Visvesvaraya Technological University

Jnana Sangama, Belagavi - 590018

A Project Work Phase-2 (18CSP83)

Report on

"WASTE SEGREGATION USING DEEP LEARNING AND IOT"

Project Report submitted in partial fulfilment of the requirement for the award of the degree of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

Submitted by

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CERTIFICATE

Certified that the Project Work Phase-II (18CSP83) entitled **"WASTE SEGREGATION USING DEEP LEARNING AND IOT"** is a bonafide work carried out by:

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In partial fulfilment for VII semester B.E., Project Work in the branch of Computer Science and Engineering prescribed by **Visvesvaraya Technological University, Belagavi** during the period of September 2023 to January 2024. It is certified that all the corrections and suggestions indicated for internal assessment have been incorporated. The Project Work Phase-2 Report has been approved as it satisfies the academic requirement in report of project work prescribed for the Bachelor of Engineering degree.

13/5/24 13/5/24

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DECLARATION

We, the undersigned students of 8th semester, Computer Science & Engineering, KSSEM, declare that our Project Work Phase-2 entitled "**Waste Segregation using Deep Learning and IoT**", is a bonafide work of our's. Our project is neither a copy nor by means a modification of any other engineering project.

We also declare that this project was not entitled for submission to any other university in the past and shall remain the only submission made and will not be submitted by us to any other university in the future.

Place:

Date:

Name and USN		**Signature**
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ABSTRACT

This paper presents an innovative approach utilizing YOLOv5, a state-of-the-art object detection model, for waste segregation specifically targeting biodegradable and nonbiodegradable waste.

Waste management is a critical global issue, and efficient segregation is pivotal for sustainable and eco-friendly waste disposal practices. The proposed system leverages the YOLOv5 model to accurately detect and classify varioustypes of waste items in real-time. By focusing on biodegradable and non-biodegradable waste, the system identifies and sorts these categories with high precision. The implementation of YOLOv5 for waste segregation demonstrates promising results in automating the sorting process, enhancing waste management practices, and contributing to a cleaner and more sustainable environment. The study showcases the effectiveness and potential of leveraging cutting-edge technology inwaste segregation for a more efficient and environmentally conscious approach to waste disposal.

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Chapter 1

INTRODUCTION

1.1 OVERVIEW

The process of segregating waste prompts the generation of energy out of waste,diminishing land fills, recycling, and reduction of waste. Erroneous disposal of waste leads to recycling contamination. Contamination is a tremendous issue to the recycling industry that can be with automatic computerized waste sorting. The presence of models or strategies which help people to sort trash hasbecome extremely important in the right discard of that garbage. Even though there are various sorts of recycling categories, many people remain confused or cannot appropriately recognize how to decide the right trash bin to dispose of every trash. Waste management and systematic sorting of them are considered tobe a significant role in ecological development around the world. Society needs to lessen waste by recycling and reusing discarded materials that result in reducing environmental problems. This project aims to create an automated waste detection system using a deep learning algorithm that will gather the waste images or videos from a camera with object recognition, detection & prediction,and categorize the waste materials like cardboard, glass, metal, paper, plastic, andtrash so that the waste can be properly dumped in the recyclable and non- recyclable bin.

1.2 PURPOSE OF THE PROJECT

Waste segregation using deep learning can serve several purposes, enhancing efficiency and sustainability in the waste management processes. Deep Learning,a subset of machine learning, involves training neural networks to recognize patterns and make decisions based on input data. Here are some purposes of waste segregation using deep learning....

- Efficient Waste Management: The primary purpose is to optimize waste management processes by automating the segregation of different types of waste materials. This automation can streamline sorting processes, reduce manual labor, and improve overall efficiency in waste treatment facilities.

- Promotion of Recycling: By accurately segregating waste materials, the project aims to increase recycling rates. This aligns with broader environmental goals by reducing the amount of waste sent to landfills and conserving natural resources through the recycling of materials.

- Reduction of Contamination: Proper waste segregation helps minimize contamination in recycling streams, ensuring that materials can be recycled effectively. By using deep learning to improve the accuracy of segregation, the project can reduce the risk of contamination and increase the quality of recycled materials.

- Data-Driven Decision Making: The project can generate valuable data on waste generation patterns, recycling rates, and operational efficiency. This data can be analyzed to inform decision-making processes related to waste management, such as optimizing collection routes, scheduling maintenance, or allocating resources effectively.

- Environmental Sustainability: By promoting recycling and reducing the amount of waste sent to landfills, the project contributes to environmental sustainability goals. It helps mitigate the environmental impact of waste disposal, including greenhouse gas emissions, soil and water pollution, and resource depletion.

1.2.1 SCOPE OF THE PROJECT

- When we segregate waste, it reduces the amount of waste that reaches landfills, thereby taking up less space.
- Pollution of air and water can be considerably reduced when hazardous waste is separated and treated separately.
- It is essential that waste is put in separate bins so that it can be appropriately dealt with.
- Careful and robust classification of waste materials is important given thestrict controls required for storage, treatment and disposal of hazardous waste, in addition to the higher costs involved compared with other wastetypes.
- It is also important to ensure that wastes are disposed of in the correct landfill sites.

1.3 DEFINITIONS

1.3.1 PYTHON

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensivestandard library are available in source or binary form without charge for allmajor platforms, and can be freely distributed.

Often, programmers fall in love with Python because of the increased productivity it provides. Since there is no compilation step, the edit-test- debug cycle is incredibly fast. Debugging Python programs is easy: a bug orbad input will never cause a segmentation fault. Instead, when the interpreterdiscovers an error, it raises an exception. When the program doesn't catch theexception, the interpreter prints a stack trace. A source level debugger allows inspection of local and global variables, evaluation of arbitrary expressions, setting breakpoints, stepping through the code a line at a time, and so on. The debugger is written in Python itself, testifying to Python's introspective power. On the other hand, often the quickest way to debug a program is to add a few print statements to the source: the fast edit-test-debug cycle makesthis simple approach very effective.

1.3.2 YOLO V5

Glenn Jocher's YOLOv3 PyTorch repository is a natural progression to the YOLOv5 repository. Developers frequently used the YOLOv3 PyTorch repository to port YOLOv3 Darknet weights to PyTorch before deploying them to production. Many people (including our Roboflow vision team) preferred the PyTorch branch's user-friendliness and would utilize it for deployment.

Following a complete replication of YOLOv3's model architecture and training process. Ultralytics started to refine research and make changes to repository design in order to enable thousands of developers to train and implement their own unique object detectors that can identify any object in the world. At Roboflow, we all share this objective. Due to the recent introduction of YOLOv4in the Darknet framework, these enhancements were initially referred to as YOLOv4. To prevent version clashes, the model was renamed to YOLOv5. TheYOLOv5 moniker sparked a lot of discussion at first, and we even released a comparison piece between YOLOv4 and YOLOv5, where you could compare the two models side by side using your own data.

In this post, we just talk about the new technologies and measurements that the YOLO researchers are sharing on GitHub discussions—we avoid doing any bespoke dataset comparisons.Notably, since the repository was released, YOLOv5 has seen substantial research advancements, which we anticipate will continue and may provide some support for the YOLO-"moniker". As a result, YOLOv5 is far from a finished model; it will continue to change.

1.3.3 PYCHARM

PyCharm is a powerful integrated development environment (IDE) designed specifically for Python programming. In this article, we will delve into what PyCharm is, its key features, and why it is a preferred choice for Python developers. PyCharm is an integrated development surroundings (IDE) used for programming in Python. It is advanced by means of the Czech organization JetBrains and is to be had for Windows, macOS, and Linux. PyCharm is to be had in two variations: Community Edition and Professional Edition. The Community Edition is loose and open supply, while the Professional Edition isa paid subscription carrier. PyCharm is a great desire for absolutely everyone who develops in Python, regardless of their experience level. It is in particular well-acceptable for developers who're operating on complex or huge Python tasks. PyCharm also can be an awesome preference for beginners who are studying to software in Python, as it could assist them to keep away from commonplace mistakes and write more green code. PyCharm is a famous IDE for Python improvement as it affords a extensive range of capabilities that help developers to jot down, debug, and test their code greater efficaciously.

Some of the important thing capabilities of PyCharm consist of:

- Smart Code Completion: PyCharm presents smart code of entirety thatpermit you to to jot down code more quickly and correctly. It can advocate keywords, variables, features, and other code elements primarily based at the context of your code.
- Code Inspections: PyCharm can inspect your code for capacity errors and troubles. It can perceive capacity syntax errors, type mistakes, anddifferent logical errors.
- Debugging: PyCharm affords a effective debugger that will let you to step via your code line by way of line, examine the values of variables,and set breakpoints.
- Testing: PyCharm integrates with famous Python testing frameworks inclusive of unit test and pytest. This allows you to run your tests at once from the IDE.
- Version Control: PyCharm integrates with popular model manage structures including Git and Mercurial. This lets in you to preserve track of your modifications on your code and collaborate with otherbuilders.

Here are a number of the advantages of the usage of PyCharm:

- Increased productiveness: PyCharm's clever code final touch, code inspections, and different features can help you to put in writing code more speedy and correctly. This can cause large increases in productiveness.
- Reduced mistakes: PyCharm's code inspections let you to discover and attach ability errors to your code before you even run it. This let you to provide more reliable and awesome code.
- Easier debugging: PyCharm's debugger makes it smooth to step thru your code line by means of line, take a look at the values of variables, and set breakpoints. This assist you to to music down and connect bugsextra speedy.
- Improved collaboration: PyCharm's integration with version control structures makes it clean to collaborate with other builders on Python initiatives.

Here are five exciting hazards of PyCharm:

- Resource Intensive: PyCharm is thought for its strong features, but these features come at a fee in phrases of system assets. The IDE may be pretty useful resource-in depth, particularly the Professional edition, which may also cause slower performance on older or much less powerful hardware. If you are running on a useful resource-restricted device, you may enjoy lags and delay.
- Steep Learning Curve: While PyCharm is highly powerful, it is able to actually have a steep learning curve, specially for novices. The multitude of features and settings can be overwhelming for someone new to programming or Python. Users may also need time to discover and customize the IDE to fit their workflow.
- Cost (Professional Edition): While PyCharm Community Edition is loose and open-source, the Professional Edition calls for a paid subscription. This cost may be a downside for individual builders or small groups on a tight finances. While JetBrains gives a free trial duration for the Professional Edition, some developers might alsolocate the pricing prohibitive ultimately.
- Slower Startup Time: PyCharm, while in comparison to light-weight textual content editors, tends to have a slower startup time. This canbe inconvenient while you need to quick edit a Python script or make minor adjustments. If you frequently open and close the IDE, this slower startup time can end up frustrating

Chapter 2

LITERATURE SURVEY

2.1 Intelligent Waste Management System Using Deep Learning with Iot,

Md. Wahidur Rahman, Rahabul Islam, Arafat Hasan, Nasima Islam Bithi, Md. Mahmodul Hasan, Mohammad Motiur Rahman.

The proposed methodology is a combination of two parts, namely, waste classification through convolutional neural network and architectural design of smart trash boxes, which aids real-time data monitoring using IoT. Two structural models are merged to find excellent results in the field of waste management. Classifying wastes into proper categories helps to identify reusable waste. Identifying recyclable wastes let us utilize them without deteriorating. In the extent of image classification, deep learning algorithms acquire peerless results. The scope of minimizing the misuse of recyclable components inspires authors to add deep learning for waste classification while monitoring waste to differentiate recyclable wastes. In this article, we have divided the wastes into two broad categories named digestible and indigestible. Lack of sufficient data for waste classification, we have used finetuned models for waste classification. The waste classification using deep learning technology helps to attain categories of wastes from images. The architecture of trash boxes enables multiple sensors to take readings and data transmission for monitoring. n this proposed scheme, acamera module will scan the waste materials. After successfully finishing the waste scanning and image capturing process, a pre-processing component for thecaptured images taken by the camera in real-time is performed. The model utilizes the only image resizing due to ensure less complexity. After that, the pre- processed images are processed by a micro processor (Raspberry pi). The microprocessor will classify the image using a classifier and sends a command toa servo motor to put waste into the corresponding trash box. The microcontrollerof the trash box will send data to an android application for realtime monitoring.

2.2 Garbage Waste Segregation Using Deep Learning Techniques

Sai Sushanth, Jenilla Livingston ,Angel Livingston

The goal of the proposed work is to develop an image classifier that can both identify an object and determine what kind of garbage is included in it.Therefore,the goal is to reduce human interaction and increase the productivity of this wastesegregation process.The goal of the proposed study is to develop an image classifier that uses a convolutional neural network to identify the object and determine the type of waste material.In order to generate predictions and discern one sort of garbage from another, four distinct CNN models—ResNet50, DenseNet69, VGG16, and AlexNet—trained on ImageNet are utilized in this work to extract features from photos and feed them into a classifier.

2.3 Smart Waste Management System Using IoT

Mrigank Mathur, Ishan Srivastava, Vaishnavi Rai, Assistant Prof. Mr. S. Kalidass

Smart netbin a normal dustbin elevated using a microcontroller based platform Arduino Uno board interfaced with Load sensor and Wi-Fi module. It consists of 2 main modules the mechanical designed components and the electric components. The mechanical components consist of shredder and the load sensing plate while the electric components consist of various components that are the Arduino Loadcell, LCD Display screen, IR Sensor, Amplifier, Relay module, Wi-Fi Router. When the user dumps the trash into the dustbin the trash will be first crashed within the shredder and the shredded trash will the get collected onto the load sensing plate present in the dustbin. The load sensor us been attached to the load sensing plate this sensor will measure the weight of thetrash been dumped in the bin. once the set limit of weight is been satisfied the password of the router will get displayed on the LCD screen, although the routeris still off .after the password has been displayed the user have to pull this plate outside so that the trash which has been collected on the plate falls down in the dustbin. This motion of the falling trash is captured by the IR sensor and once theIR sensor sense the falling motion

2.4 An Intelligent System for Waste Materials Segregation Using IoT and Deep Learning

V R Azhaguramya, J Janet, Vijay Varshini Lakshmi Narayanan, Sabari R S, Santhosh Kumar K

A Raspberry Pi camera is used in the suggested model to scan and identify the object. Following detection, the "Histogram of Oriented Gradients" approach is used to export the discovered object as input to the deep learning model. This remains constant despite the object's geometric and photometric alterations. In order to accurately classify the objects into biodegradable and nonbiodegradablewaste, the Faster Regions with the CNN algorithm (RCNN) with contextual information and incremental learning is combined to improve detection performance under unique and extreme conditions. The many layers of the FasterR-CNN neural network can be explicitly accessed using the Faster R-CNN algorithm, demonstrating the greater accuracy rate of the suggested system.

2.5 Waste Management Technique To Detect and Separate Non-Biodegradable Waste using ML and YOLO Algorithm

Aishwarya, Parth Wadhwa, Owais

This research paper presents an application of machine learning to image processing, where the custom item was detected using the YOLO (You Only Look Once) approach. In order to make it easier to separate nonbiodegradable waste from the bins, a method for detecting it from the bins is being developed. Glass, metal, and plastic garbage were the three main categories into which the data was separated for non-biodegradable waste. Each category's 450–500 photoswere gathered to train the model. Using a labeling tool in the yolo format, each image was labeled. The data set containing all three types of the photos of non- biodegradable rubbish was used to train a machine learning model.

Chapter 3

PROBLEM IDENTIFICATION

3.1 PROBLEM STATEMENT

The aim of the project is to develop a waste segregation system based on specificcharacteristics extracted from photography.

The approach is to identify a waste using a convolution neural network with theyolov5 model and classification them into biodegradable and non-biodegradable.

3.2 PROJECT SCOPE

- When we segregate waste, it reduces the amount of waste that reaches landfills, thereby taking up less space.
- Pollution of air and water can be considerably reduced when hazardous waste is separated and treated separately.
- It is essential that waste is put in separate bins so that it can be appropriately dealt with.
- Careful and robust classification of waste materials is important given thestrict controls required for storage, treatment and disposal of hazardous waste, in addition to the higher costs involved compared with other wastetypes.
- It is also important to ensure that wastes are disposed of in the correct landfill sites.

Chapter 4

GOALS AND OBJECTIVES

4.1 PROJECT GOAL

1. Enhanced Accuracy in Segregation:

- Deep Learning: Utilizing deep learning models, such as convolutional neural networks (CNNs), can improve the accuracy of waste segregation. These models can learn intricate patterns and features in images, making them effective in identifying and classifying different types of waste.
- IoT: Integration with IoT devices, such as smart bins with sensors, ensuresreal-time data collection. These devices can provide accurate information about the types and quantities of waste in the bins, contributing to more precise segregation.

2. Optimized Resource Allocation:

- Deep Learning: By accurately segregating waste at the source, municipalities and waste management companies can allocate resources more efficiently. For example, recyclable materials can be directed to recycling facilities, reducing the burden on landfills.
- IoT: Real-time monitoring through IoT devices enables dynamic resourceallocation. Collection schedules can be optimized based on the actual fill levels of waste bins, reducing unnecessary trips and fuel consumption.

3. Cost Efficiency:

- Deep Learning: Accurate waste segregation reduces contamination inrecycling streams, making recycling processes more cost-effective. Deep learning models contribute to minimizing errors in waste classification.
- IoT: Optimized collection routes and schedules, based on real-time data from IoT devices, lead to cost savings in fuel, labor, and maintenance.

4.2 PROJECT OBJECTIVES

- **Objective 1**: To develop a system using YOLOv5 that can accurately detect, classify, and segregate biodegradable and non-biodegradable wasteitems in real-time.
- **Objective 2**: Achieve a high level of precision in waste item detection to minimize sorting errors and improve the overall efficiency of waste segregation.
- **Objective 3**: Contribute to environmental sustainability by promoting proper waste disposal and recycling of segregated waste materials. In world, Around 4,00,000 to one million people die during a year because ofdiseases linked to poor managed waste in developing countries.
- **Objective 4**: According to a report by The Energy and Resources Institute(TERI), India generates over 62MT of waste in a year. Only 43MTof total waste generated gets collected, with 12MT being treated before disposal, and the remaining 31MT simply discarded in wasteyards.
- **Objective 5**: Develop an intuitive user interface for easy adoption by wastemanagement personnel or facilities.

Chapter 5

SYSTEM REQUIREMENTS SPECIFICATION

5.1 SOFTWARE REQUIREMENTS ANALYSIS

Software requirements are those that software needs in order to improve the software product's quality. These specifications are typically a form of user expectation from software that is significant and needs to be met by the program. Software requirement analysis is the process of thoroughly examining,evaluating, and characterizing software requirements in order to satisfy needs that are valid and essential for problem-solving.

5.1.1 SOFTWARE REQUIREMENTS

- Pycharm
- Windows 10 or higher

5.2 HARDWARE REQUIREMENTS ANALYSIS

The most common set of requirements defined by any operating system or software application is the physical computer resources, also knownas hardware. The purpose of the Hardware Requirements Analysis Process is to transform the hardware-related system requirements, and hardware-related system architectural design, into a set of hardware requirements.

5.2.1 HARDWARE REQUIREMENTS

- RAM = 8 GB
- Hard Disk = 500 GB
- Micro Processor = 2.42 GHz
- Micro Processor Core = Core i5
- All desktop and laptop computers with advanced configuration

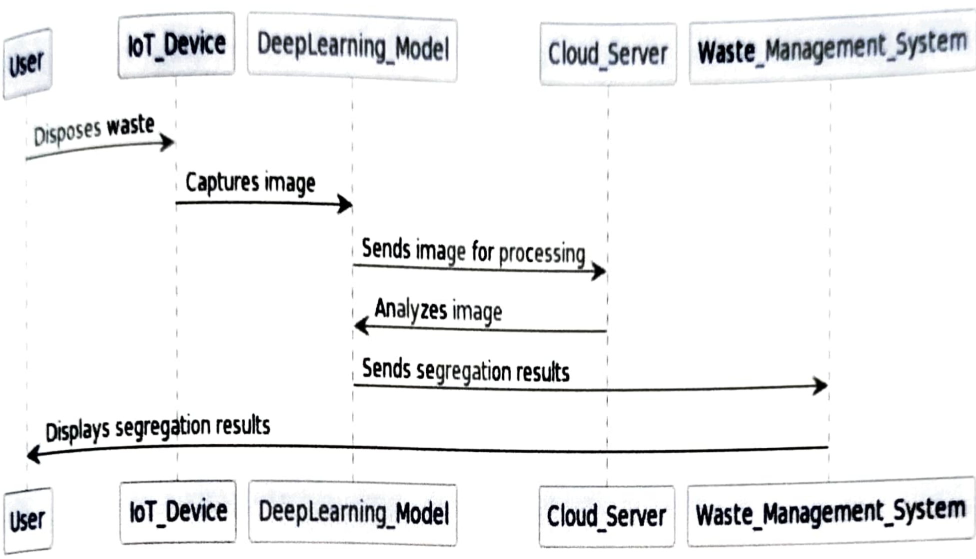
Chapter 6

METHODOLOGIES

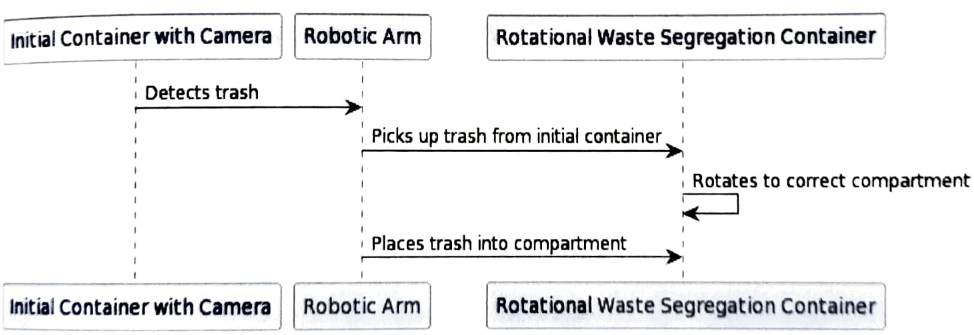
- **Methodology 1:** Data Collection and Preparation: Collect a diverse dataset of waste items, including biodegradable and non-biodegradable materials,and preprocess the data for training the YOLOv5 model.
- **Methodology 2:** Model Training: Utilize the YOLOv5 architecture to train the model for accurate detection and classification of waste items into the specified categories.
- **Methodology 3:** Real-time Detection: Implement the trained model to perform real-time object detection and classification of waste items, particularly focusing on biodegradable and non-biodegradable distinctions.
- **Methodology 4:** User Interface Development: Create a user-friendly interface to visualize the segregation process, allowing users to monitor, verify, and potentially intervene in the classification process if necessary.
- **Methodology 5:** Testing and Validation: Validate the system's performance through rigorous testing, evaluating its accuracy, efficiency, and adaptability to different waste scenario.

Chapter 7

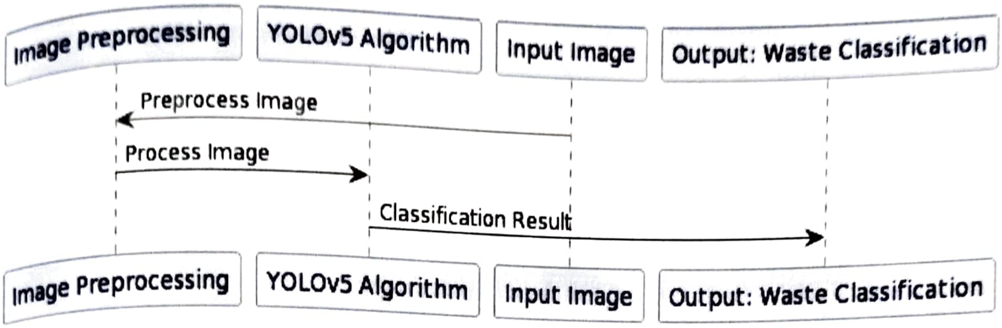
DESIGN



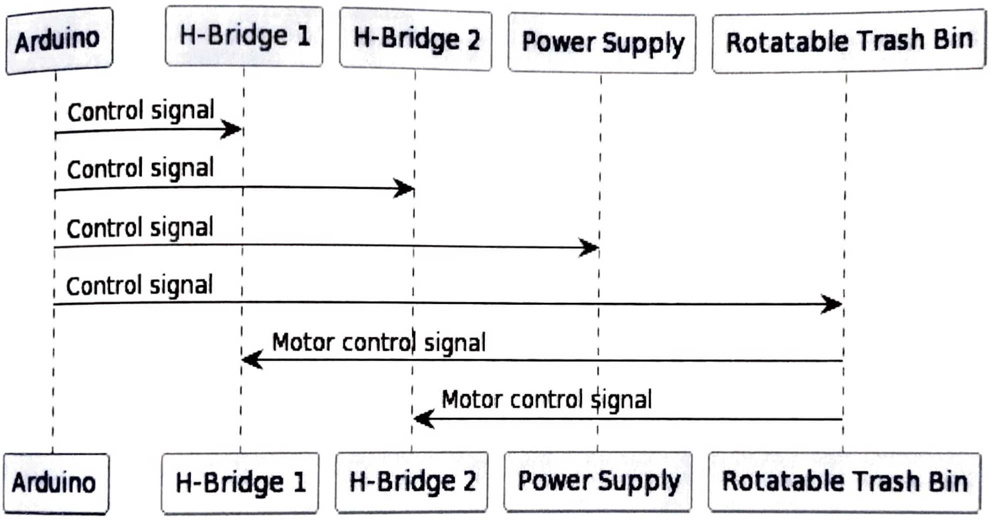
IoT Design



DEEP LEARNING MODEL DESIGN



WASTE MANAGEMENT SYSTEM MODEL DESIGN



Chapter 8

HARDWARE IMPLEMENTATION

```
#include <LiquidCrystal.h>
const int rs = 13, en = 12, d4 = 8, d5 = 9, d6 = 10, d7 =
11;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
int IN1=14;
int IN2=15;
int IN3=17;

int
IN4=16;
int IN5=18;
int IN6=19;
int IN7=2;
int IN8=3;
char ch;
int a,b,c;
void
setup()
{
 pinMode(IN1,OUTPUT);
pinMode(IN2,OUTPUT);
pinMode(IN3,OUTPUT);
pinMode(IN4,OUTPUT);
pinMode(IN5,OUTPUT);
pinMode(IN6,OUTPUT);
pinMode(IN7,OUTPUT);
pinMode(IN8,OUTPUT);


digitalWrite(IN1,LOW);
digitalWrite(IN2,LOW);
digitalWrite(IN3,LOW);
digitalWrite(IN4,LOW);
digitalWrite(IN5,LOW);
digitalWrite(IN6,LOW);
digitalWrite(IN7,LOW);
digitalWrite(IN8,LOW);
Serial.begin(9600);
lcd.begin(16, 2);
 lcd.clear();
 lcd.print("Waste
Segregation");//Initialize serial
Serial.println("Waste Segregation");
delay(2000);
delay(2000);
}
```

```
METAL_BIN_1();
{
lcd.clear();
lcd.print("Waiting. ..");//Initialize serial
}
void loop()
{
if(Serial.available()>0)
{
ch=Serial.read();
Serial.println(ch);
delay(1000);
if(ch=='D')
{
lcd.clear();
lcd.print("Dry
Waste..");
Serial.println("Dry Waste..");
Dry_Waste();}
if(ch=='W')
{
lcd.clear();
lcd.print("Wet Waste..");
Serial.println("Wet Waste..");
Wet_Waste();
}
if(ch=='M')
{
lcd.clear();
lcd.print("Metal Waste..");
Serial.println("Metal Waste..");
Metal_Waste();
}
}
}
void Dry_Waste()
{
DOWN();
delay(2000);
UP_DOWN_STOP();
delay(2000);
CLOSE();
delay(4000);
OPEN_CLOSE_STOP();
delay(2000);
UP();
delay(2000);
UP_DOWN_STOP();
delay(2000);
ROTATE();
```

SOFTWARE IMPLEMENTATION

```
import argparse
import os import
platform import
sys
from pathlib import Path
import torch
FILE = Path(_file_).resolve()
ROOT = FILE.parents[0] # YOLOv5 root directoryif
str(ROOT) not in sys.path:
sys.path.append(str(ROOT)) # add ROOT to PATH
ROOT = Path(os.path.relpath(ROOT, Path.cwd())) # relativefrom
models.common import DetectMultiBackend
from utils.dataloaders import IMG_FORMATS, VID_FORMATS, LoadImages,
LoadScreenshots, LoadStreams
from utils.general import (LOGGER, Profile, check_file, check_img_size, check_imshow,
check_requirements, colorstr, cv2,
increment_path, non_max_suppression, print_args, scale_boxes, strip_optimizer,xyxy2xywh)
from utils.plots import Annotator, colors, save_one_box
from utils.torch_utils import select_device, smart_inference_mode import
serial
ser = serial.Serial(
        'COM13',
        baudrate          =          9600,
        parity=serial.PARITY_NONE,
        stopbits=serial.STOPBITS_ONE,
        bytesize=serial.EIGHTBITS,


                    timeout=1
    )
```

```
@smart_inference_mode() def
run(
    weights=ROOT / 'yolov5s.pt', # model path or triton URL source=ROOT /
    'data/images',   #   file/dir/URL/glob/screen/0(webcam)  data=ROOT   /
    'data/coco128.yaml', # dataset.yaml path
    imgsz=(640, 640), # inference size (height, width)
    conf_thres=0.25, # confidence threshold iou_thres=0.45, #
    NMS IOU threshold max_det=1000,  # maximum
    detections per imagedevice='',  # cuda device, i.e. 0 or
    0,1,2,3 or cpu

 view_img=False, # show results save_txt=False,
    # save results to *.txt
    save_conf=False,  # save confidences in --save-txt labels
    save_crop=False,  #  save  cropped  prediction  boxes
    nosave=False, # do not save images/videos classes=None, #
    filter by class: --class 0, or --class 0 2 3agnostic_nms=False, #
    class-agnostic NMS augment=False,  # augmented inference
    visualize=False, # visualize features
    update=False,  # update all models
    project=ROOT / 'runs/detect',  # save results to project/namename='exp',
    # save results to project/name
    exist_ok=False,   #  existing  project/name  ok,  do  not  increment
    line_thickness=3, # bounding box thickness (pixels) hide_labels=False, #
    hide labels
    hide_conf=False,  # hide confidences
```

Chapter 9

SNAPSHOTS

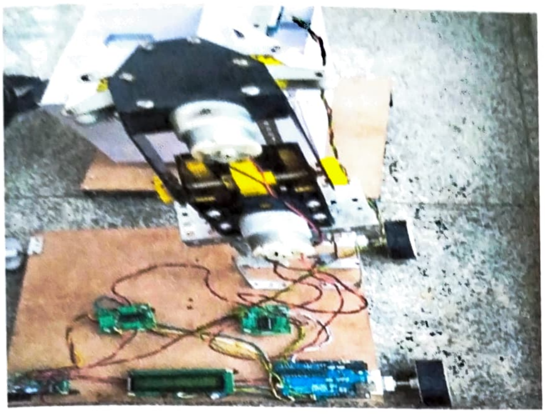


Fig 1:Model

Fig 2:Container

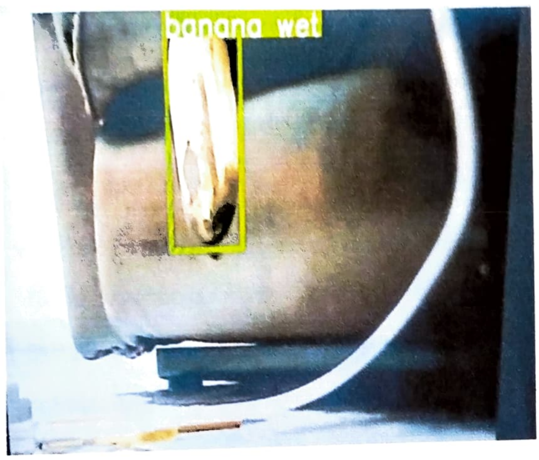


Fig 3:Wet Waste

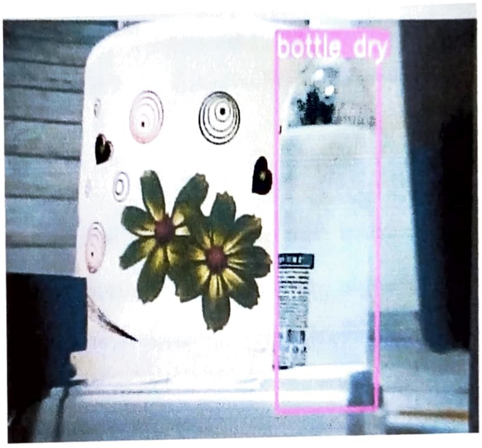


Fig 4: Dry Waste

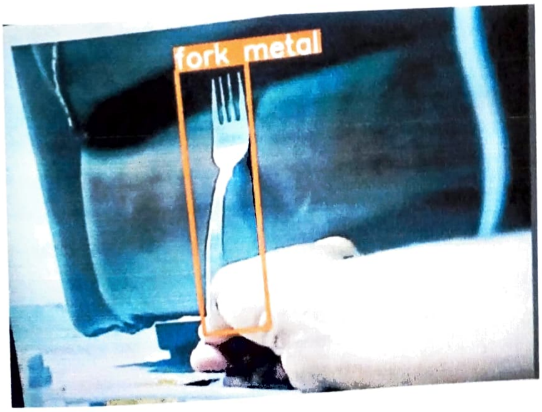


Fig 5: Metal Waste

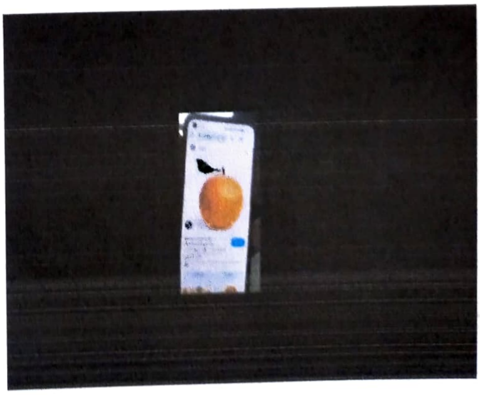


Fig 6: Wet Waste

Chapter 10

APPLICATIONS

Waste segregation using deep learning and IoT offers a promising approach to improving waste management systems and promoting sustainability. Here are some applications:

- **Automated Sorting**: Deep learning algorithms can be trainedto identify different types of waste materials such as paper, plastic, glass, and metal. IoT sensors can then be used to automatically sort waste at various stages of the waste management process, such as collection bins or sorting facilities.

- **Optimized Recycling Processes**: By accurately segregating waste materials, recycling facilities can optimize their processes. Deep learning models can help identify the most valuable materials for recycling, ensuring that resources are used efficiently and waste is minimized.

- **Waste Monitoring and Analytics**: IoT sensors can be deployed in waste bins to monitor fill levels, detect hazardous materials, or identify contamination. Deep learning algorithms can analyze this data to provide insights into waste generation patterns, optimize collection routes, and improve overall waste management strategies.

- **Smart Waste Bins**: IoT-enabled smart waste bins equipped with sensors and cameras can automatically detect and sort recyclable materials from general waste. Deep learning algorithms can continuously improve the accuracy of sorting by learning from the data collected by these bins over time.

- **Behavioral Analysis**: Deep learning models can analyze data from IoT devices to understand human behavior related to waste disposal. This insight can be used to develop targeted education and awareness campaigns to encourage proper waste segregation practices.

Chapter 11

CONTRIBUTION TO SOCIETY AND ENVIRONMENT

Waste management makes significant contributions to society across various dimensions, promoting environmental sustainability, public health, economic efficiency, and communitywell-being. Here are some key contributions of waste management to society:

1. **Environmental Protection:**
   - **Reduced Pollution:** Proper waste management minimizes the release of pollutants into the air, soil, and water, contributing to a healthier environment and mitigating the negative impacts on ecosystems.
2. **Public Health Improvement:**
   - **Disease Prevention:** Effective waste management prevents the spread of diseases by controlling the breeding of disease vectors (such as mosquitoes) inimproperly disposed waste.
3. **Resource Conservation and Recovery:**
   - **Recycling:** Waste management facilitates the recovery and recycling of materials, reducing the need for new production and conserving energy andresources.

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APPENDIX 1

DrillBit

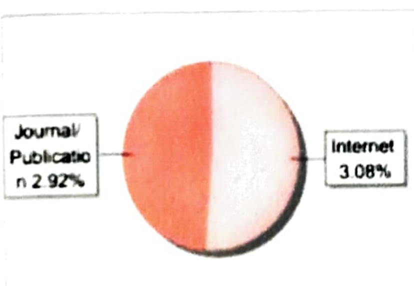
The Report is Generated by DrillBit Plagiarism Detection Software

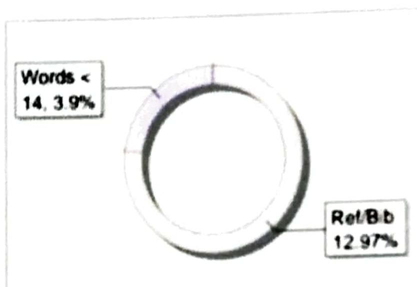
Submission Information

Author Name	Lavanya
Title	WASTE SEGREGATION USING DEEP LEARNING AND IOT
Paper Submission ID	1689501
Submitted by	supriyasuresh@kssem.edu.in
Submission Date	2024-04-24 10:55:24
Total Pages	23
Document type	Project Work

Result Information

Similarity **6 %**





Exclude Information

Quotes	Excluded
References/Bibliography	Excluded
Sources: Less than 14 Words %	Not Excluded
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Database Selection

Language	English
Student Papers	Yes
Journals & publishers	Yes
Internet or Web	Yes
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DrillBit

DrillBit Similarity Report

6	16	A	A-Satisfactory (0-10%) B-Upgrade (11-40%) C-Poor (41-60%) D-Unacceptable (61-100%)
SIMILARITY %	MATCHED SOURCES	GRADE	

LOCATION	MATCHED DOMAIN	%	SOURCE TYPE
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22	www.ijitee.org	<1	Publication

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I-GAUGE

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CERTIFICATE

This is to certify that Mr./Ms. Bhushan. P has participated in the "State Level Project Competition-2024" conducted on 27th of April 2024, organised by the Department of Information Science and Engineering, Bangalore Institute of Technology, Bengaluru - 560004.

BIT

Dr. Asha T	Dr. J. Prakash	Dr. Aswath M.U.
HOD, ISE Dept	Vice Principal, BIT	Principal, BIT

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HOD, ISE Dept.

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Vice Principal, BIT

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Principal, BIT

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