Ahsanullah University of Science & Technology
Department of Computer Science & Engineering
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CSE 3118
Microprocessors and Microcontroller Lab

Project Report

Project Name: ECODROP (A REVERSE VENDING MACHINE)

Submitted To

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Project Overview:

A **reverse vending machine (RVM)** is a smart machine for plastic and metal waste disposal systems which accepts plastic wastes (bottles) and metal (cans) for recycling. It is designed to encourage recycling by providing incentives for returning empty beverage containers. The reverse vending machine is equipped with a proximity sensor to distinguish between different kinds of bottles.This invention relates in general to waste management and recycling the plastic and metal waste (bottles) in the environment. The littering of plastic wastes in the environment and less willingness to recycle the plastic presents a continuing problem to the environment and to all living beings.

Social & Economic Benefits:

The designed Reverse Vending Machine EcoDrop can be a potential solution to minimize the plastic waste and improve the plastic waste management and recycling system. Here are some potential social values attributed to Reverse Vending Machine:

- **To the Environment :** This will help the environment as one of its major problems is the rate of plastic waste used by humanity and this study is a big help for the environment as plastic waste is not soluble in water .

- **To the Community:** This initiative will help the community reduce the negative environmental impacts caused by the excessive amount of plastic waste. It will enhance the effectiveness of waste segregation and recycling in addressing waste-related environmental problems, ultimately leading to better control over waste collection in the community.

- **To the Researchers:** This will engage their intellectual creativity in designing machines and enhance their knowledge, allowing them to apply the acquired learning and information from this study in the future or even in their daily lives.

- **To the Economy:** By diverting beverage containers from landfills or incineration facilities , **RVM** helps to save on waste management costs. Landfill space is conserved and the costs associated with waste collection, transportation and disposal are reduced.

Tools And Machines:

These following parts and tools have been used for building this project:

- Arduino Mega
- Buzzer
- Proximity Sensor
- Ultrasonic Sensor
- Micro-servo Motor
- LED
- LCD
- Breadboard
- Potentiometer
- Jumper wires
- Wi-Fi Module

Apps and Platforms:

- Arduino IDE

Working Procedure:

A Reverse Vending Machine is a device that accepts used beverage containers (the reverse of the typical vending cycle). The machines are popular in places that have mandatory recycling laws or container deposit legislation. The basic operations involve steps where the recycler places the empty bottle/can into the receiving aperture; the horizontal in-feed system allows the user to insert containers one at a time. The bottle/can is then automatically scanned with the help of the sensors.
The system workflow of the Reverse Vending Machine (RVM) is:

Step 1: Power On and Initial Setup

- Power on the Arduino Mega.
- The **LCD** will display a message like “Please Use Me”.
- The system will be in standby mode, waiting for a bottle to be placed near the proximity sensor.

<u>Step 2:</u> Detecting the Bottle

- **Proximity Sensor & Ultrasonic Sensor**: The proximity sensor and ultrasonic sensor will continuously check for the presence of an object (bottle/can) placed near the machine. If both the proximity sensor and ultrasonic sensor detect an object, the metal detection part will open. If the proximity sensor does not detect an object but the ultrasonic sensor does, the plastic detection part will open.
    - Once the sensor detects the object, it sends a signal to the Arduino Mega.
    - The Arduino Mega will trigger the next step of measuring the object.

<u>Step 3:</u> Feedback to User

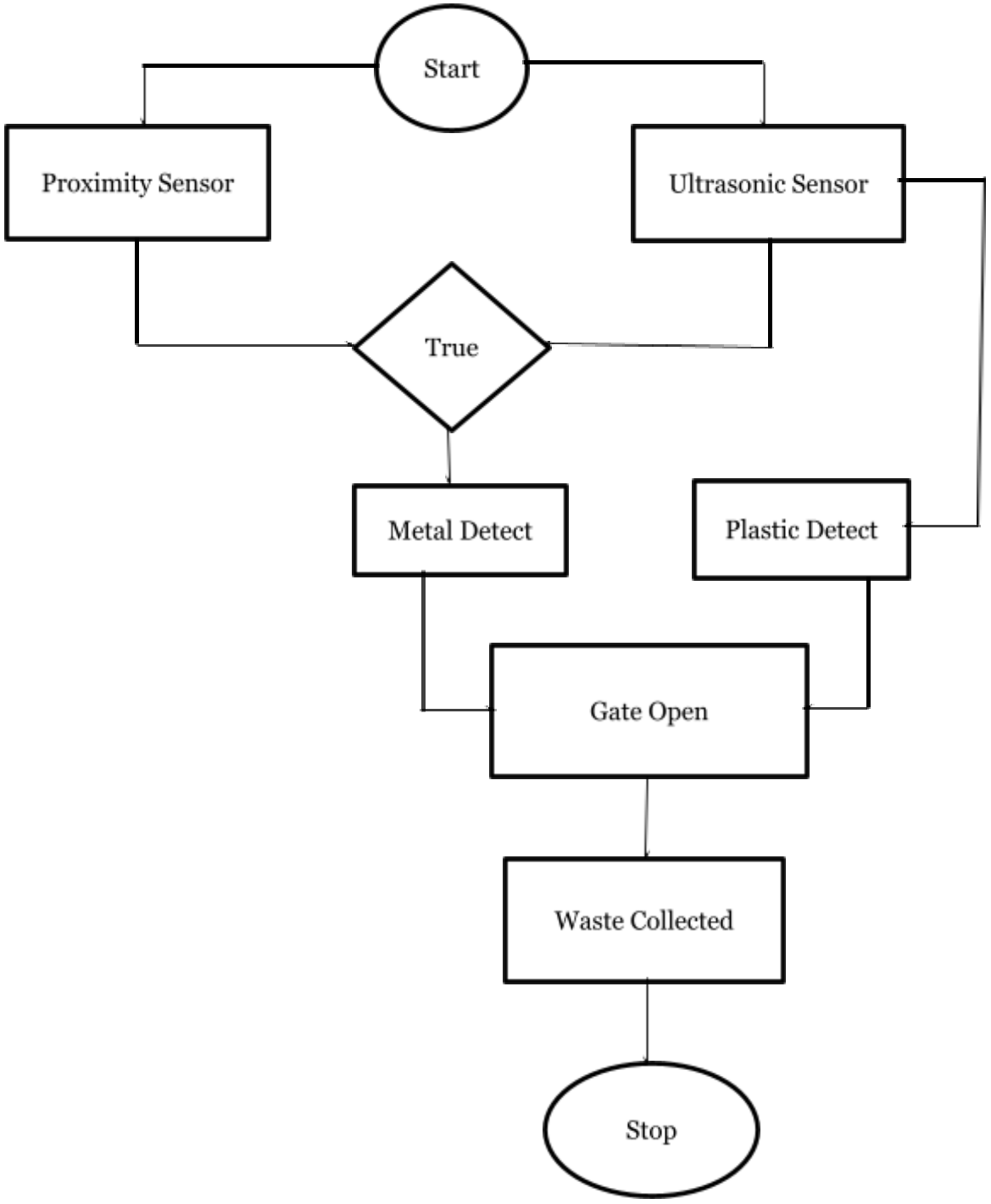
- If the object is accepted:
    - The **buzzer** will briefly beep as confirmation.
    - The **LCD** will display a message such as “Metal Detected” or “Plastic Detected”.
    - The **servo motor** will rotate, opening a small gate, allowing the bottle to fall into a collection bin.
    - The **LED** will turn on the metal side or plastic side gate to indicate that the bottle has been accepted.

<u>Step 4:</u> Resetting the Machine

- After the object is detected, the machine will reset itself to standby mode, showing “Please Use Me” on the **LCD** screen again, ready for the next item.

All components (Arduino Mega, sensors, LED, buzzer, and Wi-Fi module) will be powered by the Arduino through a connected power source.

Flow Diagram Of The System:



Estimated Budget (Final):

Equipment	Quantity	Budget(Tk)
Arduino Mega	**1**	**1895**
Ultrasonic Sensor	**1**	**93**
Proximity Sensor	**1**	**485**
Potentiometer	**1**	**24**
Buzzer	**1**	**20**
Wi-Fi Module	**1**	**295**
Micro-servo motor	**3**	**447**
LED	**2**	**40**
LCD	**1**	**350**
Breadboard	**1**	**100**
Jumper wires	**As Required**	**200**
Total	**----------**	**3949**

Multidisciplinary Contribution:

- **UX Design** - Focus on creating a seamless and impressive experience for users interacting with the machine.
- **Environmental Science** - Impact of the machine on recycling materials that bring the overall environmental benefits.
- **Industrial Design** - Focus on the user experience and aesthetics of the machine which can encourage more people to use it.
- **Business & Marketing** - We can analyze market trends, identify potential users, and develop strategies to promote the use of reverse vending machines.
- **Electrical Engineering** - Sensors for item detection, motors for moving parts, control systems for sorting, and power management systems.
- **Safety & Regulation** - Ensure that the machine supports relevant standards and regulations for electrical safety, environmental protection, and user health.

Multiple Stakeholders:

- Technology Providers
- Consumers
- Retailers
- Investors
- Environmental organizations
- Maintenance

Safety Norms:

- **Electrical Safety** - Ensure all electrical components are properly insulated and grounded to prevent electric shocks.
- **Material Safety** - Use materials that are free from harmful chemicals and toxins.
- **User Safety** - Ensure the machine is user-friendly and accessible, with no sharp edges or pinch points. and contains safety warnings.
- **Fire Safety** - Use fire-resistant materials.
- **Nature Safety** - Use eco-friendly materials and ensure that the machine can recycle materials without causing pollution.
- **Testing** - Follow testing protocols.

Challenges of the project:

1. Sensor Calibration and Accuracy

- Ensuring the correct calibration of the sensors to accurately detect different objects (plastic or metal bottles) can be tricky. Incorrect calibration might result in false detections, misclassifications, or failure to detect objects altogether.

2. Power Management

- Running multiple components (sensors, Arduino, LCD, etc.) on a breadboard setup may cause power issues. Voltage regulation and distribution across components must be properly managed to avoid system failures.

3. Limited Object Identification

- Since your system relies on proximity and ultrasonic sensors, it might not differentiate well between different types of recyclable items beyond basic material classification. More complex systems for better identification would be more accurate but add significant complexity.

4. Coding & Integration

- Correctly writing the code to handle multiple sensors, trigger actions (like opening/closing gates with the servo motor), and manage user feedback through the LCD will require careful coding and debugging.
- Integrating all the components (sensors, motors, Wi-Fi module) in the Arduino's limited memory and processing power without running into timing or resource conflicts was challenging.

5. System Overload

- Handling multiple objects being placed into the system at the same time or quickly in succession could lead to system overload if the sensors and motors aren't able to process them fast enough.
- Managing the queue of actions (detect, identify, move objects, display feedback) without crashing the system is a key challenge.

6. Cost Management

- Adding additional features like more advanced sensors, stronger motors, or robust communication systems might increase the cost of the project. Balancing functionality and budget will be an important challenge.
- The complexity of adding backup power supplies to make the machine more durable can also raise project costs.

Conclusion:

Finally, EcoDrop, designed using **Arduino Mega**, **Buzzer**, **Proximity Sensor**, **Ultrasonic Sensor**, **Micro-servo Motor**, **LED**, **LCD**, **Breadboard**, **Potentiometer**, **Jumper wires**, and a **Wi-Fi Module**, provides an innovative and automated solution for promoting waste recycling in communities. The machine successfully detects recyclable objects such as plastic and metal containers, classifies them, and automates the sorting process.

This project demonstrates how embedded systems, sensors, and basic components can be utilized to build a functional and environmentally beneficial system. However, future improvements could involve advanced object recognition technologies for better accuracy, increasing the machine's capacity for real-world implementation, and improving mechanical durability.

In conclusion, this reverse vending machine offers a practical approach to recycling management, contributing to waste reduction efforts and environmental sustainability.