RESEARCH ARTICLE OPEN ACCESS

Smart Pill Reminder and Monitoring System using IOT

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***Abstract*—Medication non-adherence has become a major problem with elderly patients and those suffering from chronic illnesses, leading to the development of various complication sand increasing the rate of hospitalization. The conventional pill reminder devices, such as pill boxes and alarm-based devices, are not capable of providing feedback on the intake of the drugs or remote monitoring capabilities. This paper focuses on the design and implementation of a Smart Pill Reminder System, which is based on the Internet of Things (IoT) paradigm. The proposed pill reminder systemhasbeendesignedusinganESP32module,a real-time clock module, and a load cell sensor with an HX711 amplifier module to sense the pill intake using the principle of weighing the pill. The pill intake status is monitored, and the pill intake status is reflected on the centralized system, which can be accessed remotely by the caregiver. The pill intake status is monitored, and the pill intake status is reflected on the centralized system, which can be accessed remotely by the caregiver. The proposed pill reminder system has been experimentally evaluated to show the reliable pill in take detection accuracy and the wireless communication stability, making the system suitable for home healthcare applications.**

***Keywords* — Smart Pill Reminder, Medication Adherence, Internet of Things (IoT), ESP32, Load Cell Sensor, Remote Health Monitoring, Real-Time Notification System.**

I. INTRODUCTION

This paper focuses on the problem of medication non-adherence, which is a major challenge in the management of chronic conditions, especially among the elderly. Skipping scheduled doses of medication can undermine the effectiveness of the medication and increase the risk of hospitalization. Traditional pill organizers and alarm-based reminders only offer time-based alerts and do not offer verification of pill ingestion.

Similarly, reminders sent by mobile application reminders also entirely rely on user compliance and do not offer physical verification of pill ingestion. With the advent of Internet oThings(IoT) technologies, smarthealthcaresystems havebeen developedtoofferremotemonitoringandtrackingofreal-time data. However, the majority of smart pill systems utilize a complex mechanical system for pill dispensing.

To address the above-mentioned limitations, this paper proposesthe development ofan Internet ofThings(IoT)-based Smart Pill Reminder System, which will utilize time and weightverificationforpillingestion.Theproposedsystemwill utilize an ESP32 microcontroller, a real-time clock (RTC) module for time-based scheduling, and a weight sensor for pill ingestion verification. The proposed system will be cost- effective and suitable for home healthcare application

LITERATUREREVIEW

Medication adherence has been a significant research area for smart healthcare monitoring systems because it directly impacts the efficiency of treatment and patient recovery. Researchers have suggested several electronic pill reminder systems to improve patient medication adherence, especially for elderly patients and those suffering from chronic diseases [1], [12]. The earlier systems were primarily timer-based systems that used alarm, buzzer, and LED-based remindersystems to improve patient medication punctuality [3], [12]. Thesystems were highly effective in reminding patients to take their medication on time. However, they were unable to monitor the consumption of pills by patients.

With recent advancements in embedded systems and communication systems, smart pill reminder systems were suggested to improve patient monitoring. The systems used microcontrollers and communication systems such as Wi-Fi and GSM to send reminders through cloud platforms and mobile applications [2], [4], [8]. The systems used IoT technology to monitor patient medication schedules remotely. The systems also used caregiver supervision to improve patient monitoring [5], [10], [13]. However, the systems used user authentication or verification through mobile applications. The systems were unable to monitor whether a patient had consumed pills or not because a patient mightdeliberatelyfail totakepillswhilestillverifyingitthroughmobile applications. Researchers have also investigated the use of motor-driven pill-dispensing systems to improve the precision of the pill-dispensing process. This involves the use of servo or stepper motors to rotate the compartments and dispense the pills at a scheduled time [1], [7], [15]. However, the use of these systems would add more complexity to the system and increase the overall cost, which would not be feasible for a home-based system for healthcare monitoring.

More recent studies have proposed the use of verification using various types of sensors. This includes the use of infrared sensors, the use of a magnetic switch,and verifying the opening ofthe compartment tocheck whether the pillbox has been opened or not [11], [14]. However, these systemswouldonlyconfirmwhetherthepillboxhasbeenopened ornot, but they would not confirm whether the pills have been taken or not, which would create a gap in the system for monitoring the adherence of the patients to the medication plan. To overcome the limitations of the abovementioned systems, the use of weight-based sensing using load cells for verifying the ingestion of the pills by the patients has been proposed as a more precise way of confirming whether the pills have been taken or not. This would be achieved by tracking the weight changes before and after the scheduled time to check whether the pills have been taken from the container or not [6], [14]. However, these systems would not be fully integrated into the IoT system, which would limit their ability to perform remote monitoring.

RELATED WORK

Several researchers have conducted studies to improve the developmentofsmartmedicationremindersystemstoimprove medication adherence, especially for elderly patients or those with chronic illnesses. In [1], an IoT-based smart medication dispenser was developed to remind patients to take their medications at designated times and send reminders to the application. In addition, the proposed system in [2] utilized an ESP32-based smart pill box to improve medication reminders.

Traditional medication reminder systems were designed with simple alarm and timer mechanisms. In [3], an automated medication reminder system utilized buzzers and LEDs to remind patients to take their medications at designated times. Althoughthisimprovedthepunctualityofpatients,itcouldnot monitor if the patient took the medication. In order to improve the monitoring feature, several researchers proposed cloud- based medication monitoring systems. In [4], a cloud-based smart pill reminder system was developed to transmit medication reminders and monitoring status to IoT platforms. In addition, real-time medication adherence monitoring using IoT technology was proposed in [5] to improve medication adherence monitoring.

Some researchers have also focused on the development of automated pill-dispensing systems in order to improve the efficiency of the system. In [7], an embedded system-based smart medicine box system that integrates mobile application technology was developed in order to automatically handle medicine reminder notifications. Similarly, in the IoT-based smart pill dispenser system proposed in [15], automated technologies were used in order to improve the accuracy of medicine-dispensing notifications.Some sensor-based verification technologies have also been proposed in order to improve the efficiency of medicine intake monitoring. In [14], a sensor-based system for monitoring pill intake detection was proposed, where the detection of pill removal is performed usingsensortechnologies.Similarly,intheproposedsmartpill dispensersystem basedonweight sensortechnologyin[6],the system uses a load cell sensor in order to detect changes in the weight of the pills in the container in order to verify whether the medicine is being taken or not.Although there is a strong reminder and monitoring system for the proposed smart pill reminder systems, there are some systems that use thedetection of the opening of the box. However, the detection of the opening of the box does not guarantee the use of the medicine.Inaddition,there aresome systems using automated dispensing technologies,and they requireextra hardware. This implies that there is a need for a smart pill reminder system.

II. PROPOSED METHODOLOGY

A. System Overview

The proposed Smart Pill Reminder and Monitoring System, using the Internet of Things (IoT) technology, would enable patients to adhere to their medication schedules. Patients, especiallytheelderly,oftenforgettoconsumetheirmedication attherighttimes.Thiscouldleadtovariouscomplicationsand affect the effectiveness of the medication. This system would ensure that patients consume their medication as scheduled.

The system architecture of the proposed system would consist of several modules, namely the reminder scheduling module, the microcontroller control module, the medication detection module,and the cloud communication module. These modules would work together to form a smart medication reminder system.

The system would start by setting the medication schedule using a mobile application or a web application. This would then be sent to the cloud database, and the microcontroller unit would be synchronized accordingly.

A Real-Time Clock (RTC) module would also be included to ensure the system tracks the time accurately. This would ensure the system reminds the patients to consume their medication at the right times.

Once the scheduled medication time arrives, the system would remind the patients using a buzzer and a light indicator. Patients would then have to retrieve their medication from the pill container. A load cell sensor would be placed beneath the pill container to measure the weight changes.

The microcontroller will then analyze the information receivedfrom the sensors and determine whether the patient has taken the medication or not. The microcontroller then sends the information to the cloud server using Wi-Fi connectivity provided by the ESP32 microcontroller.Thecloudplatformwillstorethemedicationrecords, and the patient's condition can be monitored by the family or caregiver.

The proposed system is an amalgamation of IoT technology, monitoring using sensors, and cloud storage, making it a reliable and efficient method of managing medications. The reminders and the sensors ensure the patient adheres to the medication schedule.

B. ReminderSchedulingModule

Reminderschedulingcomponent:Ittakescareofyourmedication schedules.Itremindsyouattherighttimetotakeyourmedication.You canset your medicationtime using the appor the webinterface.

These scheduled times are stored in the cloud database. They are alwayssynchronizedwiththemicrocontrollerunit.There'saReal-Time Clock(RTC)thatkeepsticking,constantlycomparingthetimewith the scheduled time.When the time matches the scheduled time, it triggers the reminder. You will hear the buzzer and see the LED light flashing to remind you to take your medicine.In summary, this component ensures that reminders are generated

C. Microcontroller Control Module

The control module, centered around a microcontroller, is at the center of the system. We have opted to use the ESP32 as the microcontroller, as it provides Wi-Fi capabilities linked to IoT-friendly design. This module retrieves the medication schedule from the cloud and maintains aconstant vigil for the current time using the RTC. When it is time to remind, the MCU wakes up the buzzer and the flashing LEDs to remind the patient.

It also receives data from the load cell sensor to check whether the medication has been taken or not. After processing the data, the system changes the status of the medication and sends the data back to the cloud. Thismodule controls all the hardware components of the system, facilitating communication between the sensors, the buzzer, the flashing LEDs, and the cloud.

D. Cloud Monitoring Module

The cloud monitoring module will allow you to track the medication status from afar. The ESP32 microcontrollerwill be used to upload the system's data to the cloud database, e.g., Firebase, using Wi-Fi connectivity.In the cloud, you will find records of the medication schedule, reminders, pill intake status, and missed medication. The caregiver can access this information through the mobileapp or web application.This feature will allow the caregiver to monitor if the medication is taken at the right time. If the medication is not taken, the caregiver will be alerted to take necessary action. This module will allow the addition of real-time data storage, remote monitoring, and better management of healthcare needs to the system.

E. DashboardandMonitoringModule

The Dashboard Module facilitates access to the medication-related information and the status of the entire system to the caregiver or the family members. It receives the necessary information from the cloud database.The ESP32 device sends the necessary medication-related information, such as the time for the medication reminder, whether the pill has been taken, or if it has been missed, to the cloud server. It does this using Wi-Fi connectivity.

Someofthefeaturesofthedashboardinclude:

- Medication Schedule Display: A list of medications along with the scheduled time to take the medicine.

- Medication Status Monitoring: The status of the medicine taken or missed.

- MedicationHistory:Thehistoryofthemedicinetaken.

- Notification Alerts: Alerts are given if the medicine has not been taken at the scheduled time.

- Remote Monitoring: The caregiver or the doctor can monitor the status from anywhere.correctly and consistently according to the scheduled time.

F. MedicationDetectionModule

The medicine check module is present to ensure that the patient actually takes the medicine after the reminder goes off. It does so by using a load cell weight sensor connected to an HX711 amplifier to detect how much the pill bottle weighs. When the patient takes the medicine, the weight of the bottle decreases slightly. The load cell thendetectsthisandsendsthe informationtothemicrocontroller.The HX711 acts as an amplifier, converting the sensor data into digital form that the microcontroller can understand.

The system then uses the weight of the bottle both before and after the reminder goes off to determine whether the medicine has been taken. This is an added layer of security, unlike in most reminder systems that only beep.*Refill Notification Module*

This module monitors the level of medicine left in the pill container and reminds the user when the medicine is running low. In the proposed system, a load cell is used to monitor the weight of the medicine container. The pills are of a known or constant weight, and thus the number of pills left in the container can be monitored by monitoringtheweightofthecontainer.TheESP32actsasthebrain of the system and receives the data from the load cell through theHX711 amplifier. When the weight of the medicine in the container goes belowathreshold,it isassumed that themedicine isrunning low and a notification is sent to the user to refill the medicine container.

The notification is sent to the user through the cloud platform, and thus the user is reminded to refill the medicine container before the medicine runs out. This module is very important in the system because it reminds the user to refill the medicine container before the medicine runs out, and thus the user is not forced to stop taking medicinedue toanempty medicine container. Thismodule makes the system more reliable and effective in its purpose.

III. SYSTEMARCHITECTURE

The Smart Pill Reminder System seeks to assist patients with their medication by ensuring timely intake. Additionally, it allows the patient's caregivers to keep an eye on the situation from a distance. The system comprises a cluster of integrated parts such as reminder scheduling,medicationdetection,alertcontrol,cloudmonitoring,and a caregiver dashboard. These parts work together to keep people on track with their medication.

The process begins with the patient's interaction with the smart pill bottle. The medication reminder schedule is stored in the Reminder Scheduling Module. This module

stores the patient's prescription schedule and controls the frequency of reminders. The module sends reminders at the appropriate time based on the stored schedule.

To monitor whether the patient has taken the medication or not, the MedicationDetectionModuleusesaloadcell,which actsasaweight sensor. The module detects changes in weight when a pill isremoved from the pill bottle.

The ESP32 acts as the central point of the system, balancing the schedule of reminders and the data being provided by the weight sensor. By processing the data, the system determines whether the patient took their medication within the scheduled window of time.

Once the scheduled window for medication arrives, the system activates the Alert Control Module. If the patient fails to take their medication, the system triggers a buzzer to remind the patient. This provides a local prompt for the patient to remind them to take their medication, keeping them on schedule.

To enable remote monitoring, the ESP32 connects to a Wi-Finetwork and transmits the data to a cloud-based monitoring system. This provides a way to record medication schedules, reminders, and adherence, allowing remote access for caregivers and medical professionals. This enhances the level of care for the patients by continuously monitoring their medication adherence

correctly and consistently according to the scheduled time.

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The system provides a user interface for the patients and caregivers, dubbed the Dashboard and Caregiver Notification Module. This provides a way for caregivers to access the medication adherence details, confirm whether the medication was taken, and receive notifications for missed medication. This enhances the level of care for the patients by continuously monitoring their medication adherence.

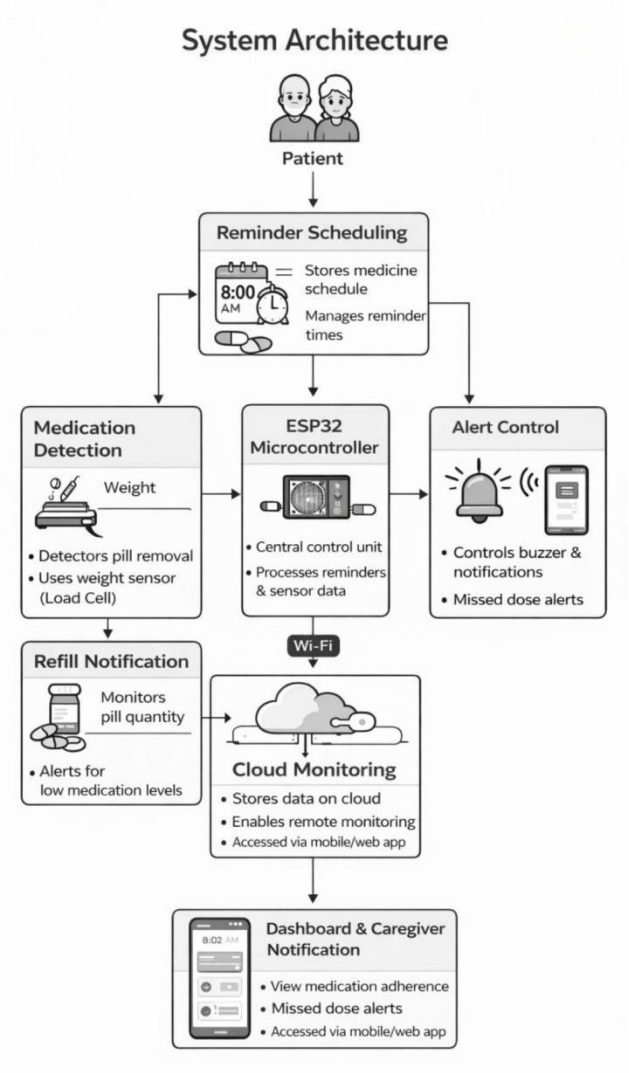

Fig.1.System Architecture

However, the system has gone further than just the timing of theintake of the medicine. The system has also been enhanced to include the Refill Notification Module that monitors the amountofmedicineremaininginthepillcontainerthroughthe loadcellsensorthatcontinuouslymonitorstheweightofthepill container and uses this information to estimate the amount of pillsremaininginthecontainer.Whentheweightgoesbelowa specified threshold, the system sends a notification that the medicinesupplyinthecontainerislow.Thisnotificationissent usingtheESP32microcontrollerandtheWiFiconnectiontothe cloudsystem.

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IV. Implementation

The Smart Pill Reminder System has been developed with the help of IoT hardware and cloud monitoring. It has been designed to incorporate sensors, microcontrollers, triggers, and wireless connections to maintain reliable medication reminders. In this Smart Pill Reminder System, the ESP32microcontroller has beenused asthe main microcontroller. It has been chosen for its availability with Wi-Fi connectivity, enough processing power, and goodcompatibility with IoTprojects.The ESP32 microcontroller manages the entireprocess, interprets sensor inputs, and communicates with the cloud platform. For the purpose of monitoring pill consumption, a load cell with an HX711 amplifier has been used to measure the changes in the weights. The pill container has been kept on the load cell to monitor the weights. When the pill container is filledwith pills, it has a certain weight. When the pill is taken, the weight reduces slightly. The sensor detects this change in the weight and communicates with the ESP32 microcontroller. The ESP32 microcontroller then interprets this change by comparing the weights.

A buzzer is used to remind the patient at the exact time to take the medication. When the time to take the medication is reached, the buzzer is activated by the ESP32. Thus, the patient is reminded to take the medication. In case the medication is not taken, the medication is recorded as missed.

Through the Wi-Fi capability of the ESP32, the medication information istransmittedtothecloudplatform.ThecloudplatformusedisFirebase. The information transmitted includes the medication schedule, the medication reminders, and the medication intake. All this information is stored securely. Thus, the cloud platform provides real-time access tothe medication information. Through the web platform, the caregiver or the family member is able to monitor the medication remotely. The web platform retrieves the medication information from the cloud platform. Thus, the caregiver or the family member is able to monitor the medication schedule, the medication intake, and the medication that is missed. Thus, the medication management system provides a reliable and efficient way of managing medication. Therefore, the medication management systemisagoodexampleofhowIoTtechnologyisusedto monitor medication.

The system has not only been able to monitor when the medicine is taken. It has also been able to monitor how much medicine is left in the pill container through a Refill Notification Module. The system is ableto monitor how much medicine is left through a load cell sensor that is used to measure the weight of the medicine container. It is able to estimate how much medicine is left in the container based on its weight. When the weight goes below a certain threshold, it sends a low supply alert. This is done through the ESP32 microcontroller.

V. Result and Discussion

The Smart Pill Reminder System was created to test the level of reminders it provides to users about their medication and the confirmationofthe pill's consumption throughasensor mechanism. Itis based on the ESP32 platform, a load cell to measure the weight of the pills, a buzzer to provide auditory feedback, and a cloud platform to provide a monitoring mechanism. The reminder mechanism was testedto seehow well it providesreminders to the user based on the scheduled times to consume the pills. It was also tested to see how well the buzzer provides auditory feedback to the user to remind them to consume their medication. The alert mechanism was tested to see how well it provides reminders based on the scheduled times. It was able to provide reminders as scheduled.

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The load cell was placed underneath the pill container to measure the weight of the pills. When a pill is removed from the container, the weight changes, which is detected by theloadcell.TheESP32processesthedatareceivedfromthe load cell to make a decision on the consumption of the pill. It was able to detect the removal of the pill from the container.

The IoT mechanism was also tested to see how well itprovides data to the cloud platform. The ESP32 was able to send the data to the cloud database through the Wi-Fi module. The datawasreceived bythe cloudplatform, which providesa dashboard to display the data.

The results have proven that the Smart Pill Reminder System can provide reminders to the user about their medication. Ithas proven to provide a mechanism to monitor the consumption of the pills. It has provided a mechanism to provide intelligent medication management to the user. It has proven to provide a mechanism to provide healthcare monitoring to the user through the cloud platform.

S.NO	Initial Weigh t	Weigth afterpill removal	Detectedby System	Result
1	120	118	yes	Correct
2	118	116	yes	Correct
3	116	114	yes	Correct
4	114	114	No	Correct
5	114	112	yes	Correct

Table1:PillDetectionTestResultsusingLoadCellSensor.

VI. CONCLUSION

The article discusses how a Smart Pill Reminder System was developed to enhance how effectively patients take their medication, utilizing Internet of Things technology. Thedevice is based on an ESP32 microcontroller, a load cell to monitorwhenmedicationisbeingtaken,andanalertsystemto remind patients to take medication. Additionally, it utilizesWi-Fi to send pill data to a cloud platform, which allows caregivers to monitor remotely using a specific dashboard.

The load cell monitors the weight of a container holding medication.Thedeviceisabletodetectwhen apillisremoved, which is used to confirm when medication is being consumed. There is also a feature to monitor when medication is running low, which tracks how many pills are left. This feature is used to inform patients when medication is running low. The device is able to prevent medication from being forgotten and ensures an adequate supply of medication is maintained.

From the experiments, it is clear that the device is able to send timely reminders to patients to take medication. The device is also able to monitor when medication is being consumed. The device is also able to send data to a cloud platform, which allows for remote monitoring. The device is a reliable way to manage medication, especially for elderly patients or those with memory issues.

Future improvements to the device can include developing an applicationtosupport smartphones, addingafeatureto allowmultiple medication compartments, and developing a feature to provide more detailed insights.

VII. FUTURE WORK

TheSmartPillReminderandMonitoringSystemisagreatexample of how the IoT can help individuals manage their medication, especially the elderly and those suffering from various diseases. It does provide the necessary reminders to help users manage their pills properly. However, there are several ways to enhance the system to make it more reliable, effective, and user-friendly.

Firstly, the project could consider developing a mobile application to work with the system. Having a mobile application would enable users to manage their reminders more conveniently. It would provide real-time reminders to the users, helping them stay on top of their medication. It would make the system more user-friendly and convenient for patients, as well as the healthcare professionals caring for them.

Another potential enhancement to the project would be to include multiple pill compartments within the pillbox. The current system only has the ability to manage a single pill container. However, the reality is that patients may need to manage several pills at different times. Having multiple compartments would enable the system to manage several pills at once, thus enhancing the overall user experience.

Goingforward,theprojectcouldconsiderexploringmoreadvanced data analysis to make the system even more effective. For instance, the system could analyze the data it collects over a long period to identify various patterns in the patients' pill consumption. It would then send reminders to the patients or their caregivers whenever it identifiesapatternofnon-compliance. Theprojectcould considerthe integration of machine learning to help the system predict potential non-compliance.

Anotherimportant featuretobeaddedtothe system wouldbemore communication features. For instance, the system could send notifications to the patient's caregivers or family members if the patient has missed a dose within a given timeframe. This would help to enhance patient safety. Another important feature to be added tothe system would be the addition of power reliability. For instance, the system could have a rechargeable battery to ensure it does notshut offin case ofa poweroutage. This would make the system more reliable, especially in home healthcare systems.

Finally, the system could have more sensors and health-tracking features. For instance, the addition of biometric sensors such as heart rate or temperature would enable the system to track the patient's health, thus transforming the system into a smart healthcare system.

correctly and consistently according to the scheduled time.

Q. MedicationDetectionModule

The medicine check module is present to ensure that the patient actually takes the medicine after the reminder goes off. It does so by using a load cell weight sensor connected to an HX711 amplifier to detect how much the pill bottle weighs. When the patient takes the medicine, the weight of the bottle decreases slightly. The load cell thendetectsthisandsendsthe informationtothemicrocontroller.The HX711 acts as an amplifier, converting the sensor data into digital form that the microcontroller can understand.

The system then uses the weight of the bottle both before and after the reminder goes off to determine whether the medicine has been taken. This is an added layer of security, unlike in most reminder systems that only beep.

correctly and consistently according to the scheduled time.

R. MedicationDetectionModule

The medicine check module is present to ensure that the patient actually takes the medicine after the reminder goes off. It does so by using a load cell weight sensor connected to an HX711 amplifier to detect how much the pill bottle weighs. When the patient takes the medicine, the weight of the bottle decreases slightly. The load cell thendetectsthisandsendsthe informationtothemicrocontroller.The HX711 acts as an amplifier, converting the sensor data into digital form that the microcontroller can understand.

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S. MedicationDetectionModule

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T. MedicationDetectionModule

The medicine check module is present to ensure that the patient actually takes the medicine after the reminder goes off. It does so by using a load cell weight sensor connected to an HX711 amplifier to detect how much the pill bottle weighs. When the patient takes the medicine, the weight of the bottle decreases slightly. The load cell thendetectsthisandsendsthe informationtothemicrocontroller.The HX711 acts as an amplifier, converting the sensor data into digital form that the microcontroller can understand.

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VIII. ACKNOWLEDGEMENT

The authors extend their heartfelt thanks to the faculty and project supervisors of the Department of Computer Scienceand Engineering for their constant support and guidance in the development of this project.
Sincere thanks go to the institution for providing the required facilities and resources for the development of this research. Finally, the authors extend their thanks to their friends and colleagues for their ideas and support in the development ofthe Smart Pill Reminder System.

REFERENCES

[1] M. Patel; et al., "IoT-Based Smart Medication Dispenser System," IEEE, 2021.
[2] R.Kumar;etal.,"DesignandImplementationofSmartPill Box Using ESP32," IEEE, 2022.
[3] S. Sharma; et al., "Automated Medication Reminder and Monitoring System," International Journal of Engineering Research and Technology (IJERT), 2020.
[4] L. Zhang; et al., "Cloud-Connected Smart Pill Reminder for Elderly Care," IEEE Access, 2021.
[5] A. Rahman; et al., "Real-Time Medication Adherence Monitoring Using IoT," IEEE, 2020.
[6] P. Singh; et al., "Weight Sensor-Based Smart Pill Dispenser," International Journal of Recent Technology and Engineering (IJRTE), 2019.
[7] D. Lee; et al., "Embedded System for Smart Medicine Box with Mobile Application," IEEE, 2023.
[8] K. Nair; et al., "Wi-Fi Enabled Medication Reminder System," IEEE, 2021.
[9] T.Johnson;etal.,"Low-CostSmartHealthcareMonitoring Using ESP32," IEEE, 2022.
[10] H. Wang; et al., "IoT-Based Healthcare Monitoring and Alert System," IEEE Access, 2020.
[11] V. Gupta; et al., "Cloud-Based Smart Pillbox with Adherence Tracking," IEEE, 2023.
[12] J. Kim; et al., "Development of an Intelligent Medicine Reminder System for Elderly Patients," IEEE, 2019.
[13] S. Ahmed; et al., "Remote Patient Monitoring Using Smart Medication Box," International Journal of Advanced Computer Science and Applications (IJACSA), 2021.
[14] M. Lopez; et al., "Sensor-Based Pill Intake Detection System," IEEE Sensors Journal, 2022.
[15] R. Thomas; et al., "Design of an IoT-Enabled Smart Pill Dispenser for Healthcare Applications," IEEE,