560 microcontroller, it offers 54 digital I/O pins and 16 analog inputs. It acts as the primary controller, managing overall machine operation.

ESP32

Provides Wi-Fi connectivity for seamless communication with a remote server, enabling OTP verification and prescription retrieval.

Arduino Nano

A compact microcontroller board based on ATmega328P, suitable for space-constrained components within the system.

IR Sensor Circuit

Contains IR transmitters and receivers to detect the presence of dispensed medicines in the collection tray.

Relay Circuit with Opto-Isolator

Ensures safe electrical isolation between high-power loads and the control circuitry.

4x4 Keypad

Used for inputting OTPs and interacting with the machine's user interface.

EM18 RFID Reader

Reads RFID cards/tags for secure access and authentication.

SMPS Power Supply

A compact, high-efficiency power source used to convert and regulate electrical power for the system.

LM2596 Buck Converter

Steps down voltage levels efficiently for various electronic modules.

DC Geared Motors

Provide controlled torque and speed necessary for rotating spirals to dispense medicines.

B Software Details

The Arduino IDE (Integrated Development Environment) is used for programming the microcontrollers. Key features include:

- Cross-platform support (Windows, macOS, Linux)
- A rich library ecosystem for sensors, displays, and communication modules
- Serial monitor for real-time debugging
- Simple code uploading
- Extensive documentation and community support
- Open-source flexibility

C Other Components of the Machine

- Storage Compartments: Separate sections to organize various types of medicines.
- Collection Tray: Receives the dispensed medicines.
- Castor Wheels: Provide mobility; selected for load-bearing ability and resistance to corrosion and weather.
- LCD Display: Shows messages, instructions, and system status.

D Dimensions of the Machine

- Machine height: 1295 mm
- Glass visible height: 790 mm
- Machine length: 812 mm
- Glass visible length: 600 mm
- Display mount dimensions: 250 × 80 mm
- Collection tray height: 160 mm
- Collection tray length: 600 mm
- LCD dimensions: 66.5 mm × 18.4 mm
- Maximum product (medicine pack) dimensions: L 90 × W 40 × H 80 mm

E Internal Design

The machine consists of four rows, each containing seven compartments. Each compartment includes a spiral mechanism capable of holding 10–20 units of the same product. When a user selects a medicine, the motor rotates the spiral, pushing one medicine pack forward until it drops into the collection tray.

Machine Operation

Web Interface

- Domain: https://anytimemedicines.in/
- Web System: https://anytimemedicines.in/svm/
- Server Validity: 1 year (extendable)

Technologies Used

- Frontend: HTML, CSS, JavaScript
- Backend: PHP
- Database: MySQL

A. Pages on Website

The website consists of the following user interfaces:

1. **Doctor's Page**

2. **Chemist's Page**
3. **Maintenance Personnel Page**
4. **Patient's Page**
5. **Home / Login Page**

B. Types of Orders / Dispensing of Medicines

User Role Categories:

1. Admin–Doctor Account

This account is operated by a registered doctor. The doctor has complete access to:

- Add / Modify / Delete / View patient records
- Create and manage prescriptions
- Approve payments
- View dispensing history

Doctor Account Details

- Username / Email ID *
- Password *
- Mobile Number *
- Role *

Adding Patient Details

The doctor can register a patient with the following mandatory fields:

1. Name *
2. Email *
3. Age *
4. Gender *
5. Address *
6. Mobile Number *
7. Card Recharge * (Amount added for prepaid usage)

Editing Patient Details

Doctors can update any patient information.

Adding a Prescription

The doctor can generate a digital prescription with the following parameters:

1. Patient Name *
2. Chief Complaint & History *
3. Medical History *
4. Examination *
5. Investigations *
6. Diagnosis *
7. Type of Order *
    - Card-Based Order
    - Online Payment Order
    - Direct Order
8. Consultation & Treatment Fee *
9. Treatment Plan *

Doctors can also select medicines along with:

- Quantity
- Dose
- Duration

Patients can view their prescriptions on the "View Prescription" screen.

2. Chemist Login Page

The chemist receives the doctor's submitted prescription and has the following view:

- Patient Name
- Chief Complaint & History
- Medical History

- Treatment
- OTP Entry Box

Chemist Function:
The chemist verifies the prescription using an OTP and accepts the medicine request.

3. Patient Login Page

Patients can log in to view their complete medical information:

- Name
- Age
- Gender
- Address
- Mobile Number
- Card Balance
- Diagnosis
- Medical History
- Medicine Prescription

This provides transparency and easy access to their treatment records.

4. Maintenance Personnel Login

The maintenance interface includes fields for updating the machine's stock:

- Medicine Name
- Cost *
- Machine Format * (Arrangement/compartment reference)
- Quantity *
- Expiry Date *

Maintenance Personnel Functions:

- Update medicine stock levels
- Update expiry status
- Ensure machine storage is accurate and safe

All records are stored securely in the online **MySQL Database**.

Types of Orders / Medicine Dispensing Methods

The system supports **three** dispensing mechanisms:

A. First Concept – Prepaid Card / Cash-Based Dispensing

- The doctor generates a digital prescription.
- The patient receives a message containing their prescription details.

Example Message to Patient (Prescription)

Dear Avneet,
Thank you for your query. Please see your prescription below:
Name: Avneet
ID: P0007
Address: Delhi
Gender: Female
Mobile: 9971061617
Complaint & History: Grinding teeth during sleep
Treatment: Night guard for 6 months, Chlorhexidine mouthwash, Clohex, Diclofenac, Paracetamol, Serratiopeptidase (twice daily for 15 days), Enafix paste for 6 months
Doctor: Dr. Sumit Singh Phukela
Please contact the doctor in case of any issues.

Message Sent to Chemist

Hello Kapil, Welcome to Anytime Medicines.
P0004 – 26267 is your verification code.
SJTECH

Dispensing Process

1. Doctor submits prescription.
2. Patient receives prescription message.
3. Chemist receives OTP to verify and accept the prescription.
4. After acceptance, the patient receives a dispensing OTP.
5. Patient enters OTP in the vending machine to receive medicines.

Advantages

- Eliminates issues related to illegible handwriting
- Saves patient time and effort
- Improves accuracy and documentation
- Works like an ATM for medicines
- Provides full inventory tracking
- Useful for academic and research purposes

B. Second Concept – Online Payment Link

- Doctor submits a digital prescription.
- Patient receives prescription + payment link.

Payment Link Example

Please pay your bill using the link below: https://anytimemedicines.in/svm/payment-link.php?id=21

After payment:

1. Patient uploads a screenshot (Figure 35).
2. Doctor approves payment (Figure 36).
3. Patient receives OTP.
4. Patient enters OTP in the machine to dispense medicines.

C. Third Concept – Direct Order for Online Consultation

This model is useful during:

- Emergencies
- Remote locations without doctors
- Areas where chemist shops are unavailable

Process:

1. Doctor provides digital consultation online.
2. Doctor submits prescription.
3. Chemist verifies using OTP.
4. Patient pays online.
5. Doctor approves payment.
6. Patient receives OTP and collects medicine from the machine.

C. Machine Functionality (FIGURE 1)

The machine supports two dispensing modes:

1. OTP Mode

- User presses any keypad button to start.
- User enters a **5-digit OTP** issued by the server.
- Machine verifies the OTP via **HTTP protocol**.
- Once verified, medicines are dispensed into the collection tray.

2. Card + OTP Mode (Two-Layer Security)

- Patient taps their prepaid card on the card reader.
- Enters OTP.
- Presses the *Star* button to release medicines.

This ensures enhanced security and prevents unauthorized dispensing.

FIGURE 1 SMART MACHINE

Summary and Conclusion

To date, no fully automated medicine-dispensing machine exists in the market. This invention introduces the first such system, addressing critical issues arising from illegible handwritten prescriptions—an issue serious enough that courts have penalized doctors.

Prescriptions serve as essential documents for patients, family members, chemists, and other doctors. Misinterpretation can result in poor medical outcomes. The proposed machine solves these problems by digitizing prescriptions and automating medicine dispensing, ensuring accuracy, reliability, and convenience.

10. Future Scope

This machine is user-friendly, simple to operate, and highly useful in:

- Rural and remote areas lacking pharmacy shops
- Mountainous terrains
- Highways and transit zones
- Emergency situations

Patients can obtain prescribed medicines anytime, similar to an ATM. This system can also help during natural disasters, pandemics, and other situations requiring unattended medicine supply.

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