Embedded System Based Medicine Assistant And Dispenser Powered By AI

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Abstract—**Accessibility to basic healthcare is fundamental for community development globally. This paper introduces an innovative machine leveraging artificial intelligence (AI) to tackle healthcare provision challenges in regions where establishing traditional medical facilities is arduous. This device represents a paradigm shift in healthcare delivery, ensuring simplicity and user-friendliness. Its intuitive interface empowers users, even those with limited technical knowledge, to browse and select from a diverse range of medications, a critical feature for remote regions with limited access to medicines.**

Upon selecting a medication, the machine guides users through a secure payment process, eliminating the need for physical cash transactions and promoting hygiene. State-of-the-art technology verifies payment amounts, ensuring accuracy and reliability in dispensing medications, thus enhancing transparency and minimizing errors.

Through AI integration, the machine comprehends user symptoms via sensors and questions, suggesting appropriate medicines. This transformative tool amalgamates technology, accessibility, and affordability, offering hope to communities with limited healthcare access. Its deployment harbours the potential to significantly enhance health outcomes, serving as a beacon of progress in healthcare provision. This innovative approach addresses not only the logistical challenges of healthcare Delivery to remote regions. But also, the socio-economic barriers that impede access to essential medical services, ultimately contributing to the overall well-being and development of communities worldwide.

Index Terms— Arduino board, LCD Screen, Medicine, AI chatbot, Medication Dispensing, physical cash transaction, GSM module Arduino, user-friendly interface

I. INTRODUCTION

The medicine dispensing machine strives to offer essential medical accessibility to unreachable places, bridging gaps caused by various factors. These factors include:

- Emergency situations: Immediate access to medications during accidents or sudden illnesses
- Convenience: Access to medications at any time, especially for people in remote areas or with busy schedules
- Confidentiality: Discreet transactions without face-to-face interaction, maintaining privacy
- Reduce overcrowding: Alleviate congestion in traditional pharmacies during peak hours
- Cost savings: More cost-effective than physical pharmacy locations, potentially leading to lower medication prices
- Remote healthcare support: Complement existing services in underserved areas, providing basic medications and healthcare products

The automated medicine dispensing system facilitates the distribution of over-the-counter (OTC) medications upon receipt of payment for the requested dosage. Designed for near-autonomous operation, the system features preset pricing and utilizes an image processing unit to authenticate customer payments. This autonomy streamlines operations, necessitating human intervention solely for restocking medication or cash reserves.

Furthermore, advancements in artificial intelligence (AI) integration are poised to enhance the system's capabilities. Leveraging sensors and a series of structured inquiries, AI algorithms will soon offer personalized medication recommendations tailored to individual needs and symptoms. This evolution promises to revolutionize the dispensing process, optimizing both efficiency and patient care.

II. RELATED WORK

Various actions had been taken to integrate technology into healthcare systems, particularly in the sector of medicine dispensing and management. This part check-up related works in the sector of embedded systems and AI-powered healthcare devices.

A. Automated Medicine Dispensing Systems

Automated medicine dispensing systems have been developed to improve medication adherence and reduce errors in dispensing. Systems like the MedReady automated dispenser [1] and the Philips Automated Medication Dispensing Service [2] use programmable interfaces to dispense medications at scheduled times. While these systems

offer convenience, they lack the intelligent decision-making capabilities of AI-powered systems.

B. AI-Powered Healthcare Assistants

AI-powered healthcare assistants, such as ADA Health and Babylon Health, provide personalized health information and recommendations based on user input. These systems make use of machine learning algorithms to analyse symptoms and suggest appropriate actions, including medication recommendations. While these assistants excel in providing general health advice, they lack direct integration with medication dispensing systems.

C. Integration of AI and Embedded Systems

Several projects have integrated AI with embedded systems to enhance healthcare services. For example, the MediPulse system [3] combines an embedded device for vital sign monitoring with AI algorithms for early detection of health issues. Similarly, the AIoMT (AI in Medicine and Healthcare) framework [4] provides a foundation for integrating AI capabilities into existing medical devices. These projects demonstrate the potential for AI-powered embedded systems to improve healthcare delivery.

D. Gap in Existing Literature

While existing systems address aspects of medication dispensing and AI-driven healthcare, there is a gap in the integration of AI with embedded systems for medication assistance and dispensing. The proposed system aims to fill this gap by providing an autonomous medication dispensing solution that leverages AI for personalized medication recommendations based on user input.

III. EMBEDDED SYSTEM BASED MEDICINE ASSISTANT AND DISPENSER POWERED BY AI

An embedded system-based medicine assistant and dispenser powered by AI can revolutionize healthcare accessibility, particularly in rural areas [5]. It can offer quick and quality healthcare services to users by providing sanitation facilities, symptom screening for various illnesses, and integrating an AI chatbot for health advice [6]. The system will be placed in schools, colleges, and public transportation hubs, ensuring easy access to healthcare services. Additionally, it will give proper medicine recommendations based on user input. The advantage of this system lies in its power-efficient design, allowing it to operate 24x7 [7]. Installing such a system in these locations can ensure instant healthcare services, benefiting students, commuters, and the general public who are unable or reluctant to visit traditional healthcare facilities.

IV. IMPLEMENTATION

The medication dispensing system is a sophisticated amalgamation of meticulously engineered components aimed at efficiently gathering patient input on symptoms and general health information. At its core are the Microcontroller and Microprocessor, represented respectively by the Raspberry Pi and Arduino UNO. These components are intricately designed to adeptly process commands, ensuring smooth operation of the system.

A pivotal feature of the system is its interactive touchscreen display, facilitating seamless patient consultation. Through this interface, users can easily input their health information and receive tailored medication recommendations. Precision motors further enhance the system's functionality by ensuring accurate medication dispensation, guaranteeing precise dosages for patients.

In addition to its hardware components, the system incorporates a cloud-based database, seamlessly integrated to meticulously catalogue medication data. This database enables healthcare providers to access comprehensive patient information and make informed decisions regarding medication management. Moreover, it allows for the generation of personalized medication regimens tailored to individual patient needs.

An intuitive graphical user interface (GUI) displayed on the touchscreen enhances patient accessibility to a myriad of essential services. This user-friendly interface simplifies navigation and ensures that patients can easily access the features and functionalities of the system without encountering any usability issues.

Overall, the medication dispensing system represents a cutting-edge solution in healthcare technology, leveraging advanced components and innovative design to improve patient care and medication management processes. Its comprehensive features and intuitive interface make it a valuable asset in modern healthcare settings, promising enhanced efficiency and patient satisfaction.

A. Components and Implementation Strategies

a) Microcontroller (Raspberry Pi): The Raspberry Pi is like the brain of the system. It manages different parts of the system and can handle complex tasks, such as collecting patient information, suggesting medicines, and interacting with the database. It can also easily connect with other hardware, making the system work well together.

b) Microprocessor (Arduino UNO): The Arduino UNO works with the Raspberry Pi to control important tasks like dispensing medicines. It can quickly respond to sensors and controls, ensuring medicines are given accurately and on time. Its reliability and ease of use are crucial for the system to work smoothly.

c) Sensor: A non-contact thermometer to check the patient's body temperature. This thermometer allows for accurate temperature readings without physical contact, ensuring patient comfort and hygiene. Additionally, the system includes an oximeter (SpO2 sensor) to measure the patient's oxygen levels. These sensors help monitor patients' health more accurately, providing valuable information for medication recommendations and monitoring. The temperature and oxygen level data gathered is then used to provide precise medication recommendations and monitor the patient's health status.

d) Interactive Touchscreen Display and Graphical Interface(GUI): The interactive touchscreen display, featuring a user-friendly graphical interface, simplifies patient interaction by allowing easy input of symptoms and health information. It also presents medicine suggestions and other pertinent details, enhancing the overall user experience and accessibility for patients of varying technical abilities.

e) Precision Motors: These motors are used to dispense medicines accurately. They are programmed to give the exact amount of medicine as suggested by the system. This

accuracy is important for patient safety and effective treatment.

f) Cloud-Based Database: The database stores patient information, medicine data, and other important details. It allows healthcare providers to access patient records from anywhere, helping them make informed decisions about treatment. The cloud-based system also allows for the storage of large amounts of data securely.

g) Artificial Intelligence (AI): AI algorithms are used to analyze patient input, such as symptoms and general health information, to generate personalized medication recommendations. These algorithms are designed to adapt and improve over time, providing more accurate and effective recommendations based on user feedback and new data. AI also plays a role in optimizing medication dispensation , ensuring that patients receive the right medications.

h) Machine Learning (ML): ML algorithms are employed to continuously improve the system's medication recommendation capabilities. By analyzing patterns in patient data and medication outcomes, ML algorithms can identify trends and refine their recommendations to enhance patient outcomes. ML also enables the system to adapt to new medications and treatment protocols, ensuring that it remains up-to-date with the latest medical advancements.

B. *Advanced Techniques and Algorithms*

a) Natural Language Processing (NLP) Techniques:

- *Tokenization:* Essential for breaking down user inputs into individual words or phrases, facilitating analysis and understanding of symptoms.
- *Named Entity Recognition (NER):* Crucial for identifying and extracting relevant entities like symptoms and diseases from user inputs, aiding the chatbot in understanding key components of the query.
- *Word Embeddings:* Utilized to represent symptoms, diseases, and medications as dense vector representations, capturing semantic similarities and relationships for better contextual understanding.
- *Intent Recognition:* Important for discerning the purpose behind the user's query, enabling the chatbot to provide appropriate responses based on user intent.
- *Contextual Understanding:* Leverages information from previous interactions to maintain coherence in conversations and offer personalized recommendations based on user history and preferences.

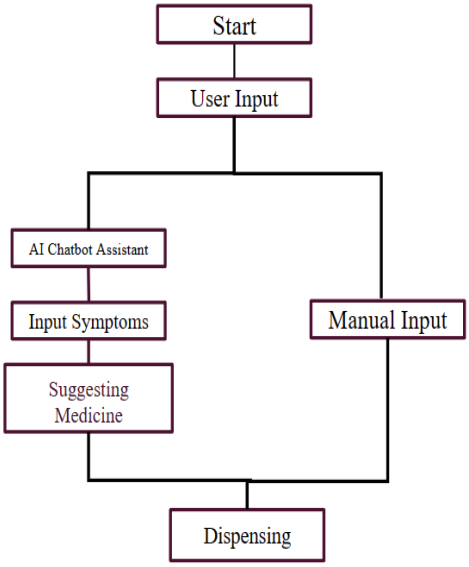
b) Machine Learning (ML) Module and Algorithms:

- *Decision Tree Algorithm:* Chosen for its interpretability and ability to capture complex relationships between symptoms, diseases, and medications, facilitating transparent decision-making in symptom classification and medication recommendation.
- *Gradient Boosting Machines (GBM):* Employed to capture intricate relationships between symptoms, diseases, and medications, achieving high predictive accuracy by combining the predictions of multiple models in a sequential manner.

c) AI Algorithms: Combination of Rule-based Logic and ML Algorithms: Integrating rule-based logic for transparent, guideline-compliant recommendations with ML algorithms for capturing complex relationships and providing personalized recommendations based on user-specific symptoms, disease characteristics, and demographics.

This ensures that the medicine recommendation chatbot remains equipped to effectively understand user inputs, identify relevant symptoms and diseases, and provide accurate and personalized medication recommendations.[9]

V. SYSTEM WORKFLOW



1) Start: This phase marks the initiation point of the process, where the user engages with the AI Chatbot Assistant to address their medical concerns.

2) User Input: At this stage, the user provides initial information regarding their symptoms or medical needs, initiating the interaction with the AI system.

3) AI Chatbot Assistant: This block represents the AI system responsible for interacting with the user. It aids in understanding the problem through a series of questions, processing the input to suggest appropriate medicine or treatments.

4) Input Symptoms: Users input their symptoms into the chatbot, enabling the AI to analyze and provide relevant medical guidance.

5) Suggesting Medicine: Based on the symptoms provided, the AI suggests suitable medicines or treatments to address the user's health issues effectively.

6) Manual Input: This essential step involves additional data entry or interaction, where users may directly input specific details such as the name of the medicine required, or other items like cotton and bandages.

7) Dispensing: The final step of the process involves the delivery of the suggested medicine or other first aid items to

the user, completing the interaction and addressing their medical needs.

VI. CONCLUSION AND FUTURE WORKS

In conclusion, our project has created a smart medicine dispenser that suggests and provides basic medicines based on what users tell it about their symptoms. This system is designed to help people in places where getting simple medicines is not easy. By using this machine, people can get the right medicines quickly and easily. We have shown that using artificial intelligence (AI) in this way can make healthcare more accessible and efficient.

Looking ahead, we plan to enhance our system in several ways. Firstly, we aim to improve the AI's accuracy in medicine recommendations by refining its algorithms and incorporating more extensive medical databases. Additionally, we intend to expand the system's capabilities to include a broader range of healthcare services, such as incorporating virus medical kits for monitoring blood pressure, sugar levels, and temperature.

Furthermore, we plan to add an SOS calling feature to enable users to quickly contact hospitals in emergencies. We also aim to implement a feedback system to gather user input and continuously improve our system based on real-world usage.

By continually innovating and improving our system, we aim to make healthcare more accessible and convenient for everyone, regardless of their location or circumstances. Our ultimate goal is to positively impact healthcare outcomes and enhance the quality of life for individuals worldwide.

ACKNOWLEDGMENT

We acknowledge the collective efforts and expertise that have contributed to the conceptualization of the Embedded System based Medicine Assistant and Dispenser powered by AI. This work reflects the collaborative spirit and dedication of the research community towards advancing healthcare solutions. The transformative potential of AI technology in personalized medicine is central to our vision for this project.

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