BRAC UNIVERSITY

CSE461: Introduction to Robotics

Lab Project Report

Title: *Automated Sanitizer and Mask Dispensing Robot*

Group_No : 02
Section : 02

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DATE : 02. 01.2026

Abstract :

This project is aimed at creating the Automated Hygiene and Mask Dispensing Robot that will improve the safety of the population due to absence of any human contact. The primary goal is the identification of approaching users and the automatic dispensing of hand sanitizers and masks. The Arduino Uno , PIR sensor and ultrasonic sensor are used to sense human movement and measure distance , IR proximity sensors and actuators, i.e., a sanitizer pump and a dc motor are used to dispense masks and sanitizer. There is a 16x 2 LCD screen, which takes the user through the procedure. The operations are all automated, hygienic as well aimed at avoiding repeated triggering.

The prototype can show a valid low-cost, cost-effective solution applicable in crowded social places. Sustainably, it would promote improved physical hygiene practices, minimize physical contact with communal surfaces and provide practical way to individual health in resource-constrained areas, such as Bangladesh.

Keywords :

Microcontroller, Automation, Embedded Systems, Public Health, Contactless Technology.

1. Introduction

Most individuals come across the same surfaces daily in places like universities, libraries, hospitals, and offices among others. This exposes people to more chances of transmitting diseases, particularly during stages of flu outbreaks or pandemics. There should also be human contacts in the distribution of manual hand sanitizers and the distribution of masks and this may not always be hygienic and efficient.

This project proposal aims at designing and developing an automated, no-contact hygiene checkpoint robot which is able to:

- Sensing the presence of human.
- Auto dispense of hand sanitizer.
- On user request, giving face mask without physical contact.

The area covered by this project will be limited to a fixed prototype that can be used in building entry doors. It incorporates sensor, actuator, and a microcontroller to illustrate techniques of computer interfacing in real life, which include sensor integration, motor control and real time decision making with Arduino.The project is very applicable to Computer Interfacing since it will integrate the hardware and the software logic to form an automated smart system.

2. Related Work/ Inspiration :

In the context of the COVID-19 pandemic, automatic hand sanitizer dispensers and manual counters called mask distribution were present in many places of the general population. By some sophisticated systems, there was also the screening of temperature and facial recognition. Nevertheless, the majority of the existing systems:

- Give either mask or sanitizer.
- expensive and complex.
- Not built on an automatic robot (TexoBot, 2020)

The present project is based on such systems yet is different in a number of aspects:

- It is a unified device that comprises a sanitizer and mask dispensing.
- Includes low end, cheap parts.
- Contact-free operation .
- It fits in developing nations such as Bangladesh.

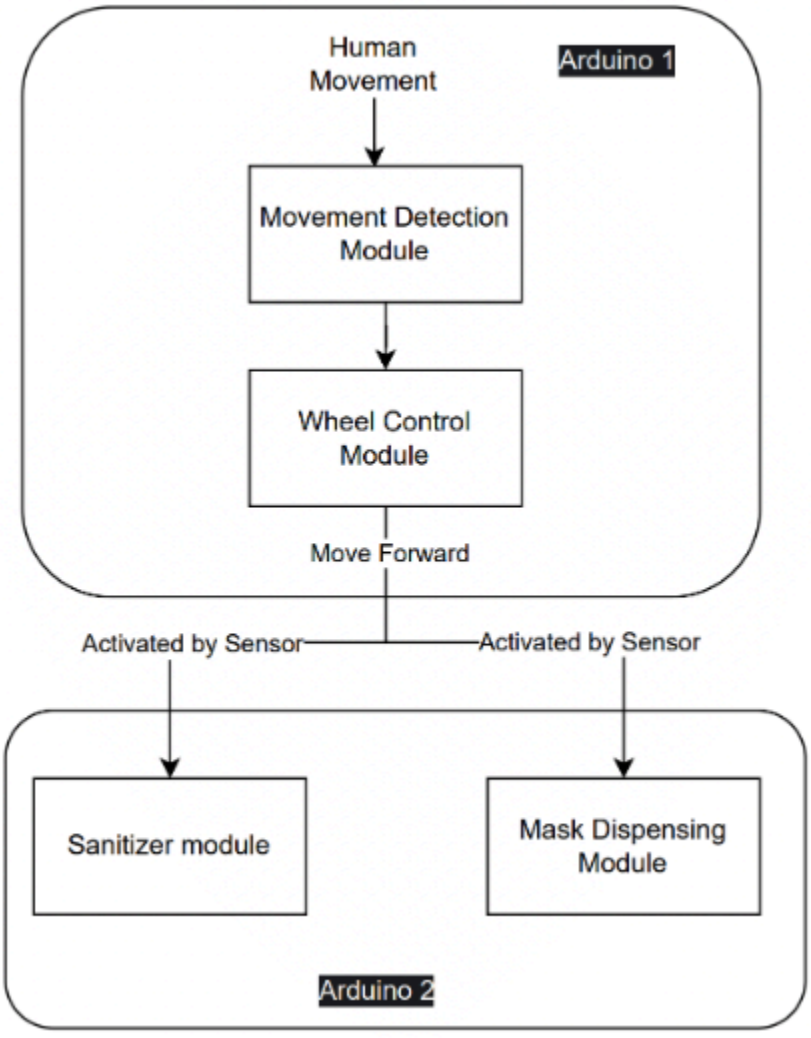
The system aims to address a real-life issue such as offering a cheap and easy to install hygienic system to overcome the crowding problem.

3. Technical Approach

☐ **System Architecture:**

Automated Sanitizer and Mask Dispensing Robot has been made as an embedded sensor-driven system with an Arduino Uno microcontroller. This system enables activation of the system using various sensors as inputs and actuators as outputs to make contactless.

An ultrasonic sensor detects an individual moving towards a specified distance. Upon this detection the Arduino lights up an LCD display (16×2) to display instructions. There are two IR proximity sensors that monitor the hand gestures, one of them being the dispensing of sanitizers and the other being the dispensing of masks. Delay logic is applied so that there is avoidance of repetitive triggering.



☐ **Components Used:**

Hardware Components:

- **Arduino Uno R3- primary controller.**
- **Ultrasonic Sensor (HC-SR04) -user sense.**

- **IR Proximity sensors (2) - gesture recognition.**
- **5 V Submersible Pump - sanitizer releasing pump.**
- **Servo Motor (SG90) -mask dispensing.**
- **16×2 LCD Display – user guidance**
- **18650 Battery**
- **jumper wires**
- **breadboard.**

Software Tools:

- **Arduino IDE -programming and uploading codes.**
- **Arduino and embedded C program language.**

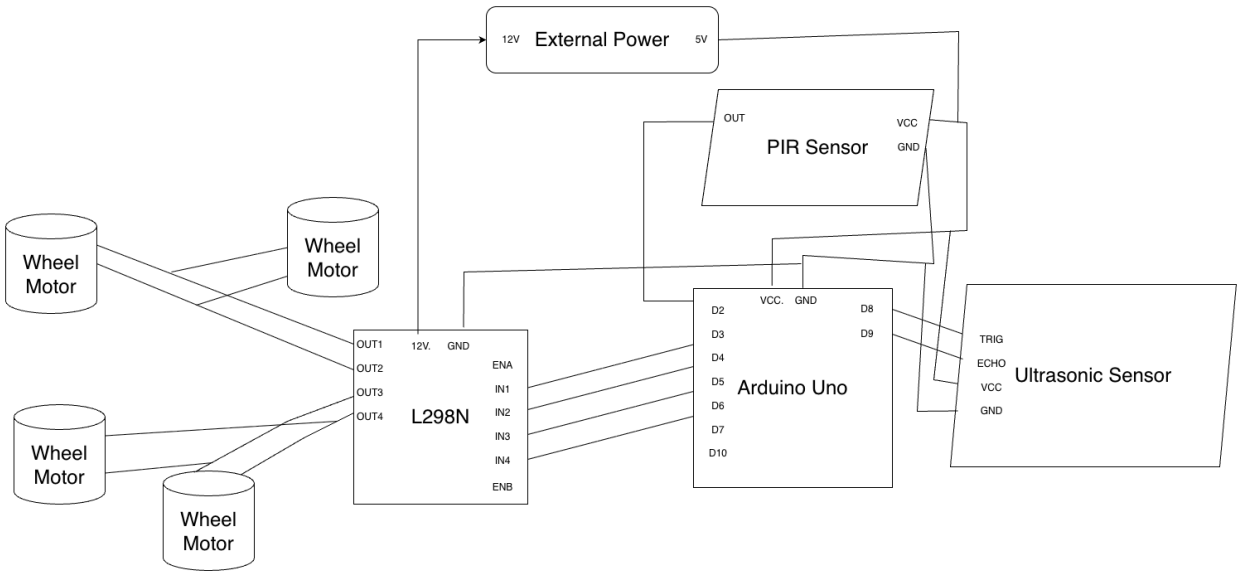
☐ **Cost Breakdown:** Components Unit Cost Total (in **BDT/TK**):

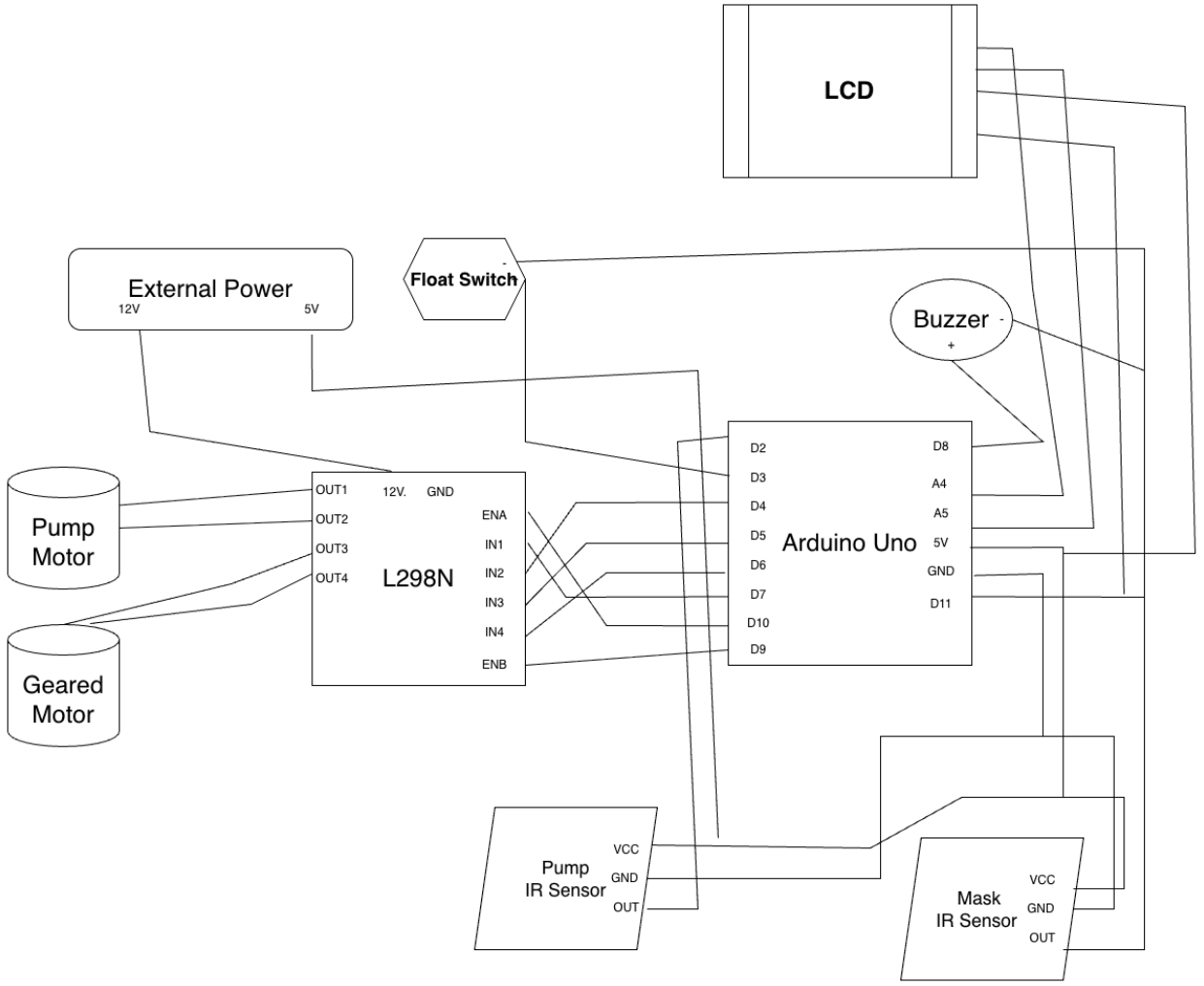
Component Name	**Quantity**	**Unit Price (TK)**	**Total Price (TK)**
Arduino	2 pcs	900	1,800
L298N Motor Driver	2 pcs	450	900
LCD Monitor (I2C Module)	1 pc	500	500
IR Sensor	2 pcs	150	300
DC Motor	6 pcs	—	300
Car Chassis	1 pc	1,400	1,400

PIR Sensor	1 pc	480	480
Ultrasonic Sensor	1 pc	450	450
Wheels	5 pcs	—	350
Cardboard	—	—	250
Spring	—	—	100
Battery	6 pcs	—	600
Battery holder module	3pcs	—-	350

Grand Total Cost = 8180 TK

- ☐ **Circuit/Schematic:**


12V
External Power
5V
OUT
PIR Sensor
VCC
GND
Wheel Motor
Wheel Motor
Wheel Motor
Wheel Motor
OUT1
OUT2
OUT3
OUT4
12V.
GND
ENA
IN1
IN2
IN3
IN4
ENB
L298N
VCC.
GND
D2
D3
D4
D5
D6
D7
D10
D8
D9
Arduino Uno
TRIG
ECHO
VCC
GND
Ultrasonic Sensor


LCD
External Power
12V
5V
Float Switch
-
Buzzer
-
+
Pump Motor
Geared Motor
OUT1
OUT2
OUT3
OUT4
12V.
GND
ENA
IN1
IN2
IN3
IN4
ENB
L298N
D2
D3
D4
D5
D6
D7
D10
D9
D8
A4
A5
5V
GND
D11
Arduino Uno
Pump IR Sensor
VCC
GND
OUT
Mask IR Sensor
VCC
GND
OUT

☐ **Functionality:**

Functions

1: User Detection:

- **Ultrasonic sensor picks up a human being when within 1 meter.**
- **LCD screens: The screen Displays thorough information about mask and Sanitizer. Also compiles the amount of masks dispensed per day.**

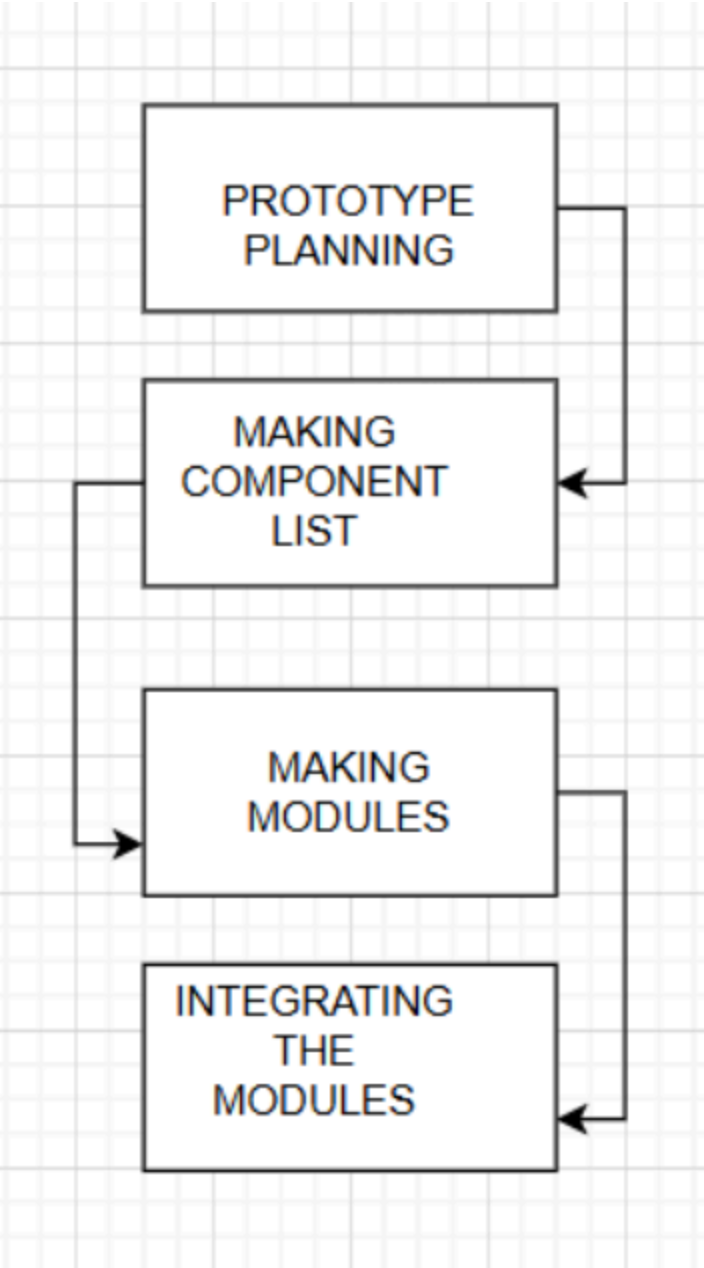
2: Sanitization Dispenser.

- **hand detected by IR sensor.**
- **Pump turns ON for 1.5 seconds**
- **Delay of system activation is 3 seconds.**

3: Mask Dispensing

- **IR sensor identifies hand wave in proximity of mask slot.**
- **DC motor rotates over a duration of time**
- **There is the paddle mechanism, which leaves one mask out.**

☐ **workflow diagram :**



☐ **Challenges:**

- **False sensor triggering: solved with delays.**
- **Most of the liquid flow is controlled → timed by regulating pump.**
- **problem with mask jamming problem resolved through mere mechanical design.**
- **power stability 5V supply correct = ensured.**

4. Sustainability & Impact :

☐ **Sustainability :**

- Uses low power components
- May be supplied with rechargeable batteries.
- Less wastage through measure dispensation of sanitizers.

☐ **Impact :**

- Enhances social hygiene education.
- Limits spreading of diseases.
- Applicable in universities, offices, hospitals.
- Appropriate to the Bangladesh budget and the environment.

☐ **Future Work :**

- Add temperature sensor
- Add IoT monitoring
- Solar power integration
- Mobile alert system

☐ **Limitations:**

- Stationary system only
- Limited sanitizer capacity
- No multiple mask authentication.

5. Results & Discussion :

- **Testing Setup :**

The Automated Hygiene & Mask Dispensing Robot was put in an indoor setting that resembled a building entrance. The modules of the system were tested individually and finally, they were

tested as an integrated system. Several experiments were also done to test accuracy, response time, and reliability.

- **Experimental Results :**

Table 1: Actuator and Sensor Performance :

Test Parameter	Expected Outcome	Observed Result
Range of Ultrasonic sensor detection	≤ 1 meter	Detected users within 80–100 cm
Response of IR sensor	detect hand gesture	Accurate hand detection
Pump activation time	1.5 seconds	Consistent (±0.1 s)
IR sensor response (mask)	Detect hand gesture	Accurate hand detection
Servo rotation angle	180°	Correct rotation
LCD message display	Show instructions	Displayed correctly

- **System Accuracy Test:**

The functionality was tested 10 times each.

Table 2: System Functionalities Success :

Functionality	Successful Attempts	Total Attempts	Accuracy
User detection	9	10	90%
Sanitizer dispensing	10	10	100%
Mask dispensing	9	10	90%

☐ **Response Time Analysis:**

- Approx time of user detection: less than one second.
- Delay of the dispensing of the sanitizer: 1.5s.
- Dispensing time of the masks: about 2 seconds.
- System reset delay: 3 seconds

Response time was not very slow that it could be used in a public area with delays to the user. Based on the experimental outcomes, the system was able to achieve all the objectives of the project successfully. The ultrasonic sensor was able to identify the users at the desired distance with accuracy in order to show the instructions in time. The IR sensors ensured hand detection without any contacts, thus, making the sanitizers hygienic and the dispensing design ensured a consistent level of liquid, which minimized wastage. Most of the trials were successful with the mask dispensing system, and there were small failures due to improper arrangement of the masks not due to electrical problems. The minor errors can be corrected through superior sensor calibration and mechanical refinements, however, the system is adequate within the range of the work.

In general, the findings prove that the robot is:

- Reliable
- Low-cost
- Efficient
- Available to serve in public hygiene.

The small errors can be corrected with the help of improved calibration of the sensors and mechanical fine tuning, though the system shows a good performance within the frame of the project.

6. Conclusion :

The project managed to design and build an Automated Hygiene and Mask Distributing robot based on arduino and sensor collectively automation. The system was found to be contactless, inexpensive and dependable.

The project underlines the significance of sustainable automated public health solutions, and how computer interfacing may address issues in the real world. The system can be registered to large scale deployment with additional enhancements.

7. Contribution

Name	ID	Role(s) / Responsibilities	Specific Contributions
Fabiha Kazi	22101435	Documentation & Report Lead	● Developed the entire project documentation, which consists of abstract, introduction, related work, methodology, results, discussion and conclusion. ● Formatted and arranged the lab report format based on the CSE461 requirements and standards of the essay. ● Theory and practical Developed and launched the mechanical round-shaped mask dispensing mechanism, which helped to release the masks smoothly ● Helped in Arduino coding and logic implementation especially at testing and integration stages.
MD. Abu Tarabin Surzo	22101349	Project Lead & Coordinator	● Served as the overall project leader where he/she provides overall direction, planning and coordination of the project lifecycle. ● Established project goals, viability and implementation plan, which the team will use to act and implement the system. ● Integrated work between the team member and made sure that all was in order with timely completion and

			integration of hardware, software and documentation. ● Helped in solving problems and making choices in cases of design and implementation issues. ● Verified alignment of project objectives, technical project implementation, and course specifications.
Shadman Salif Swanan	22101573	Hardware connection setup and physical design	● Fined all hardware connections, including wiring between the Arduino Uno, the ultrasonic sensor, PIR sensor, and IR proximity sensors, LCD, sanitizer pump, motor driver, motor motor, power modules. ● Helped in mechanical adjustment of the mask dispensing machine to minimize jamming and guarantee balanced single mask output. ● Carried out hardware level debugging, troubleshooting and problem solving of problems like loose connections, misplaced sensor activation and non-reliable actuator behavior.
SM Azmain Faysal	22101576	Software Setup and Intermediate connection of software and hardware.	● Coded the Arduino software, sensor reading, decision, and control of the actuators in sanitizers and masks dispensing.

			• Combined the ultrasonic sensor, PIR sensor, IR sensors with LCD display, pump, and motor control logic to one unified software. • Apply timing controls and time delay to eliminate false triggering to provide a safe and reliable operation. • Accomplished software level debugging and testing, logic refinement upon observed system behavior. • Created the project poster, which graphically displays the system concept, elements, workflow, and results in a neat and impressive way.
MD. Raiyan Uddin	21301613	Senior Systems Architect and Research.	• Architected the high-level system architecture of the Automated Sanitizer and Mask Dispensing Robot, including what various sensors, actuators, controller, and display do to each other to make up a complete system. • Research and selection of the components and the conduction of comparisons on the alternatives of sensors, motors, pumps, and display modules to select the hardware preferable and cost effective under Bangladesh environment.

			• Measured viability, cost, and sustainability elements, aiding in defining the final list of components and project scope in general. • Helped the team by outlining constraints and areas of future enhancement as determined in the research and current reflection on the related work.

References

TexoBot. (2020, August 28). *Automatic mask and sanitizer dispenser using Arduino || DIY || TexoBot* [Video]. YouTube. https://www.youtube.com/watch?v=H_RXfDeFDbw