CSE360: Computer Interfacing
Project Report

SanitiServe: A Sanitary Napkin Dispenser with Auto Refill Signal

Lab Section: 05
Group: 04

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Abstract: "SanitiServe," the focus of this project, presents the design and guidance of an automated sanitary napkin dispensing system aimed at improving user convenience. Again, the system's primary function is the on-demand dispensing of individual sanitary napkins, achieved basically by a servo motor meticulously guided by an Arduino microcontroller, and to ensure uninterrupted service, an integrated infrared (IR) sensor continuously detects the internal napkin stock. Findings that the stock has fallen below a predefined threshold level, the Arduino activates a clear observer alerting displayed on a Liquid Crystal Display screen, prompting a timely showcase. Besides, the system employs a simple yet effective digital signal from the IR sensor for stock level assessment and utilizes. The successful completion of this project is expected to yield a functional prototype demonstrating reliable dispensing mechanics coupled with an efficient low-stock alert system, providing a tangible solution for maintaining hygiene supplies in various settings. The project effectively showcases the interfacing capabilities of a microcontroller with Arduino diverse peripherals, including sensors for input, actuators for mechanical action, and display units for user feedback, resulting in a user-friendly automated device. Implementation prioritizes the accuracy of the dispensing mechanism and the dependability of the alerting system, establishing an environment for future improvements in automated discovery handling for an essential, useful environment.

2. Introduction

Problem Statement: The supply of sanitary napkins is often difficult due to manual checks and outdated dispensers, which can guide shortages and hygiene concerns. The main goals to address the issue by presenting an automated system that dispenses napkins and sends alerts when supplies run low.

Objectives:

● To implement an automated sanitary napkin dispensing mechanism using an Arduino microcontroller and a servo motor and integrate an IR sensor monitor the level of sanitary napkins within the dispenser.

● To develop a low-stock alert system that displays a message on an LCD screen when the napkin level falls below a defined threshold. Besides establish accepted communication between the IR sensor, servo motor, and LCD screen via the Arduino microcontroller.

● Again, create a functional prototype demonstrating the integrated dispensing , alert functionalities, and the combination of each other.

Significance: The "SanitiServe" project presents a smart, affordable way to manage the availability of sanitary napkins in shared spaces. Its automated dispensing system makes access quick and simple for users, while built-in low-stock alerts help ensure timely restocking, minimizing the chances of the dispenser running empty. Aside from this, the solution is versatile and can be applied very well in various situations such as schools, colleges, malls, offices, and hospitals. By streamlining both monitoring and maintenance through automation, *SanitiServe* not only uses hygiene standards but also reduces the burden on cleaning and facility staff. Additionally, the integration of sensors, actuators, and user interfaces in this system serves as a strong foundation for updating the same automated inventory management and important tools, extending its usefulness beyond sanitary napkins to other important supplies in public and private situations.

3. Interfacing Design

Interfacing Components:

● **Arduino Uno:** The central processing unit that controls the entire system it receives input from the IR sensor, controls the servo motor for dispensing, and manages the display on the LCD screen.
● **Servo Motor:** An actuator responsible for the mechanical dispensing of a single sanitary napkin upon receiving a signal from the Arduino.
● **IR Sensor (Reflective Type):** Used to detect the presence or absence of sanitary napkins at a certain level within the dispenser. A change in the reflected infrared light indicates a change in the stock level.
● **LCD Screen (16x2):** A display unit used to show the low-stock alert message to users or maintenance personnel.
● **Connecting Wires:** Used to establish electrical connections between the Arduino, sensor, servo motor, and LCD screen.
● **Power Supply:** Provides power to the Arduino and other equipment.

System Circuit Diagram:
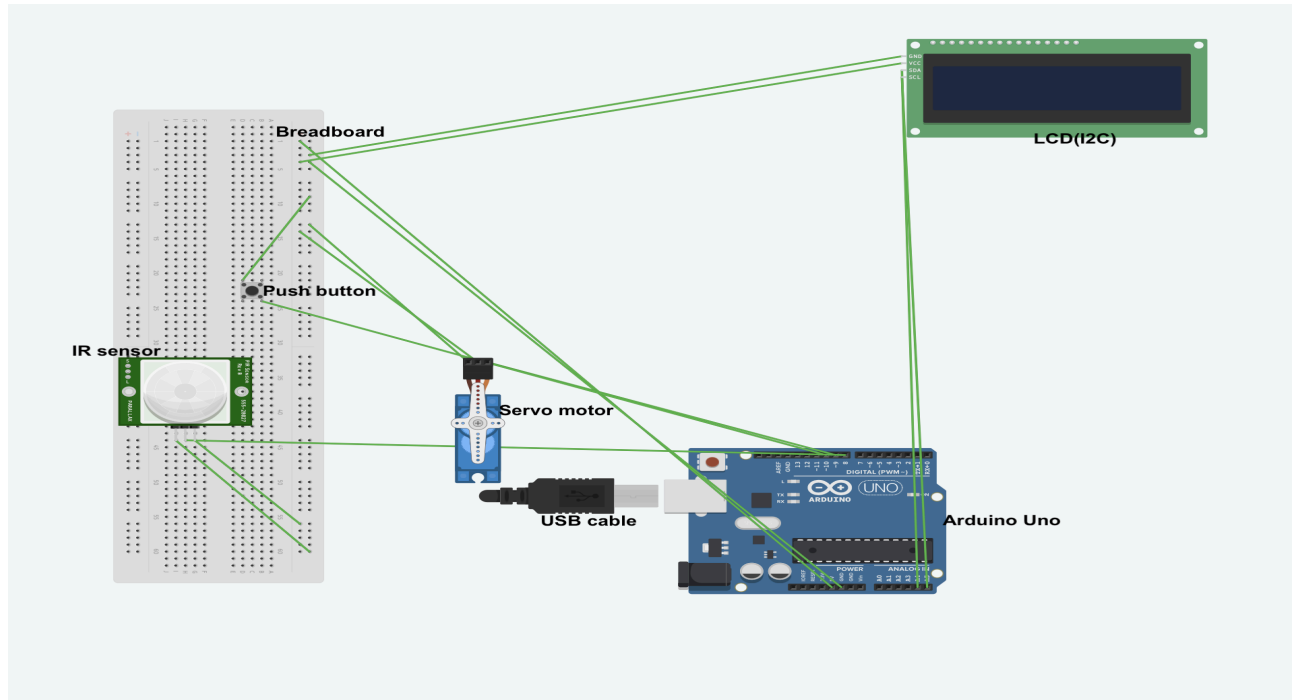
Interfacing Challenges:

- **IR Sensor Signal Integrity:** Susceptible to dust, surface variations, and ambient light.
- **Solution:** Thresholding, averaging, strategic placement, and shielding.
- **Precise Servo Control:** Requires accurate angle and speed for single napkin dispensing.
- **Solution:** Can be maintained with Arduino code.
- **Dispensing and Alert Synchronization:** Low-stock detection must precede empty state.
- **Solution:** Strategic sensor placement and effective Arduino logic for timely alerts.
- **Power Management:** Stable and sufficient power is critical for all components.
- **Solution:** Select an appropriate power source with adequate capacity and regulation.

4. Communication Protocols

Protocol Selection:

- **Digital Input/Output (GPIO):** Used for communication between the IR sensor and the Arduino. The IR sensor will likely output a digital signal (HIGH or LOW) indicating the presence or absence of napkins at the detection point.
- **Inter-Integrated Circuit (I2C):** Used for communication between the Arduino and the 16x2 LCD screen. This two-wire protocol allows for efficient communication using only two pins (SDA and SCL).

Protocol Justification (Short, Precise, and Accurate):

- **GPIO for IR Sensor:** Simple digital output from the IR sensor efficiently interfaces with Arduino's digital input for basic stock level detection; high data rates are unnecessary.
- **I2C for LCD:** The I2C protocol provides a simplified wiring interface for the LCD, reducing the number of pins required on the Arduino and making the circuit cleaner and more manageable, especially for displaying simple text alerts.

5. Implementation Plan

Methodology:

Pseudocode:

BEGIN

INCLUDE Servo library

INCLUDE Wire library (for I2C)

INCLUDE LiquidCrystal_I2C library

CREATE a servo object named "myservo"

SET buttonPin to 10

SET irPin to 8

SET lastButtonState to HIGH

SET isAtZero to TRUE

INITIALIZE LCD at I2C address 0x27 with 16 columns and 2 rows

FUNCTION setup:

ATTACH myservo to pin 9

SET myservo to 0 degrees

CONFIGURE buttonPin as INPUT with pull-up

CONFIGURE irPin as INPUT

 INITIALIZE LCD

TURN ON LCD backlight

SET LCD cursor to (2, 0)

DISPLAY "System Ready" on LCD

FUNCTION loop:

READ irSensor value into irState

IF irState is LOW THEN

CLEAR LCD

SET LCD cursor to (2, 0)

DISPLAY "Please Refill"

WAIT for 1 second

RETURN (skip rest of loop)

READ button state into buttonState

IF lastButtonState is HIGH AND buttonState is LOW THEN

IF isAtZero is TRUE THEN

SET servo to 180 degrees

SET isAtZero to FALSE

ELSE

SET servo to 0 degrees

SET isAtZero to TRUE

ENDIF

CLEAR LCD

SET LCD cursor to (1, 0)

DISPLAY "Please Collect"

SET LCD cursor to (4, 1)

DISPLAY "Your Pad"

WAIT 2 seconds

CLEAR LCD

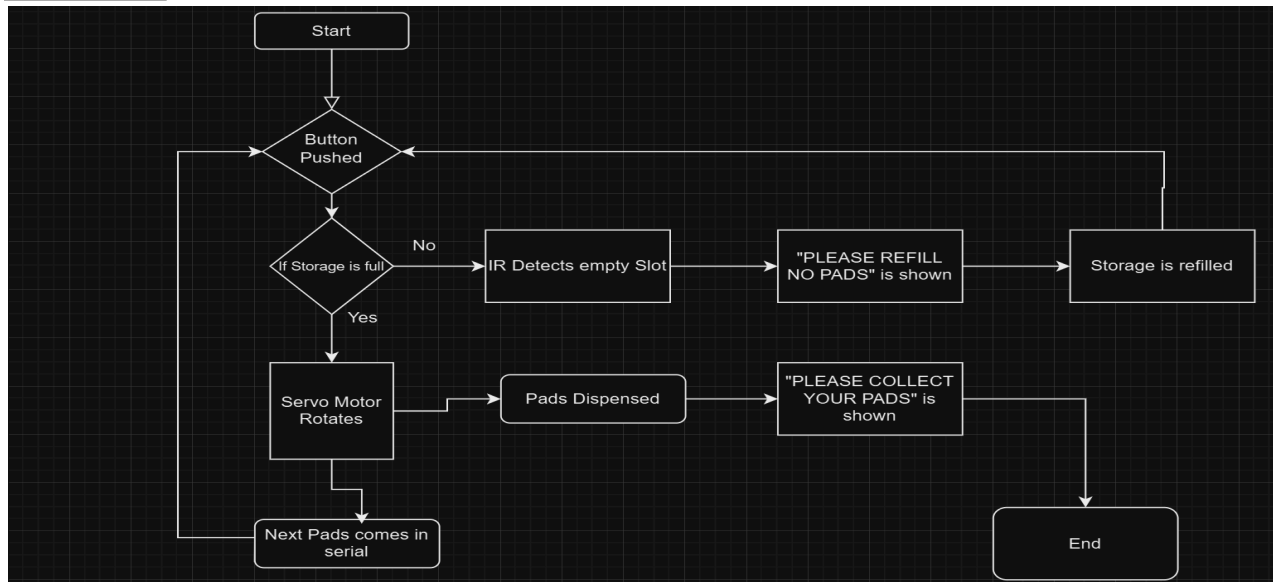SET LCD cursor to (2, 0)

DISPLAY "System Ready"

WAIT 200 milliseconds (debounce delay)

ENDIF

UPDATE lastButtonState with current buttonState

END LOOP

Flowchart:

Expected Outcomes:

- **Automated Dispensing:** The servo motor will reliably dispense a single sanitary napkin upon a user-initiated request (simulated by a button press in the current code).
- **Accurate Stock Monitoring:** The IR sensor will effectively detect when the napkin level falls below the predefined threshold.
- **Clear Low-Stock Alert:** The LCD screen will display a clear and timely "LOW STOCK!" message when the napkin supply needs to be replenished.
- **Functional Prototype: An** Operational prototype will be developed, showcasing the seamless integration of the Arduino microcontroller with an IR sensor, servo motor, and LCD screen.
- **Reliable Interfacing:** Communication between all hardware GPIO pins,
- and the parallel interface for the LCD, resulting in a smoothly functioning and dependable system.

6. Future Work and Potential Applications

Future Improvements:

- **User Interface Enhancement:** A physical push-button or a contactless sensor gives users a simple and hygienic way to activate the dispenser.

- **Remote Monitoring:** Wireless communication technologies like Wi-Fi or Bluetooth enable the dispenser to send automatic low-stock notifications to a central system.
- **Inventory Management:** Allows the system to monitor the number of napkins dispensed over time and estimate optimal refill intervals.
- **Dispenser Mechanism Refinement:** The mechanical design of the dispensing unit can result in more consistent and jam-free operation the overall reliability.
- **Power Optimization:** Energy-saving features, such as low-power operational modes, are crucial for battery-powered systems.
- **Integration with Payment Systems:** In public or commercial setups, embedding digital payment options, such as card readers or mobile payment interfaces

Applications:

- **Public Restrooms:** Convenience and hygiene in restrooms located in schools, colleges, and universities by ensuring sanitary napkins are easily accessible at all times.
- **Workplaces:** Facilitating seamless access to sanitary napkins for employees, fostering a more inclusive, comfortable, and supportive environment.
- **Healthcare Facilities:** The consistent availability of sanitary products contributes to better hygiene standards in clinics, hospitals, and medical centers.
- **Educational Institutions:** Meeting the hygiene needs of students by making sanitary napkins readily available in restroom facilities across schools, colleges, and universities, promoting health and dignity.
- **Community Centers:** Hygiene support in community-accessible spaces, ensuring that sanitary napkins are available to individuals who may not have access elsewhere.

Reference:

Kumar, A., & Sharma, R. (2010, June 1). *The design of a medical electronic dispenser*. IEEE Conference Publication. https://ieeexplore.ieee.org/document/5535478

Roy, A., Roy, S., & Das, D. (2024, April 18). *Combined model of incineration and dispenser for sanitary napkins*. IEEE Conference Publication. https://ieeexplore.ieee.org/document/10559302