Pill Master Automatic Pill Dispenser

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Abstract— The automatic pill dispenser, powered by Arduino, addresses the critical issue of missed medication doses among the elderly, who often struggle with memory loss and other health challenges. It allows users to schedule dosage times, releasing prescribed pills automatically, accompanied by friendly greetings and audible alerts for easy interaction. This innovative device alleviates the need for constant monitoring, aiding not only seniors but also individuals across age groups prone to forgetfulness. By promoting medication adherence, it enhances independence, lessens caregiver burdens, and positively impacts overall health outcomes.

Index Terms- Automatic Pill Dispenser, Automation, Health Monitoring System, IoT Integration.

I. INTRODUCTION

Older adults often grapple with common health issues like forgetfulness and short-term memory loss, leading to missed medication dosages. In the past, joint families facilitated easier health monitoring, but with families now dispersed due to work and other commitments, seniors may feel neglected. Forgetfulness exacerbates the problem, leaving them unable to take medicine on time with no one available to remind them. This scenario isn't limited to seniors; teens and adults also face similar challenges due to heavy workloads and stress.

The Automatic Pill Dispenser emerges as a solution to prevent missed dosages. This innovative device employs a buzzer to emit a loud sound for pill reminders, complemented by an LCD display for user-friendly interaction. The device's programmability allows the setting of alarms and schedules, personalized to individual preferences. Integrating an RTC 3231 for input/output functions and a servo for precise pill dispensing, it offers a cost-effective and user-centric solution.

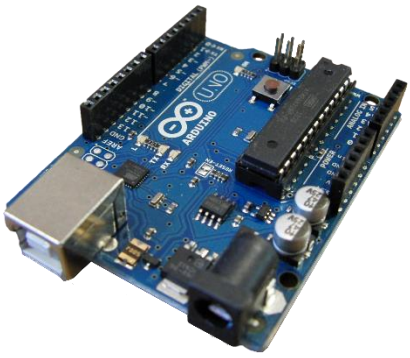
This pocket-friendly dispenser tackles the issue of missed dosages effectively. The primary goal is to create an affordable, user-friendly device to enhance medication adherence for individuals across age groups. By mitigating the challenges posed by forgetfulness and hectic lifestyles, this device aims to significantly improve medication compliance and overall health outcomes.

II. METHODOLOGY

A. Components of the Circuit

Hardware - ARDUINO UNO, LCD DISPLAY, RTC DS 3231, BREADBOARD, BUZZER, REGISTER 1K OHM, 10K OHM, SERVO MOTOR, JUMPER WIRE.
Software - EMBEDDED C/C++, ARDUINO LIBRARIES.

ARDUINO UNO: -
The Arduino Uno stands as a key player in embedded systems, renowned for its open-source design, simplicity, and versatility. Fueled by the ATmega328P microcontroller boasting 32 KB of flash memory, it provides an accessible platform for diverse research and development projects. Facilitated by the Arduino Integrated Development Environment (IDE) for simplified programming, the Uno is an ideal choice for rapid prototyping and experimentation. Noteworthy features include a range of digital and analog input/output pins, accommodating various sensors and actuators. Compatibility with communication protocols like I2C, SPI, and UART enhances its versatility, further extended by the integration of various shields for exploring complex functionalities.



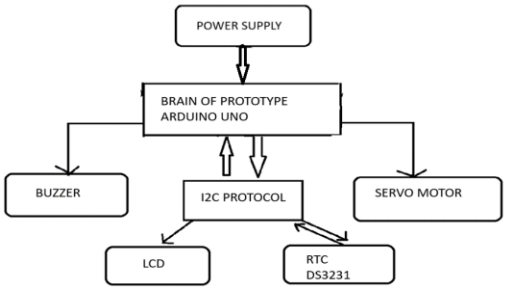
RTC DS 3231: -

The DS3231 is a highly accurate real-time clock (RTC) module produced by Maxim Integrated. It features a temperature-compensated crystal oscillator for precise timekeeping, has a temperature sensor, and provides a 32.768 kHz square wave output. The module is often used in electronic projects where accurate timekeeping is essential.

In this project we have done coding in Arduino IDE. While writing code, we used various functions, if-else loops. We have used digital as well as analog pins for the device.

The RTC DS3231 is a highly accurate, low-cost real-time clock module that utilizes the I²C protocol for communication, making it simple to integrate with various microcontrollers. Notable for its exceptional accuracy, the DS3231 maintains a precision of ±2 ppm from 0°C to +40°C and ±3.5 ppm from -40°C to +85°C, thanks to its integrated temperature-compensated crystal oscillator (TCXO) and crystal. This integration ensures stable timekeeping across a wide temperature range. The module features a battery backup, allowing it to continue keeping accurate time even during power interruptions. It provides comprehensive calendar functions, including seconds, minutes, hours, day, date, month, and year, with automatic leap year compensation up to 2100. Additionally, the DS3231 includes two programmable time-of-day alarms and a programmable square-wave output, further enhancing its functionality for various applications.

B. Block Diagram



Working: -

In the design of an automatic pill dispenser using an Arduino, selecting an appropriate power supply is crucial for ensuring reliable and consistent operation. The Arduino, serving as the central controller, manages and coordinates all peripheral devices such as servo motors, the RTC module, and the LCD display. Here's a more detailed breakdown of the power supply considerations:

Power Supply Options

1. USB Power from a Computer:
Easy to set up and use during development and testing phases.
Provides a steady 5V supply which is sufficient for the Arduino and most attached components.
Mobility is restricted as the device needs to be tethered to a computer.
Not practical for a standalone or portable deployment.

2. External Power Supply:

Eables the dispenser to operate independently from a computer, enhancing portability and practicality in everyday use.
Can provide a more robust power source capable of driving additional components like multiple servo motors without straining the Arduino's onboard voltage regulator.
Requires careful selection to ensure the correct voltage and current capacity to avoid damaging the Arduino and connected components.
Adds to the complexity and cost of the setup.

Choosing the Right Power Supply
Voltage Requirements: Most Arduino boards operate safely on an input voltage of 7-12V when using an external power supply connected to the Arduino's barrel jack. This range is ideal as it provides enough voltage for the onboard regulator to stabilize and distribute a consistent 5V to the Arduino and its peripherals.
Current Requirements: Calculate the total current draw expected based on the components used. For example, each servo motor can draw substantial current, especially under load or when starting. Ensure the power supply can handle peak currents without voltage dips or instability.
Stability and Safety: Choose a power supply with overcurrent protection, and possibly a fuse, to protect the Arduino and peripherals from accidental damage.

Implementation
During Development: Use USB power for simplicity while coding, testing, and debugging. This setup also makes it easy to upload new code and make adjustments.
In Deployment: Switch to an external power supply for everyday use. This allows the dispenser to be placed anywhere it's needed without the need to be close to a computer.

In summary, while USB power is convenient during the development phase, an external power supply is recommended for deploying the automatic pill dispenser in a real-world setting to ensure that it operates reliably and without restrictions on placement and mobility.

1. Setup and Programming:
The user programs the Arduino with a schedule for dispensing the pills. This includes specifying times and possibly the number of pills.
The Arduino code uses libraries suitable for handling the RTC, servo, and LCD display.

2. Operation:
The RTC module continuously provides the current time to
the Arduino.
When the current time matches a preset dispensing time, the Arduino triggers the servo motor to actuate.
The servo motor moves the compartment that contains the pills to an open position where the pills can drop out or be accessed.
An alarm or a notification (using a buzzer or LCD display) can be activated to alert the user that it's time to take the medicine.

3. User Interaction:
The user can set or adjust the dispensing times using the buttons and view the settings on the LCD display.
The user refills the compartments when necessary and can troubleshoot or adjust the schedule as required.

Programming Aspects
Code Logic: Involves reading the RTC data, comparing times,
controlling servo movements based on time matches, and
updating the display.
Libraries: Often uses `Servo.h` for controlling the servo
motors, `Wire.h` and a specific RTC library (like `RTClib.h`)
for the real-time clock, and `LiquidCrystal.h` for the LCD.

Safety and Reliability
Includes features to prevent dispensing errors, such as checking that the correct compartment is in position.
Might also include sensors to detect and confirm pill dispensing, adding a layer of reliability.

Here we are using I2C protocol, it is used here to control LCD screen. I2C protocol is also known as Master-Slave protocol. I2C combines the best features of SPI and UARTs. With I2C, you can connect

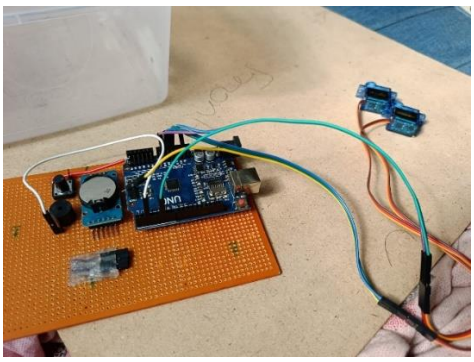
multiple slaves to a single master (like SPI) and you can have multiple masters controlling single, or multiple slaves. This is useful when you want to have more than one microcontroller logging data to a single memory card or displaying text to a single LCD.

I2C is a two-wire serial communication protocol using a serial data line (SDA) and a serial clock line (SCL). The protocol supports multiple target devices on a communication bus and can also support multiple controllers that send and receive commands and data. Communication is sent in byte packets with a unique address for each target device.

I2C, often called I 'two' C, stands for the Inter-Integrated Circuit protocol. I2C was developed in 1982 by Philips Semiconductor (now NXP Semiconductor) as a low-speed communication protocol for connecting controller devices such as microcontrollers and processors with target devices such as data converters and other peripheral devices. Since 2006, implementing the I2C protocol does not require a license, and many semiconductor device companies, including TI, have introduced I2C-compatible devices.

I2C is a widely used protocol for many reasons. The protocol requires only two lines for communications. Like other serial communication protocols, there is a serial data line and a serial clock line. I2C can connect to multiple devices on the bus with only the two lines. The controller device can communicate with any target device through a unique I2C address sent through the serial data line. I2C is simple and economical for device manufacturers to implement

C. Output



III. RESULTS

The automatic pill dispenser built around Arduino stands as a groundbreaking solution for managing medications with unparalleled efficiency and reliability. Its intricate design integrates several key components: Arduino as the central controller, an RTC module ensuring precise timekeeping, a servo motor meticulously dispensing medications from their containers, and supplementary features like a buzzer and RGB system for comprehensive alarm functionality. This innovative device leverages Arduino's programmable nature to provide meticulous dosing accuracy and timely reminders, revolutionizing patient adherence to medication schedules. Its potential integration with healthcare systems opens avenues for seamless monitoring and facilitates better tracking of medication intake, thereby enhancing overall healthcare outcomes.

CONCLUSION

The automatic pill dispenser built around Arduino stands as a ground-breaking solution for managing medications with unparalleled efficiency and reliability. Its intricate design integrates several key components: Arduino as the central controller, an RTC module ensuring precise timekeeping, a servo motor meticulously dispensing medications from their containers, and supplementary features like a buzzer and RGB system for comprehensive alarm functionality. This innovative device leverages Arduino's programmable nature to provide meticulous dosing accuracy and timely reminders, revolutionizing patient adherence to medication schedules. Its

potential integration with healthcare systems opens avenues for seamless monitoring and facilitates better tracking of medication intake, thereby enhancing overall healthcare outcomes.

By employing Arduino's flexibility, this dispenser enhances medication safety by delivering precise doses while ensuring patient convenience. Its intuitive design simplifies the complex task of medication intake, fostering greater ease and accessibility for individuals managing multiple prescriptions. Moreover, this system's integration with healthcare networks promises comprehensive oversight, allowing healthcare providers to monitor patient adherence and tailor interventions as needed, thus elevating the standards of care. Ultimately, this pioneering device redefines medication management, significantly improving patient health and well-being through enhanced adherence and streamlined healthcare practices.

IV. FUTURE SCOPE

The future scope of the automatic pill dispenser using Arduino is promising, with potential advancements in several areas:
1) Smart connectivity: Integration with IoT for remote monitoring and control, enable doctors to track medication adherence.
2) Data Analytics: Implementing data analytics to analyse medication adherence.
3) mobile Applications: Development of mobile apps for interaction with the dispenser.
(4) Biometric Authentication: Implementing Biometric Authentication to enhance security

Acknowledgment

The Automatic Pill Dispenser project provided profound insights into programming Arduino, mastering the intricacies of code structure and execution. Exploring various components such as sensors, motors, and displays enhanced understanding of their functions and applications. Hands-on experience in establishing intricate connections between these components provided a practical grasp of hardware integration. Confronting and overcoming challenges during the project honed problem-solving skills, teaching resilience in real-life applications. This endeavor not only fortified programming proficiency but also underscored the significance of systematic planning and adaptability when translating theoretical knowledge into tangible solutions.

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