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DEVELOPMENT AND IMPLEMENTATION OF A SMART PILL DELIVERY SYSTEM

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Abstract: Today, forgetting to take your medication on time is a serious issue. Age-related issues frequently affect the elderly as a result of the earlier issue. A personal nutritionist engaged for the job is not a practical or cost-effective solution. This is not the end of it. Even for professionals who are currently employed, the issue persists. They frequently overlook a number of crucial responsibilities, with health care topping the list. Making an automated machine for the purpose is one suggested remedy for the issues raised. The bot will provide the user with the tablets in accordance with the pre-programmed instructions. For analysis, information about the medications is kept in a database. The project's main objective is to help carers and elderly patients take their prescriptions effectively so that they don't risk forgetting to take them. The carers receive prompt reminders to restock and maintain the system. Using a mobile application, a monitoring system can be set-up to cater the needs of the user or patient. The goal of this initiative is to increase the person's self-awareness and assist them to concentrate more on their personal or professional lives. The dispensing of a particular pill from a particular box is done using stepper motors. They are portable since they have batteries connected and are integrated with ESP modules. Patient detection can be realized using Face detection algorithms, backed either by a line follower or ROS.

Index Terms - Monitoring System, Stepper motor, ROS & ESP Module.

I. INTRODUCTION

It has become common for people to miss out on their medical prescription. This in itself is a problem that can deteriorate the person's health. This is an issue that needs to be addressed. With the target audience being aged & bedridden people, having a personal nutritionist do the job is not a viable option. A pill dispenser is a system that provides pills to the user/patient at determined intervals. Once the pill data is fed & pills are loaded, the dispenser is ready to go. A pill delivery system is one that delivers the necessary pills to the user/patient once the dispensing is done. A combination of the two systems is being worked upon that can solve the issue of having a person physically attend the patient. This system has a great potential, which increases with the scale of the project.

Patients can better manage their prescription schedules with the help of the creation of a smart pill dispenser with a monitoring system. To store the patient's needs and to generate reminders via a microcontroller and communication module, an app is necessary. To prevent overdose, the dispenser needs to be locked. A cost-effective drug management solution must be built into the system architecture [1].

The system requires a straightforward and flexible wireless power transfer system that can provide constant voltage and constant current charging. To keep the module in a constant ON state, it is important to use a dual feedback loop control method and a variable impedance matching network to manage the output voltage and current [3].

For patient detection, a system for facial detection and recognition using a low-cost, credit card-sized microprocessor called a Raspberry Pi is essential. The required libraries for image processing and machine learning methods for face detection and recognition must be utilized to construct the system. It is also vital to achieve highly precise real-time face detection and recognition [6].

To create the delivery system, a line follower robot must be designed and implemented. A microcontroller is used by such a robot for decision-making and motor control, while infrared sensors are used for line detection. Before integration into the main system, it is required to overcome the difficulties encountered throughout the development process, such as sensor calibration, power management, and mechanical design. The suggested approach shows promise for additional robotics research and development. [11].

II. PILL DISPENSING SYSTEM

An apparatus or tool can be called a pill dispensing system, if it helps with the precise and efficient delivery of medication at the prescribed time. It is utilized to control patient medication adherence in residential care facilities, long-term care facilities, and healthcare facilities like pharmacies and hospitals.

History-

When chemists first started using pill-counting trays to precisely count and dispense pills in the late 19th century, the history of pill dispensing systems can be traced. The introduction of computerized pill counters in the 1950s improved the precision and effectiveness of pill counting. In the 1970s, the first automated pill distribution device was introduced.

In order to track patient medication adherence and lower medication errors, more sophisticated pill dispensing systems were created in the 1990s.These systems made use of barcode scanning and computer software. These devices also made it possible to remotely manage and monitor patient medication schedules.

Construction –

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User Interface: It is the component of the pill distribution system that enables user interaction. A straightforward display and buttons or a more intricate touchscreen interface could be used.

Applications – There are several uses for pill dispensing systems in medical facilities. They are frequently used to enhance medication administration and lower the risk of medication errors in hospitals, nursing homes, and other care facilities. Systems for dispensing pills can be set to do so at predetermined intervals, ensuring that patients get the proper dose at the right time. They can also monitor medicine use and send warnings when a dose is about to run out or a refill is needed. Pill dispensing systems are crucial tools in contemporary healthcare because they can increase patient safety, reduce pharmaceutical waste, and promote medication adherence. Scaling up pill dispensing systems can boost patient safety, eliminate medication errors, and better manage medications. By automating the dispensing process, removing the need for manual labour, and reducing pharmaceutical waste, it can also improve efficiency and save costs.

Figure 1 – Fabricated Pill box

Figure 2 – Pill Dispensing Mechanism placed inside the pill box,

III. PILL DELIVERY SYSTEM

The A system that delivers pills directly to a patient's body is called a pill delivery system. It is often utilized when more conventional drug delivery techniques, including oral pills or injections, are ineffective or inappropriate. Early in the 1970s, the first pill delivery device was created; since then, technology has advanced tremendously. To dispense medication with great accuracy and precision, modern pill delivery systems incorporate cutting-edge electronics and sensors. The insulin pump, which was first developed in the 1970s, is one of the earliest examples of a pill delivery device. Through a tiny tube inserted under the skin, this device provided insulin to diabetic patients. Since then, mechanisms for delivering more medications have been added to pill delivery systems.

Construction –

The primary elements of a standard pill distribution device are:

Pill box: It is the container that contains the drug that will be administered. It could have a single compartment or be divided into several for various drugs.
Control Circuit: The electronic component that oversees the delivery process is known as the control unit. It has sensors, software, and a microcontroller or computer that manages the pump and keeps tabs on medicine use.
Delivery Mechanism: It provides the patient with the drug. Based on the application this mechanism can be implemented in different ways. It can possibly be a Line follower or a robot powered by RoS.

Applications – Tailored treatment, focused drug administration, remote patient monitoring, and regulated drug distribution are some benefits of using a pill delivery system. Reminding patients to take their prescription at the proper time can help patients better adhere to their drug schedule. Equipped sensors serve to monitor the patient's vital signs, enabling doctors and carers to keep track of the patient's health. Depending on the unique requirements of the patient, the medication delivery system can be designed to administer medication at particular times or in specific amounts. It can be used as a controlled drug delivery system set up to release drugs gradually over time, which is very helpful for drugs that need to release slowly over an extended period.

Figure 3 – Pill delivery system using line follower & camera for facial recognition

IV. INTEGRATION OF PILL DISPENSING & DELIVERY SYSTEMS

Using technology, patients can receive their medication regularly without the need for human assistance by integrating pill dispensing and delivery systems. The combination of these systems can provide the following advantages:
Increased medication adherence: Patients can receive their medication regularly by combining pill dispensing and delivery systems, improving their adherence to their prescription schedule. This integration of the two systems comes with various benefits:

Greater convenience: Patients can now pick up their medication without having to go to a drugstore or a doctor. Regularly, the medication is automatically delivered to their door.
Increased accuracy: By precisely dispensing and delivering the proper drug, dosage, and frequency, pill dispensing and delivery systems can lower the chance of medication errors.
Remote patient monitoring: By integrating medicine delivery and dispensing systems, healthcare professionals can keep an eye on their patient's vital signs and medication compliance from a distance, and if necessary, take appropriate action sooner rather than later.
Savings: By minimizing the need for in-person trips to doctors' offices and pharmacies, integrating pill delivery and dispensing systems can lower the cost of medication management.

Therefore, a combination of pill delivery and dispensing systems can help patients, healthcare professionals, and healthcare systems in several ways. It can boost convenience, accuracy, remote patient monitoring, and drug adherence, as well as lower expenses.

V. RESULTS & DISCUSSION

As the name implies, a prototype was built to accomplish the specified goal. The pill dispensing mechanism was initially constructed. A line follower is used to realize the delivery mechanism. When the user is recognized via facial recognition, it stops following the line across the platform. The pill dispensing system then kicks into action. We were able to extract a single tablet from the package of pills contained in the pill box. Stepper motors are used to power the dispensing mechanism. The corresponding stepper is driven to release the pill from the specified container. The time and date are recorded on a Google spreadsheet once a medication has been dispensed. Real-time updates are made to the database regarding the total amount of pills available in the container.

VI. CONCLUSION

Combining pill delivery and dispensing technologies can make managing medications much easier for individuals, healthcare professionals, and healthcare systems. These technologies can lower expenses, enable remote patient monitoring, boost convenience, improve accuracy, and improve medication adherence.
Patients can receive their prescription on a regular basis without the need for human interaction by automating the process of dispensing and distributing it, which lowers the likelihood of medication errors and boosts adherence. Remote monitoring of patients' vital signs and medication compliance by healthcare practitioners enables early intervention when necessary.
Furthermore, by lowering the need for in-person trips to doctors' offices and pharmacies, the integration of these systems can save money. Additionally, customized drug administration can improve the efficacy of the therapy and lower the likelihood of side effects.
Hence, the installation of pill delivery and dispensing systems can significantly enhance the medication management procedure, leading to better patient health outcomes and lower costs for healthcare organizations.

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VIII. DEFINITIONS, ACRONYMS, ABBREVIATIONS

Monitoring System: It refers to a system capable of timely monitoring the existing systems & able to project the status on some platform.
Stepper Motor: It is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is correctly sized to the application in respect to torque and speed.
ROS: Robotic Operating System– It is a set of software libraries and tools that help one build robot applications. From drivers to state-of-the-art algorithms, and with powerful developer tools, ROS has what is needed for robotic projects. And it's all open source.
ESP: Espressif Systems– This module is used as an external microcontroller to control the operations in the entire system. It is also referred as Node MCU.

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