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Embedded Systems & Microprocessors

Smart Pill Dispenser with Water System

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Abstract

In this project, a smart pill dispenser that is connected to an automated water delivery and temperature control system is presented. Automating the pill and water administration process and making sure that tablets are taken correctly and in the right atmosphere are two ways it seeks to improve medication adherence. A PIC16F877A microcontroller, a number of sensors, motors, actuators, and safety features are used in the system to distribute tablets only in the event that a cup is identified, water is accessible, and the temperature is at its ideal level. Patients with chronic ailments, the elderly, and those following rigorous prescription regimens will find this approach very helpful.

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Introduction

Medication mistakes, missing doses, or inappropriate administration might result from manual pill-taking practices. These issues are particularly prevalent with older or visually impaired users. This procedure is automated by the Smart Pill Dispenser with Water System, which lowers human error and enhances drug administration. When a pill is successfully dispensed, the system detects the presence of water and a cup, maintains the proper storage temperature, and tells users visually or audibly of any problems.

Objectives

- Automate the administration of pills with little assistance from humans.
- Before distributing water, make sure a cup is in place.
- Verify the availability of water before permitting dispensing.
- Keep an eye on and control the temperature of the pill storage.
- When there are system warnings (such as, no pill, no cup, or no water), consumers are alerted via buzzer and LED.
- Provide a medicine system that is both safe and easy to use.

Components Used

PIC16F877A Microcontroller

The PIC16F877A is the system's central nervous system. It manages the smart pill dispenser's logical judgments, output devices, and all sensor inputs. Based on the preprogrammed logic, it provides control signals to the motors, LEDs, pump, and buzzer after receiving data from the infrared, ultrasonic, and temperature sensors.

Servo Motor

The trap door must be operated by the servo motor. The servo motor opens the trap door to let pills into the revolving wheel when the device is turned on. The servo secures the pills in position and signals that the device is ready to operate when the user clicks the start button, closing the trap door.

Relay Module

The motor that rotates the pill wheel is managed by the relay. It functions as a switch to securely operate the wheel motor at the appropriate point in the appropriate cycle.

DC Motor (Fan)

When the LM35 temperature sensor determines that the pill storage environment falls below a predetermined threshold, this motor, which is connected to a fan, is turned on. The fan ensures that medication is stored safely by helping to maintain the proper temperature inside the pill compartment.

H-Bridge Motor Driver

A key part of powering the water pump motor is the H-bridge. When the proper conditions (cup presence and water availability) are met, it enables the microcontroller to use low-power digital signals to regulate the pump, turning on or off water flow.

Pump

Once a pill has been effectively dispensed and a cup has been recognized, the pump—a tiny DC water pump—pours water into the cup. It is managed by the H-bridge, and the microcontroller gives it commands based on input from the sensors.

IR Sensor 1 (Pill Detection)

This infrared sensor is placed beneath the pill dispenser's escape path. It checks to see if a pill has fallen off the rotating wheel successfully. If a pill is detected, the LED and buzzer are activated, and the process moves on to the next steps, which include checking for the presence of a cup and water.

IR Sensor 2 (Cup Detection)

The user should place their cup on the second infrared sensor, which is situated at the base of the dispenser. Before water is supplied, it makes sure there is a cup present. The system will notify the user with an LED and buzzer until a cup is positioned correctly if no cup is detected.

Ultrasonic Sensor

The water level inside the tank is tracked by this sensor. The mechanism can start pumping water into the cup if the water level is adequate. The system goes into a wait mode until the water is replenished, and the buzzer notifies the user if the tank is empty.

LM35 Temperature Sensor

The temperature inside the pill container is continuously monitored by the LM35 sensor. To restore the environment to a range that is appropriate for storing pills, it turns on the DC motor that is attached to the fan if it senses that the temperature has dropped below a safe threshold.

LED 1 (Pill Drop Indicator)

When a pill is dropped successfully, this LED illuminates, providing the user with visual proof. To let the user know when the pill is ready to be taken, it cooperates with the buzzer and IR sensor 1.

LED 2 (No Cup Indicator)

When the system determines that no cup is positioned beneath the dispenser, this LED turns on. It acts as a visual cue to the user to set down a cup before the water is poured by the system.

Buzzer

Several system events are given audio feedback by the buzzer. The device emits a beep when the system is turned on, when the tank is empty of water, when the cup is absent during the distribution of pills, or after a pill has been dropped successfully, and not taken yet.

Start Button

The user loads pills into the wheel and then presses this button. By pressing it, the countdown to the first pill dispensing attempt begins, the trap door closes, and the system cycle begins.

Reset Button

To manually restore the system to its initial configuration, use the reset button. If there is a malfunction, or the user wants to reload pills into the system, this is quite helpful.

Voltage Regulator

This part makes sure that the circuit as a whole gets a steady 5V power source. It is essential for shielding delicate parts from voltage spikes, like sensors and the microprocessor.

Flowchart

The Smart Pill Dispenser with Water System's operational logic is depicted in the flowchart figure 1. It shows the order in which the system operates, from initialization to the dispensing of pills, the pouring of water. This covers decision points including cup presence, water availability, and pill detection. In order to ensure proper operation flow and simple troubleshooting or future upgrades, the flowchart helps make clear how each component interacts logically.

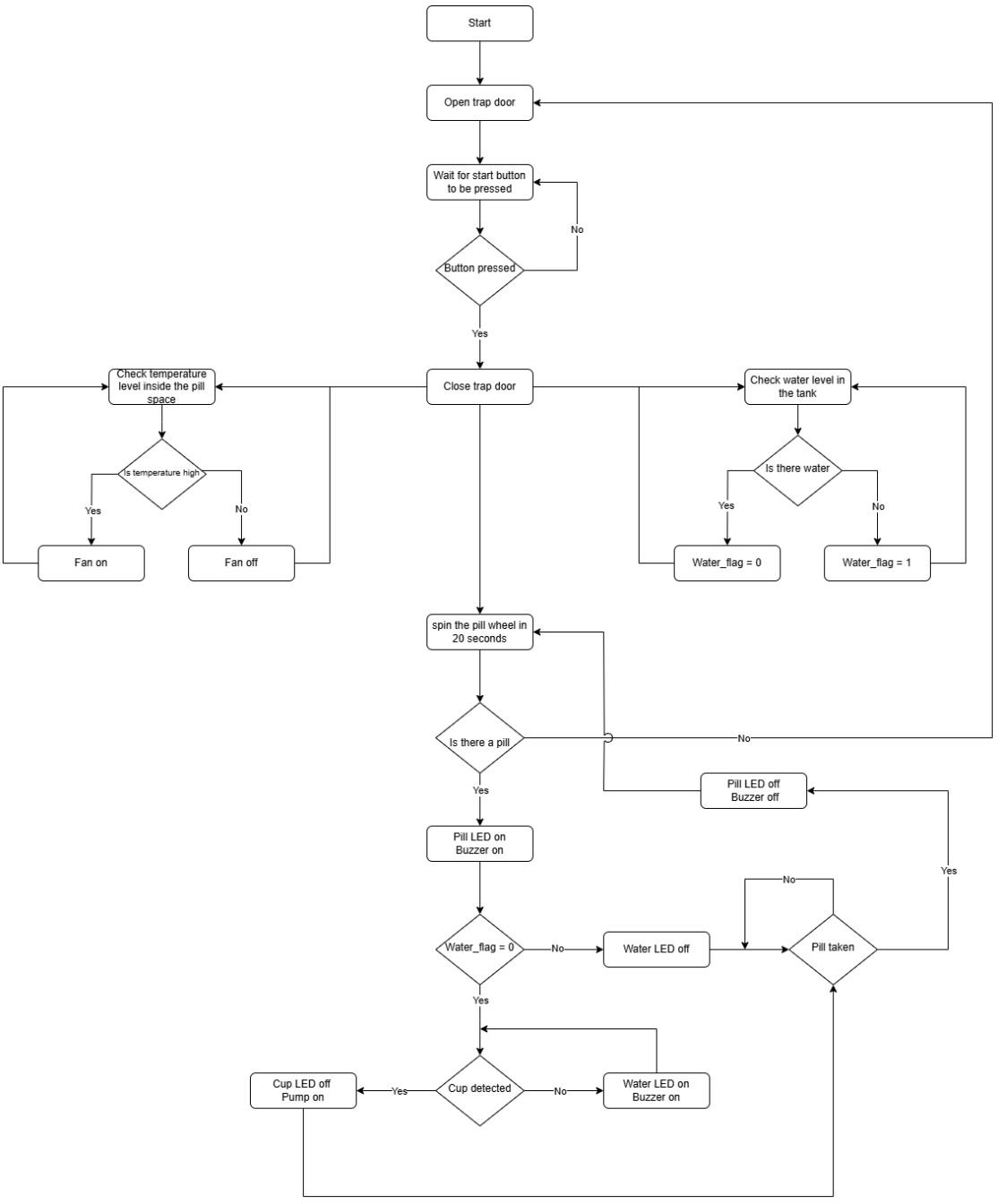

Figure 1. Flowchart

Electrical Design

All component connections, power supply regulation, and control signals are all part of the system's electrical architecture. This schematic shows the connections between the microcontroller and the power management components (voltage regulator, relay, battery), output devices (LEDs, buzzer, servo, motors), and input sensors (IR, ultrasonic, temperature). Relays are used to isolate high-current devices, and the microcontroller and sensors are kept at safe voltage levels. The schematic makes it easier to see how all of the hardware used in the project is arranged both logically and physically.

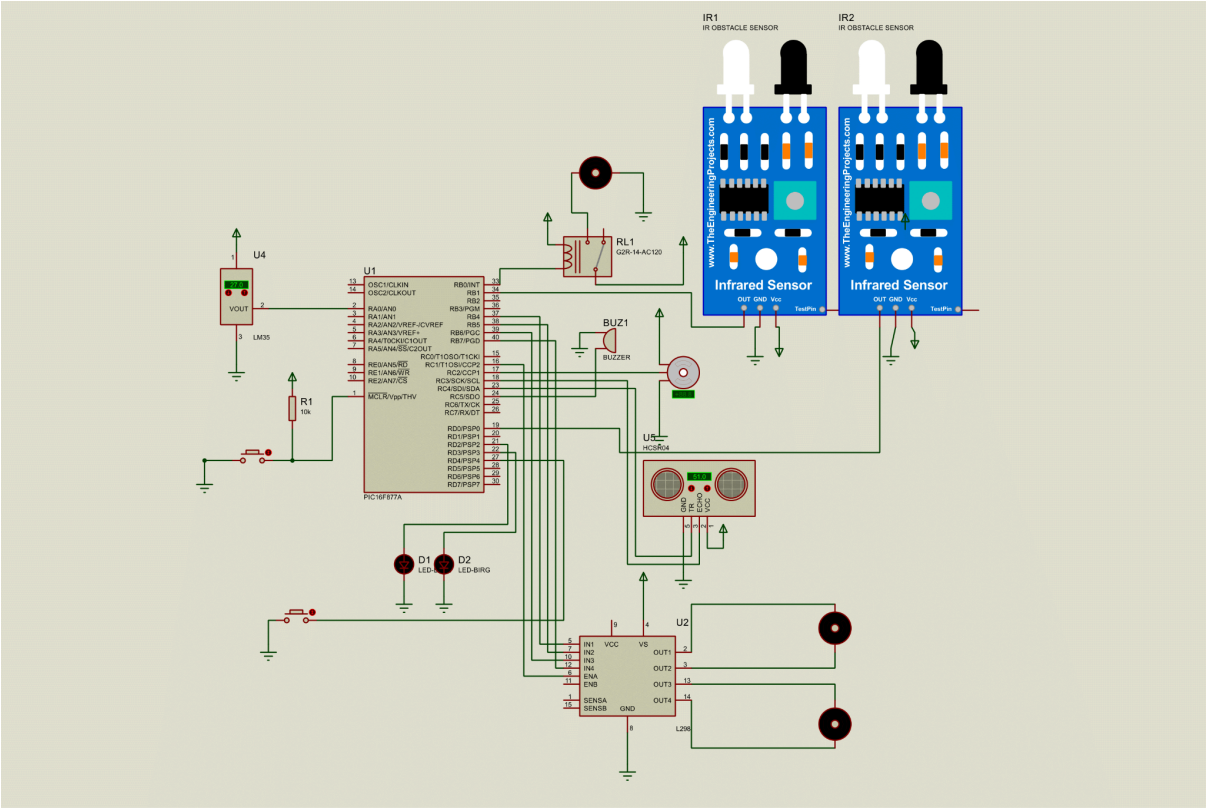

Figure 2. Electrical Design

Mechanical Design

The Smart Pill Dispenser with Water System is shown physically in the layout design in figure 3. And the laser cut design in figure 4, done using AutoCAD. Understanding the practical implementation, user interface points, and the spatial organization of internal components for effective operation and maintenance is made easier with the aid of this visual reference. The design's user-friendliness is also reflected in the arrangement, which makes sure that water dispensing, and pill loading are simple and convenient.

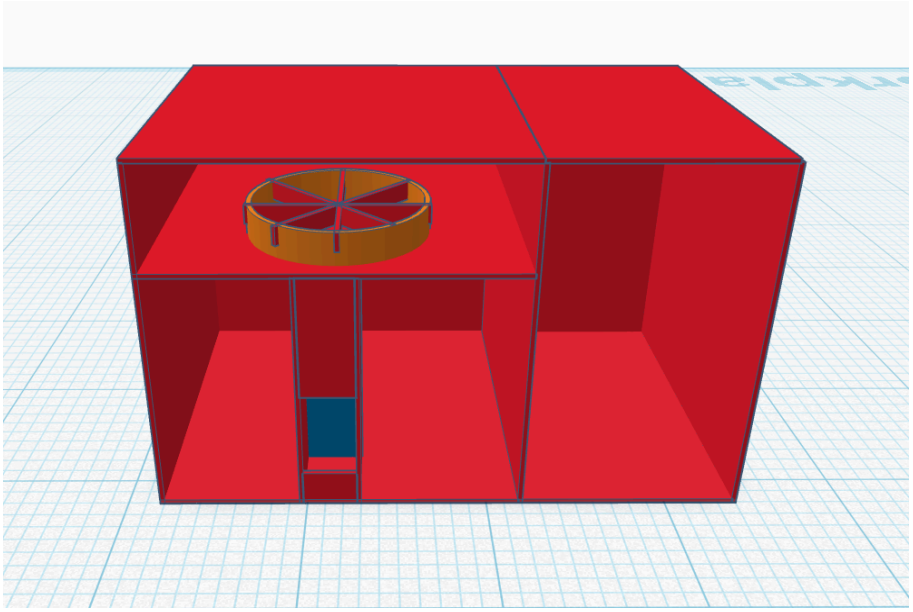

Figure 3. Smart Pill Dispenser Layout Design

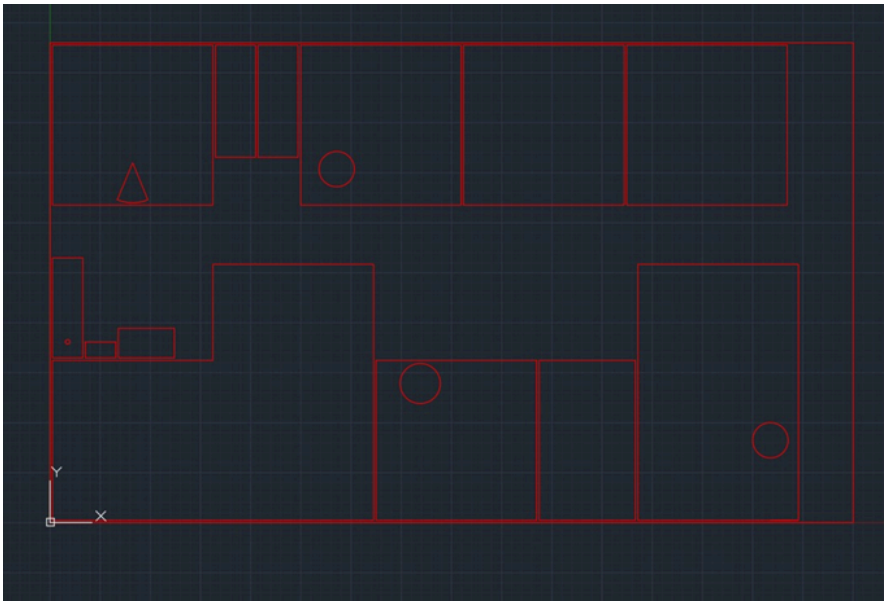

Figure 4. Laser Cut Design.

Security and Safety Features

- **Buzzer Alerts:** Audible notifications of serious mistakes (no cup, no water, system start).
- **LED Indicators:** Visual confirmation of cup presence and pill drop status.
- **Temperature Control:** If the temperature falls below a certain point, the system detects it and turns on the fan.
- **Water & Cup Checks**: Stops dispensing if the requirements are not fulfilled.
- **Trap door reset:** If the pill compartment is empty, the trap door reset stops it from spinning.

Challenges Faced

- **Sensor Calibration**: Ensuring precise and dependable detection from infrared and ultrasonic sensors.
- **Power management:** which includes controlling component voltage and separating high-power elements (motor, relay) from logic circuits.
- **Motor time:** Coordinating the time of the pill wheel spin.
- **False Positives:** Preventing IR sensor misreads brought on by interference from ambient light.

Conclusion

The Smart Pill Dispenser with Water System project offers a dependable and easy-to-use way to automate the taking of medications. It makes sure that consumers only receive medicines and water when all the conditions are right by integrating sensor feedback, actuator control, and safety alerts. This invention is very helpful for busy people, elderly patients, and healthcare environments. Wireless connectivity can be included into future developments to enable remote reminder and monitoring systems.

References

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