**YOLO-LitterPatrol**

**THESIS SUBMITTED IN PARTIAL FUFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF B.Sc. IN COMPUTER SCIENCE**

**BY**

**OGUEBIE TOBENNA KELVIN**

**BU/21C/IT/5966**

**IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE, FACULTY OF COMPUTING AND APPLIED SCIENCE, BAZE UNIVERSITY, ABUJA.**

**AUGUST,2024**

# DECLARATION

I hereby declared that this research project has been written by me under the supervision of Dr. Usman Bello Abubakar. The work has not been presented in any previous research for the award of B.Sc. degree to the best of my knowledge. The work is entirely mine and I accept the sole responsibility for any errors that might be found in the work, while the reference to publish material have been duly acknowledge.

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Date

TOBENNA OGUEBIE

BU/21C/IT/5966

**APPROVED BY**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Head of Department,**

Department of Computer Science

# CERTIFICATION

This project entitled “meditrack: diet recommendation for diabetics” meets the requirements governing the award of Bachelor of Science in Computer Science in Baze University, Abuja.

# APPROVAL

# This is to certify that the research work title Design and Implementation of YOLO-LitterPatrol by Tobenna Oguebie with BU/21C/IT/5966 has been approved by the Department of Computer Science, Faculty of Computing and Applied Science, Baze University, Abuja, Nigeria.

By

Dr Usman Bello Abubakar

Supervisor Date

Assoc Prof. Chandrashekhar Uppin

Head of Department Date

Prof Peter Ogedebe

Dean, Faculty of Computing and Applied Science Date

Prof Choji Davou Nyap

External Examiner Date

# DEDICATION

I extend my deepest appreciation to my professors for their mentorship, expertise, and guidance that have been pivotal in the shaping of this project. My sincere thanks go to my classmates for their collaborative spirit and shared commitment, turning challenges into opportunities for growth. I am grateful to Dr. Usman Bello for their valuable contributions and support, which significantly enhanced the project's depth and breadth.

Additionally, I want to acknowledge the understanding and encouragement provided by my family and friends. Their unwavering support has been a constant source of motivation throughout this academic journey. Each person involved has played a crucial role in the successful completion of this project, and I am truly thankful for the collaborative effort that has brought us to this point.

# ACKNOWLEDGMENT

God, the creator of mankind, the most merciful and kind, deserves all praise and appreciation for his blessings, protections, courage, and guidance. Dr. Usman Bello Abubakar, who stood by me and made sure I completed this project efficiently and effectively, has my undying thanks. I also want and my parents for their continuing support, direction, and encouragement in ensuring that I complete this program successfully. I would also like to thank my instructors and everyone else who has helped me get to this point in my academic career.

# *ABSTRACT*

# The increasing prevalence of littering from vehicles is a significant environmental concern that contributes to pollution. This project, “YOLO-LitterPatrol”, aims to address this issue by developing a real-time object detection system that identifies instances of littering from vehicles.

# The system leverages the state-of-the-art You Only Look Once (YOLO) algorithm for object detection. YOLO, with its ability to perform object detection in real-time, is particularly suited for this application. The project involves collecting a dataset of images or videos of cars throwing things from the window, training the YOLO model on this dataset, and testing the model’s performance on new, unseen data.

# The goal of the project is to create a tool that can be used to monitor roads and highways for littering behavior, providing data that can be used to inform policy and enforcement measures. By identifying and addressing this environmentally harmful behavior, the project contributes to efforts to reduce pollution and promote sustainable practices.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# CHAPTER ONE

# INTRODUCTION

* 1. Overview:

The "YOLO-LitteringPatrol" project aims to develop a real-time object detection system to identify littering instances from vehicles, utilizing the efficient and accurate You Only Look Once (YOLO) algorithm. By addressing this pressing environmental concern, the project endeavors to contribute to pollution reduction and sustainable practices. Through meticulous dataset collection, model training, and performance evaluation, the project seeks to create a monitoring tool capable of detecting littering behaviors on roads and highways. Leveraging advanced machine learning techniques, the project aligns with broader initiatives aimed at mitigating environmental degradation.

* 1. Background and Motivation:

Littering from vehicles is a major contributor to environmental pollution. Despite various measures to curb this behavior, it remains prevalent. The motivation behind this project is to leverage advanced machine learning techniques to detect and report such instances, thereby contributing to efforts to reduce pollution and promote sustainable practices. It discusses how despite existing efforts, littering remains a significant environmental concern. The motivation behind the project is explained, emphasizing the need to employ advanced machine learning techniques to address this persistent issue. This section highlights the project's alignment with broader environmental goals of pollution reduction and sustainable practices.

**1.3 STATEMENT OF THE PROBLEM**

The problem this project addresses is the real-time detection of littering instances from moving vehicles, a significant yet often overlooked environmental issue. The challenge lies in accurately identifying the act of littering amidst various other activities that may occur in and around a vehicle.

The solution involves several complex steps. Firstly, it requires the collection of a robust dataset comprising images or videos capturing instances of cars discarding items from the window. This dataset must be sufficiently diverse to account for various lighting conditions, vehicle types, and litter items.

Secondly, the collected data must be meticulously labelled, marking bounding boxes around the objects of interest, i.e., the discarded items. This step is crucial as the quality of labelling directly impacts the model’s learning and subsequent detection accuracy.

The next step involves training the YOLO model on this prepared dataset. This process adjusts the model’s parameters to minimize the difference between the model’s predictions and the actual labels. It’s a computationally intensive task requiring careful selection of hyperparameters for optimal learning.

Finally, the performance of the trained model is tested on new, unseen data. This step evaluates the model’s generalization capability, i.e., its ability to accurately detect littering instances in scenarios not present in the training data. The model’s performance is then analysed using appropriate metrics to determine its readiness for deployment.

Each of these steps presents its own set of challenges and complexities, making this a non-trivial problem to solve. However, the potential environmental impact of successfully addressing this problem makes it a worthwhile endeavour.

* 1. Aim and Objectives:

The aim of the project is elaborated upon, focusing on the development of a monitoring tool for detecting littering behaviors on roads and highways. The objectives are delineated into specific tasks, including dataset collection, model training, performance evaluation, and testing. Each objective contributes to achieving the overarching aim of creating an effective detection system. The objectives of this project include:

* Collecting and preprocessing a suitable dataset
* Training the YOLO model on the dataset
* Evaluating and optimizing the model’s performance
* Testing the model on new data
  1. Significance of the project:

The project holds significant potential for informing policy and enforcement measures related to littering from vehicles. By providing real-time data on such instances, it can contribute to efforts to reduce pollution and promote sustainable practices. This section underscores the importance of the project's outcomes in informing policy and enforcement measures related to littering from vehicles. By providing real-time data on littering incidents, the project has the potential to drive meaningful change and contribute to broader environmental conservation efforts. This highlights the practical implications and societal impact of the project's results.

* 1. Project risk assessment:

The “YOLO-LitteringPatrol” project, while promising, is not without potential risks and challenges that could impact its successful execution and outcomes. These risks span across various aspects of the project, from data collection to model training and performance.

* Data Collection: One of the primary challenges lies in collecting a sufficiently large and diverse dataset. The quality and quantity of the data directly influence the model’s ability to learn and generalize. There might be difficulties in finding enough instances of littering from vehicles captured in images or videos. Additionally, the dataset needs to be diverse to account for various lighting conditions, vehicle types, and types of litter, which might be challenging to procure.
* Data Labeling: Even after collecting the data, it needs to be accurately labeled, marking bounding boxes around the objects of interest. This process can be time-consuming and requires a high level of precision to ensure the model learns correctly.
* Model Training: Training the YOLO model on the collected dataset can pose challenges due to computational limitations. The training process is resource-intensive, requiring high computational power and memory. Depending on the available resources, this could potentially limit the complexity of the model or the size of the dataset that can be used.
* Model Performance: There is always a risk that the model might not achieve the desired level of accuracy. Factors such as overfitting, where the model learns the training data too well and performs poorly on new data, or underfitting, where the model fails to capture the underlying patterns in the data, can affect the model’s performance
* Real-Time Detection: The project aims for real-time detection, which requires the model to process and predict in a very short time frame. Achieving this speed without compromising on the accuracy of detection can be a challenging task.
  1. Scope/Project Organization:

This section outlines the comprehensive scope of the project and its organizational framework. It explicitly states that while the primary focus lies in the development and rigorous testing of the detection system using a dataset, the deployment of the system in real world scenarios is not presently included in the project’s objectives.