SMART DUSTBIN

by Shitanshu Shubham

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A project report on

SMART DUSTBIN

Submitted in partial fulfillment of the requirements for the degree of

B. Tech
In
Electronics and Computer Science Engineering

By

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BHUBANESWAR

APRIL 2024

CERTIFICATE

This is to certify that the project report entitled **"Smart Dustbin"** submitted by

NAME:- Shitanshu Shubham **Roll No:- 2130132**
NAME:- Soumyadwip Das **Roll No:- 2230610**

The following document is a bonafide record of my (our) work completed at the **School of Electronics Engineering, KIIT (Deemed to be University)** to fulfill partial requirements for the award of the Bachelor of Technology degree in Electronics and Computer Science Engineering.

Signature of Supervisor
Prof. N.K.Rout
School of Electronics Engineering
KIIT (Deemed to be University)

ACKNOWLEDGEMENTS

Our deepest and most sincere gratitude goes out to Professor N.K Raot sir for his excellent guidance throughout our project work. It has been a pleasure to work with him due to his kindness, dedication, hard work, and attention to detail. Thank you very much, sir, for your unwavering support and patience. We would particularly like to thank him for all help in patiently and carefully correcting all our manuscripts.

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ABSTRACT

Urbanization has led to a surge in waste production, necessitating innovative waste management solutions. In this study, we propose the implementation of smart bins—a fusion of Raspberry Pi Pico and Arduino Uno boards equipped with ultrasonic and moisture sensors. These intelligent bins prevent overflow, streamline waste collection, and contribute to a cleaner, healthier environment. By replacing traditional bins with smart alternatives, we aim to create sustainable urban ecosystems.

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CHAPTER 1

INTRODUCTION

1.1 Motivation

Though the world is in a stage of up gradation, there is yet another problem that has to be dealt with. Garbage! Pictures of garbage bins being overfull and the garbage being spilled out from the bins can be seen all around. This leads to various diseases as large number of insects and mosquitoes breed on it. A big challenge in the urban cities is solid waste management. Hence, smart dustbin is a system which can eradicate this problem or at least reduce it to the minimum level. Our present Prime Minister of India, Sri Narendra Modi ji has introduced the concept of implementing 100 smart cities in India. "Swachh Bharat Abhiyaan" was initiated to ensure a clean environment. Majority of viruses and bacterial infections develop in polluted environment . Safeguarding the environment using technology sources is needed at present. Majority of the public environment seems to be polluted with the waste material. So, modernization of the restaurants is needed by imparting the smart technology. Amounts of waste are largely determined by two factors: first, the population in any given area, and second, its consumption patterns.

- Most of the cities, towns and villages in India are not well designed to facilitate the suitable garbage collection methods.
- Common Public dustbins are filling over with the garbage and no one is concerned to clear them up as and when they get completely packed with overflowing garbage.

Keeping in view of this big problem, it will be a good suggestion to do something to deal with this unmanaged waste

1.2 Background Studies /Literature Survey

Creating a smart dustbin involves integrating various technologies such as sensors, actuators, microcontrollers, and communication modules to optimize waste management processes. Conducting background studies and literature surveys is crucial to understanding existing technologies, methodologies, and challenges in this domain.

1.3 Objectives

1) **Optimizing Waste Collection:** Smart dustbins aim to optimize waste collection processes by monitoring fill levels in real-time. This allows waste management authorities to schedule collections more efficiently, reducing unnecessary trips and associated costs.

2) **Improving Resource Allocation:** By analyzing data on waste generation patterns, smart dustbins enable better resource allocation for waste collection and disposal. This includes optimizing routes, allocating personnel, and managing fleet operations more effectively.

3) **Reducing Environmental Impact:** By minimizing unnecessary waste collection trips and promoting recycling, smart dustbins contribute to reducing the environmental impact of waste management activities. This includes reducing fuel consumption, greenhouse gas emissions, and landfill usage.

4) **Enhancing Public Health and Safety:** Smart dustbins help maintain clean and hygienic public spaces, reducing the risk of disease transmission and improving overall public health and safety.

5) **Promoting Environmental Awareness**: Smart dustbins can serve as educational tools to raise awareness about waste management issues and promote environmentally friendly behaviors. They can provide educational content, tips on waste reduction, and information on the environmental impact of different waste disposal practices.

CHAPTER 2

METHODOLOGY

2.1 Applied Techniques and Tools

ARDUINO UNO BOARD

Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers

Here's an overview of the Arduino Uno board:

Microcontroller: The Arduino Uno is based on the Atmega328P microcontroller, which is a low-power, high-performance chip manufactured by Atmel (now owned by Microchip Technology).

2) Input/Output Pins: The Arduino Uno features a total of 14 digital input/output (I/O) pins, of which 6 can be used as PWM (Pulse Width Modulation) output pins. These pins can be used to interface with various electronic components such as sensors, LED's, motors, and displays. Additionally, there are 6 analog input pins for reading analog signals from sensors or other devices.

3) Power Supply: The Arduino Uno can be powered via a USB connection, a DC power jack, or an external power source connected to the Vin pin. It operates at a voltage of 5V and can supply up to 500mA of current through the 5V pin for powering external components.

4)Communication Interfaces: The Arduino Uno has several built-in communication interfaces for interfacing with other devices. It includes a USB interface for serial communication with a computer, as well as UART (Universal Asynchronous Receiver-Transmitter) and SPI (Serial Peripheral Interface) ports for communication with other micro controllers, sensors, and modules.

5) Reset Button: The board is equipped with a reset button that restarts the micro controller, allowing you to quickly reset your program or upload new code.

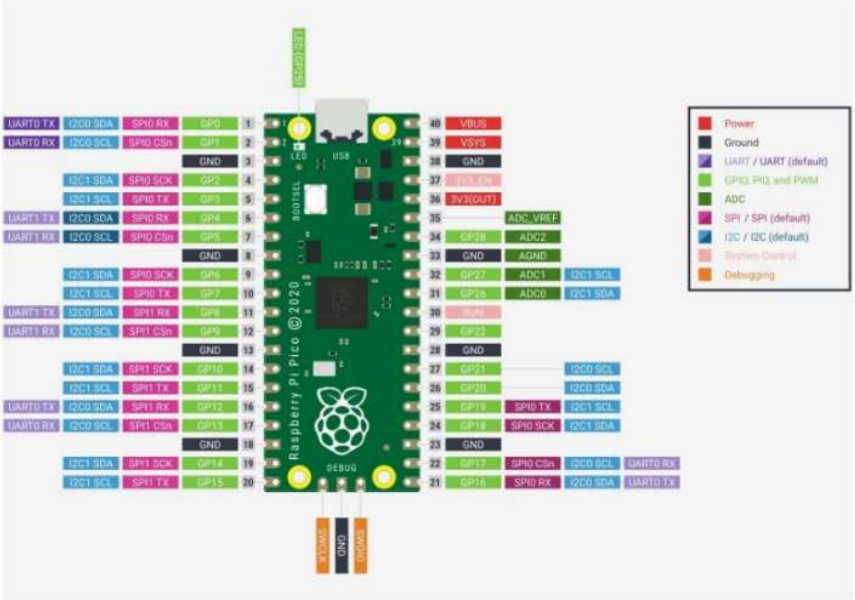
6) LED's: The Arduino Uno has built-in LED's for indicating power (on the board), serial communication (TX and RX), and general-purpose use (connected to digital pins 13).

7) Compatibility: The Arduino Uno is compatible with the Arduino Integrated Development Environment (IDE), a user-friendly software tool for writing, compiling, and uploading code to the board. It supports a simplified version of C++ programming language, making it accessible to beginners while offering flexibility for advanced users.

8)Shields: The Arduino Uno is compatible with various expansion boards called shields, which can be stacked on top of the Uno to add additional functionality such as Ethernet connectivity, Wi-Fi, Bluetooth, motor control, and more.

RASPBERRY PI PICO

The Raspberry Pi Pico is a micro controller board developed by the Raspberry Pi Foundation, released in January 2021. It marks the foundation's entry into the micro controller market, offering a low-cost, high-performance solution for embedded projects, IoT applications, and education.



Key features of the Raspberry Pi Pico include:

1)RP2040 Micro controller: The Pico is powered by the RP2040 micro controller chip, designed by the Raspberry Pi Foundation. It features a dual-core ARM Cortex-M0+ processor running at up to 133MHz, providing ample processing power for a wide range of applications.

2)Memory: The Pico comes with 264KB of SRAM, allowing for efficient data storage and manipulation. It also includes 2MB of onboard flash memory for storing program code and data.

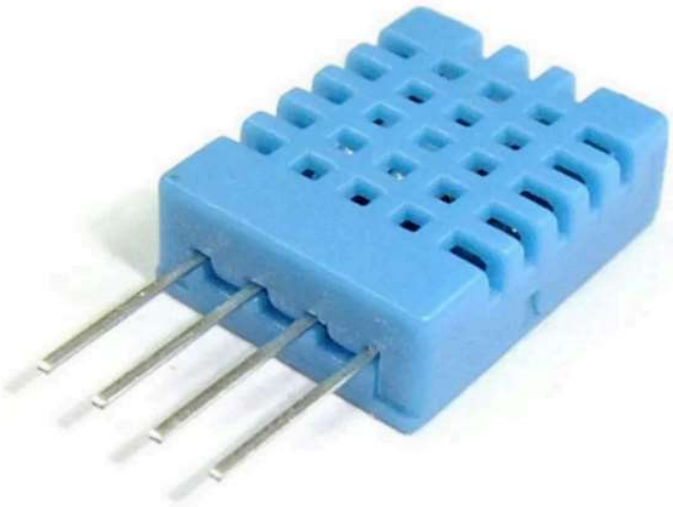
3)GPIO Pins: The Pico features 26 multi-function GPIO pins, which can be configured for digital input/output, analog input, PWM output, SPI, I2C, UART, and other communication protocols. These pins provide versatility and flexibility for interfacing with external sensors, actuators, and peripherals.

4)USB Connectivity: The Pico can be programmed and powered via its USB Type-C connector, making it easy to connect to a computer for development and debugging. It supports USB mass storage device boot mode for programming without the need for additional hardware.

5)Low Power Consumption: With its efficient design and low-power components, the Pico is capable of operating on minimal power, making it suitable for battery-powered and energy-efficient applications.

MOISTURE SENSOR

A moisture sensor is a device used to measure the moisture content or relative humidity of a substance or environment. In various applications, such as agriculture, horticulture, construction, and HVAC systems, moisture sensors play a critical role in monitoring and controlling moisture levels.



Working Principle:

1) The working principle of a moisture sensor depends on its type. Resistance-based sensors measure changes in electrical resistance, capacitance-based sensors measure changes in capacitance, and so on.

2) When exposed to moisture, the sensing element of the sensor undergoes physical or chemical changes that alter its electrical properties.

3) The sensor converts these changes into electrical signals, which are then processed and interpreted to determine the moisture content or relative humidity.

Applications:

Agriculture and Horticulture: Moisture sensors are used in soil moisture monitoring systems to optimize irrigation and prevent over watering or under watering of crops and plants.

Building and Construction: Moisture sensors are used to detect moisture intrusion in building materials, such as wood, concrete, and drywall, to prevent structural damage and mold growth.

HVAC Systems: Moisture sensors are used in heating, ventilation, and air conditioning (HVAC) systems to control indoor humidity levels and prevent condensation and mold formation.

Food and Beverage Industry: Moisture sensors are used in food processing and storage to monitor moisture levels and ensure product quality and safety.

Industrial Processes: Moisture sensors are used in various industrial applications, such as pharmaceutical manufacturing, chemical processing, and paper production, to control moisture levels and optimize process efficiency.

ULTRASONIC SENSOR

The HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object just like the bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm or 1" to 13 feet. The operation is not affected by sunlight or black material, although acoustically, soft materials like cloth can be difficult to detect. It comes complete with ultrasonic transmitter and receiver module

Technical Specifications

Power Supply – +5V DC

Quiescent Current – <2mA

Working Current – 15mA

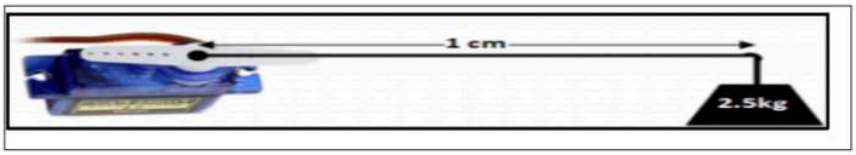
Effectual Angle – <15°

Ranging Distance – 2cm – 400 cm/1″ – 13ft

Resolution – 0.3 cm [8]

SERVO MOTOR

There are lots of servo motors available in the market and each one has its own speciality and applications. Most of the hobby Servo motors operates from 4.8V to 6.5V, the higher the voltage higher the torque we can achieve, but most commonly they are operated at +5V. Almost all hobby servo motors can rotate only from 0° to 180° due to their gear arrangement so make sure you project can live with the half circle if no, you can prefer for a 0° to 360° motor or modify the motor to make a full circle. The gears in the motors are easily subjected to wear and tear, so if your application requires stronger and long running motors you can go with metal gears or just stick with normal plastic gear. Based on the load which you use in the project you can select the motor with proper torque. The below picture will illustrate the same



Working of a Servo Motor

The servo motor has some control circuits and a potentiometer (a variable resistor, aka pot) connected to the output shaft. In the pot can be seen on the right side of the

circuit board. This pot allows the control circuitry to monitor the current angle of the servo motor

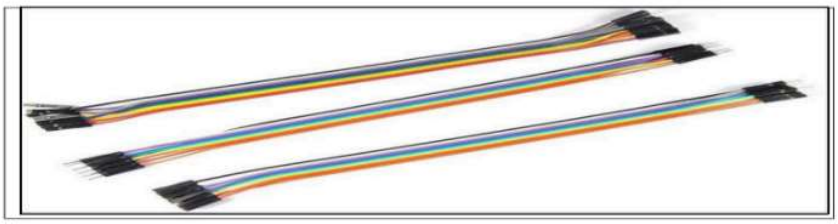
The power applied to the motor is proportional to the distance it needs to travel. So, if the shaft needs to turn a large distance, the motor will run at full speed. If it needs to turn only a small amount, the motor will run at a slower speed. This is called proportional control

BATTERY

A power supply is responsible for providing a circuit with all the power it will need during normal operation. It provides the circuit with a certain voltage and current.

JUMPER WIRES

The term "jumper wire" simply refers to a conducting wire that establishes an electrical connection between two points in a circuit. A jump wire is an electrical wire, or group of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering



CHAPTER 3

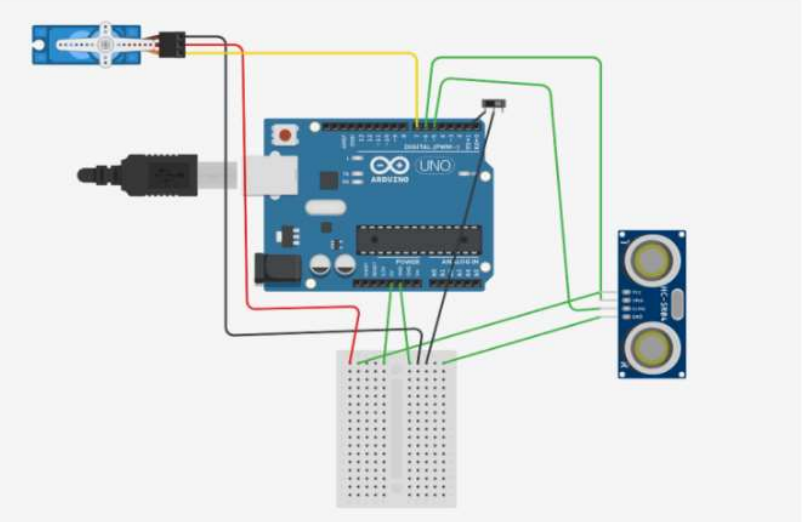
EXPERIMENTATION AND TESTS

3.1 Circuits and program.

A)Arduino Uno:- program code(in c++)

```
#include <Servo.h>
Servo servoMain; // Define our Servo
int switchPin = 1;
int switchState = 0;
int trigpin1 = 5;
int echopin1 = 6;
int distance1;
float duration1;
float cm;
void setup() {
 servoMain.attach(7); // servo on digital pin 9
 pinMode(switchPin, INPUT_PULLUP);
 pinMode(trigpin1, OUTPUT);
 pinMode(echopin1, INPUT);
}
void loop() {
 switchState = digitalRead(switchPin);
 digitalWrite(trigpin1, LOW);
 delay(2);
 digitalWrite(trigpin1, HIGH);
 delayMicroseconds(10);
 digitalWrite(trigpin1, LOW);
 duration1 = pulseIn(echopin1, HIGH);
 cm = (duration1/60);
```

```
distance1 = cm;
if (switchState == LOW) {
  servoMain.write(90);  // Turn Servo to 90 degrees
  delay(500);
 } else {
  if(distance1<20){
    servoMain.write(90);  // Turn Servo back to center position (90 degrees)
    delay(5000);
  }
  else{
    servoMain.write(0);
    delay(50);
  }
 }
}
```



Circuit diagram of Arduino Uno:

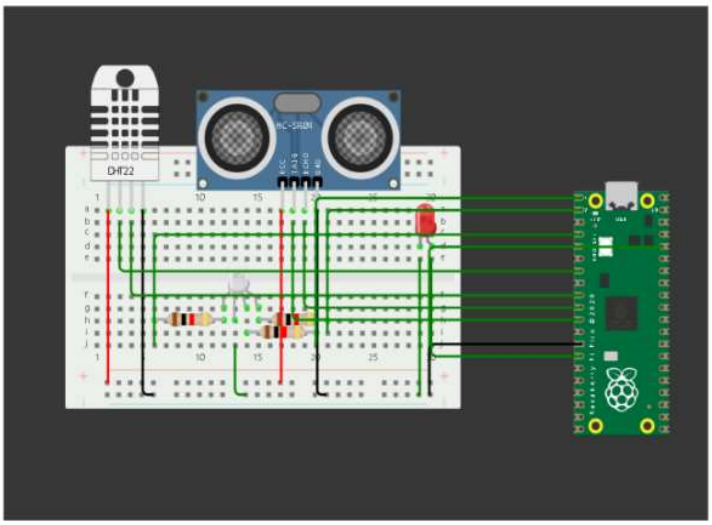
B)Circuit diagram of raspberry by Pico:

```
import machine
import utime
import network
import time
import uasyncio as asyncio
TRIG_PIN = 0  # GPIO pin for ultrasonic sensor trigger
ECHO_PIN = 1  # GPIO pin for ultrasonic sensor echo
RED_PIN = 2   # GPIO pin for red LED
GREEN_PIN = 3  # GPIO pin for green LED
BLUE_PIN = 4   # GPIO pin for blue LED
trig = machine.Pin(TRIG_PIN, machine.Pin.OUT)
echo = machine.Pin(ECHO_PIN, machine.Pin.IN)
red_led = machine.Pin(RED_PIN, machine.Pin.OUT)
green_led = machine.Pin(GREEN_PIN, machine.Pin.OUT)
blue_led = machine.Pin(BLUE_PIN, machine.Pin.OUT)
def measure_distance():
    trig.low()
    utime.sleep_us(2)
    trig.high()
    utime.sleep_us(10)
    trig.low()
    while echo.value() == 0:
        pass
    start_time = utime.ticks_us()
    while echo.value() == 1:
        pass
    end_time = utime.ticks_us()
```

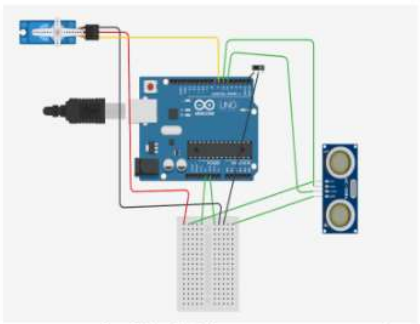
```
    duration = utime.ticks_diff(end_time, start_time)
    distance_cm = duration / 58.0
    return distance_cm
def set_rgb_color(distance_cm):
    if distance_cm >= 50:
        green_led.on()
        blue_led.off()
        red_led.off()
    elif 20 <= distance_cm < 50:
        green_led.off()
        blue_led.on()
        red_led.off()
    else:
        green_led.off()
        blue_led.off()
        red_led.on()
async def handle_client(reader, writer):
    request = await reader.read(1024)
    response = b"HTTP/1.1 200 OK\r\nContent-Type: text/html\r\n\r\nHello,
Sitanshu"
    await writer.awrite(response)
    await writer.aclose()
async def start_web_server():
    server = await asyncio.start_server(handle_client, " 192.168.166.199", 80)
    print("Web server running at http://<PICO_IP_ADDRESS>/")
    await server.serve_forever()
wlan = network.WLAN(network.STA_IF)
wlan.active(True)
wlan.connect("Open2", "88888888")
```

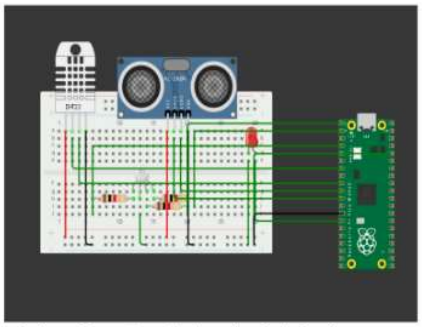
```
wait = 10
while wait > 0:
    if wlan.status() < 0 or wlan.status() >= 3:
        break
    wait -= 1
    print('Waiting for Wi-Fi connection...')
    time.sleep(1)
if wlan.status() != 3:
    raise RuntimeError('Wi-Fi connection failed')
else:
    print('Connected to Wi-Fi')
    print('IP:', wlan.ifconfig()[0])
async def main():
    while True:
        distance = measure_distance()
        set_rgb_color(distance)
        await asyncio.sleep(1)  # Update every second
loop = asyncio.get_event_loop()
loop.create_task(start_web_server())
loop.create_task(main())
loop.run_forever()
```

Circuit diagram raspberry by Pico:



3.2 Experimental Design





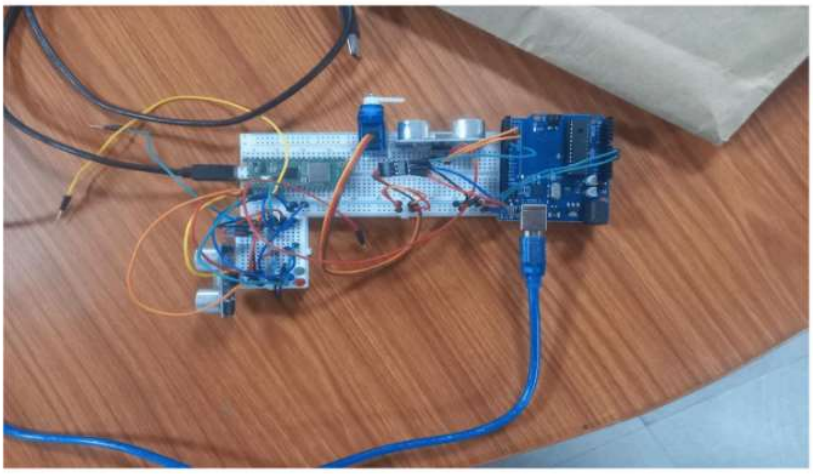
on the The left image represents the Arduino Uno simulation And right image only presents the raspberry by Pico Simulation BothSimulation is being done differently due to the limitation in Simulation the Ardino Uno simulation is done in Tinker Cad Raspberry Pi Pico simulation It's been done in wokwi.com

3.3 Prototype Simulations

The image represented below display is the prototype of a smart dustbin. As we can see the Arduino Uno is being used only to control the servo motor according to the ultrasonic sensor and it follows instruction from Raspberry Pi Pico to open or close the dustbin.

Raspberry pi pico is the master of the model it controls the Arduino Uno read data form dht11 to check The temperature and humidity of the dustbin as well as the capacity of it Using the second ultrasonic sensor .

The Raspberry Pi Pico is also capable of hosting web application which allows us to check our dustbin remotely and control it through wifi.



CHAPTER 4

CHALLLEGES, CONSTRAINTS AND STANDARDS

4.1 Challenges and Remedy

During this project we faced Some challenges

Limitation of Ardino Uno :

Ardino Uno is a microcontroller with single processor due to which it cannot run more than one task at a time Neither it can handle multiple loop in the program nor it can do function overloading

Remedy:-We used another microcontroller to overcome this which is raspberry pi pico it allowed us not only to run multiple function but also help us to monitor our dustbin Through web application.

4.2 Design Constraints

The server motor we were using was not strong enough to automate the opening and closing of the dustbin But we can overcome this by using a stronger servo motor. Or by using a different design Like a smaller dustbin.

4.3 Alternatives and Trade-offs

Instead of using two microcontrollers the better alternative would be to use one, which can do all the tasks at the same time for example raspberry pi zero w which is a Micro Controller as well as Micro Computer which is around the same price of Ardino Uno and Pico combined.

4.4 Standards (as applicable)

Some examples of standards that might impact design choices:

Standardized network technologies: e.g. Bluetooth, Zigbee/IEEE 802.15.4, IEEE

802.11a/b/g, Internet Protocol—IPv 4 and IPv6, TCP, etc.

Standardized security mechanisms and protocols: IPSEC, SSL/TLS, SMIME, PGP,

SET, Kerberos, AES,etc.

Standards for electric power systems: IEEE 1547, IEEE 2030, UL 1741, etc.

Powerline communication standards: IEEE 1901.2, x10 (an open industry standard

for home automation)

Standardized software development tools, and software environments: Java Software

Development Kits, JVM, JRE, MATLAB, Cadence, Labview, etc.

Standardized software engineering practices: MIL-STD-498, IEEE 12207, POSIX, etc.

Standardized quality management guidelines: ISO 9000, ISO 9001, etc.

Hardware standards: microcontroller standards, plug-and-play standards, measurement bus standards (GPIB/IEEE 488, PCI, PXI), etc.

Open source standards, software, and operating systems: Linux, Apache server, Gnu, OpenGL, etc.

CHAPTER 5

RESULT ANALYSIS AND DISCUSSION

5.1 Results Obtained (Tabulation and /or Graphs should be included)

Specifying the technical discussion on different case studies under investigation provide suitable results obtained in form of graphical representation and/or tabulations. Further, figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation "Fig. 1", even at the beginning of a sentence.

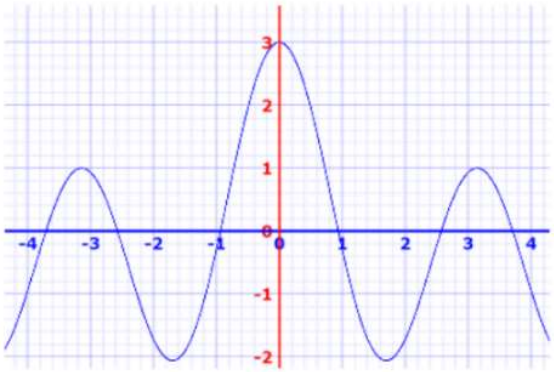


Fig. 1: Suitable title to briefly describe the graph

5.2 Analysis and Discussion

During this project while using raspberry pi pico to automate opening and closing the dustbin There was a slight delay due to other task running in the background of Pico so we decided to use Ardino Uno to Automate opening and closing the dustbin while Raspberry Pi Pico handles the other processes which made the servo motor responsive while Raspberry Pi Pico still has the control over the spin using the method called Master–slave model in IoT

[Master–slave is a model of asymmetric communication where one device or process (the master) controls one or more other devices or processes (the slaves).]

5.3 Project Demonstration

Introduction:

Dustbins (also known as garbage bins or trash cans) are essential for waste collection in homes, offices, streets, and parks. In this project, we'll design a Smart Dustbin that automatically opens its lid upon detecting a human hand. The smart dustbin identifies the type of material being thrown inside and segregates it into bio or non-biodegradable categories.

How It Works:

one ultrasonic sensor is placed in front of the dustbin.

When no one is in front of the sensor, the smart dustbin lid remains closed.

As soon as someone approaches the dustbin, the ultrasonic sensor detects their presence.

The Arduino Uno processes this information and activates the servo motor.

The servo motor opens the lid, allowing the person to deposit waste material into the dustbin.

In side the bin there is another ultrasonic sensor and a humidity sensor.

The ultrasonic sensor inside the bin is used to calculate the capacity of the dustbin left after use

where the moisture sensor is used to check temperature and humidity inside the dustbin

The data from the second ultrasonic sensor and humidity sensor is then processed in the Raspberry Pi Pico w And then it is represented to us in the web application.

CHAPTER 6

CONCLUSIVE REMARKS

6.1 Conclusion

In conclusion The Smart Dustbin It's a pretty useful device to have luxury of hands free dustbin. While also in the same time reminding the user for the hygiene to prevent the disease spread due to the contaminated dustbin.

6.2 Further Plan of Action / Future Work

Automatic garbage fill alerting system helps us to reduce the pollution. Many times garbage dustbin is overflow and many animals like dog or cow enters inside or near the dustbin. Also some birds are also trying to take out garbage from dustbin. This project can avoid such situations. And the message can be sent directly to the cleaning vehicle instead of the contractor's office. Apart from this, differentiation can be made between dry trash bin and wet trash bin collecting plastic dry waste and biodegradable waste respectively.

- To enhance it further, an automated system can be developed which is able to pick up waste in and around the bin, segregate them and put them in respective bins.
- We have try to new innovation in this project like we think about fit the GSM module which helps to send a message to particular service room and around the smart bin area it indicates dustbin was full in shortly please collect the garbage from the bin.
- New one adding feature is solar panel which is natural recourses and its works on solar energy it's fully automated and all the components of smart bin works upon the solar energy.

Another we think on artificial intelligence its guide to peoples which compartment is dry west and wet west it is very helpful for blind peoples who don't look where is the compartment of dry and wet garbage. In this feature we need to proximity sensors and computer master in artificial intelligence

REFRENCES

Here are some references of research papers and articles on smart dustbins using IoT technology:

[1]https://www.researchgate.net/publication/342014124_Smart_dustbin_with_automatic_openclose_cover

[2] https://www.seeedstudio.com/blog/2021/03/26/10-raspberry-pi-pico-projects/

[3] Title: Smart Waste Management System using IoT

Authors: Pooja M. Upadhyay, Prof. Urmila Shrawankar

Published in: International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE), 2018

[4] Title: Smart Garbage Monitoring System using Internet of Things (IoT)

Authors: Neelambika M. Pattanashetti, Vishweshwarayya S. Patil, et al.

Published in: International Journal of Engineering Research & Technology (IJERT), 2018

[5] Title: IoT-Based Smart Garbage Management System for Smart City

Authors: Mr. Tejaskumar S. Patel, Prof. Y. P. Kosta, et al.

Published in: 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS)

Appendix A: Gantt Chart

	Jan.	Feb.	March	April
Research Gap/Problem Identification				
Research on the Project Objective				
Hardware/Software/Tool Selection				
Formation of Codes/Experiment Design				
Trial and Testing				
Challenges and Remedy				
Assembling of the Prototype/Model				
Project Demonstrations				
Formation of the Project Report				
Finalizing of Project Presentation				

Appendix B: Project Summary

Project Title	SMART DUSTBIN USING IOT
Team Members	**Shitanshu Shubham, Soumyadwip Das**
Supervisors	**Prof. N.K. Rout**
Semester / Year	**6th/ 3rd year**
Project Abstract	In this recent world, urbanization has increased tremendously. At the same phase, there is increasing amount of in waste production. Waste management has been a crucial issue to be considered. This report is a different way to achieve this good cause. In this report, smart bin is built on a micro controller based platform Raspberry pi pico & Arduino - Uno board , which is interfaced with Ultrasonic sensor. It will stop overflowing of dustbins along roadsides and localities as smart Dustbins are managed in real time. Once these smart bins are implemented on a large scale by replacing the traditional bins, the waste can be quickly managed to its efficient level as it avoids unnecessary lumping of wastes on roadside. Foul smell from these rotten wastes that remain untreated for a long time, due to negligence of authorities and carelessness of public may lead to long term problems. Breeding of insects and mosquitoes can create nuisance around promoting unclean environment. This may even cause dreadful diseases. The goal of this project is to keep our environment clean. It also aims at creating a clean as well as green environment.
List **codes** and **standards** that significantly affect your project.	• 802.11b/g/n HT40 Wi-Fi transceiver. • The LM35 is rated to operate over a −55° to +150°C temperature range. • Blynk server by default tries to use the latest available protocol TLSv1.3
List at least two significant **realistic design constraints** that are applied to your	The two primary constraints of this project are the formation of the mobile application (APP) and availability of the wireless communication such as IEEE 802.11 (b/g/n) standards across rural

project.	landscapes of India.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen	• This device is tested for body parameter tracking which are in a specific range. • It is not tested for fractional changes in body parameters.
Describe the **computing aspects, if any,** of your project. Specifically identifying **hardware-software** trade-offs, interfaces, and/or interactions	The C language codes have been written for implementing the Vital Body Parameter Tracker. This software is compatible with NodeMCU.
Culminating Knowledge and lifelong learning experience	For this project knowledge from, EC 3003 Microprocessors and Microcontrollers EC 3007 Digital Signal Processing EC 3093 Microprocessor and Microcontroller Lab EC 4003 Wireless and Mobile Communication, subjects has been used.

SMART DUSTBIN

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