DETECTION OF STREET AND RIVER POLLUTION USING AI MAPPING SYSTEM

A MINOR PROJECT-IV REPORT

Submitted by

PRABHAVATHI K S	**927622BEC145**
PRIYADHARSHINI P	**927622BEC156**
RESHMA N	**927622BEC165**
SAMUTHRA M	**927622BEC170**

BACHELOR OF ENGINEERING

In

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M.KUMARASAMY COLLEGE OF ENGINEERING

(Autonomous)

KARUR – 639 113

MAY 2025

M.KUMARASAMY COLLEGE OF ENGINEERING, KARUR

BONAFIDE CERTIFICATE

Certified that this**18ECP106L - Minor Project IV** report "DETECTION OF STREET AND RIVER POLLUTED AREA USING AI MAPPING SYSTEM**"** is the Bonafide work of **"PRABHAVATHI K S (927622BEC145) , PRIYADHARSHINI P (927622BEC156),RESHMA N(927622BEC165),SAMUTHRA M (927622BEC170)"** who carried out the project work under my supervision in the academic year 2024 - 2025 **EVEN**.

SIGNATURE

Dr.A.KAVITHA, B.E., M.E., Ph.D.,

HEAD OF THE DEPARTMENT,

Professor,

Department of Electronics and

Communication Engineering,

M.Kumarasamy College of Engineering,

Thalavapalayam,

Karur-639113.

SIGNATURE

Dr.S.MEIVEL, B.E., M.E., Ph.D.,

SUPERVISOR,

Assistant Professor,

Department of Electronics and

Communication Engineering,

M.Kumarasamy College of Engineering,

Thalavapalayam,

Karur-639113.

This report has been submitted for the **18ECP106L – Minor Project IV** final review held at

M. Kumarasamy College of Engineering, Karur on _______________________.

PROJECT COORDINATOR

INSTITUTION VISION AND MISSION

Vision

To emerge as a leader among the top institutions in the field of technical education.

Mission

M1: Produce smart technocrats with empirical knowledge who can surmount the global challenges.

M2: Create a diverse, fully -engaged, learner -centric campus environment to provide quality education to the students.

M3: Maintain mutually beneficial partnerships with our alumni, industry and professional associations

DEPARTMENT VISION, MISSION, PEO, PO AND PSO

Vision

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives

PEO1: Core Competence: Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering

PEO2: Professionalism: Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: Lifelong Learning: Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfil the industrial expectations.

Abstract	Matching with POs,PSOs
Unmanned Aerial Vehicles (UAVs),Environmental Sensors, High-Resolution Cameras, Infrared Sensor, Gas and Water Quality Detectors	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2

ACKNOWLEDGEMENT

We gratefully remember our beloved **Founder Chairman, (Late) Thiru. M. Kumarasamy**, whose vision and legacy laid the foundation for our education and inspired us to successfully complete this project.

We extend our sincere thanks to **Dr. K. Ramakrishnan, Chairman**, and **Mr. K. R. Charun Kumar, Joint Secretary**, for providing excellent infrastructure and continuous support throughout our academic journey.

We are privileged to extend our heartfelt thanks to our respected Principal, **Dr. B. S. Murugan, B.Tech., M.Tech., Ph.D.,** for providing us with a conducive environment and constant encouragement to pursue this project work.

We sincerely thank **Dr. A. Kavitha, B.E., M.E., Ph.D.,** Professor and **Head, Department of Electronics and Communication Engineering**, for her continuous support, valuable guidance, and motivation throughout the course of this project.

Our special thanks and deep sense of appreciation go to our **Project Supervisor, Mrs. L. Kavitha, B.E., M.E.,** Assistant Professor, **Department of Electronics Engineering (VLSI Design and Technology),** for her exceptional guidance, continuous supervision, constructive suggestions, and unwavering support, all of which have been instrumental in the successful execution of this project.

We would also like to acknowledge **our Class Advisor, Mrs. L. Kavitha, B.E., M.E.,** Assistant Professor, **Department of Electronics and Communication Engineering,** and **our Project Coordinator**, **Mrs. L. Kavitha, B.E., M.E.,** Assistant Professor, **Department of Electronics Engineering (VLSI Design and Technology),** for their constant encouragement and coordination that contributed to the smooth progress and completion of our project work.

We gratefully thank all the **faculty members of the Department of Electronics and Communication Engineering** for their timely assistance, valuable insights, and constant support during various phases of the project.

Finally,we extend our profound gratitude to our **parents and friends** for their encouragement, and support, without which the successful completion of this project would not have been possible.

ABSTRACT

Environmental pollution in metropolitan streets and rivers poses significant health and environmental challenges, with conventional detection methods relying on manual inspections or ground-based systems that are costly, time-intensive, and geographically restricted. This study introduces a drone mapping system using unmanned aerial vehicles (UAVs) equipped with high-resolution cameras, infrared sensors, and environmental sensors like gas and water quality detectors to address these limitations. These advanced sensors enable the identification of air pollutants such as gases and particulate matter, as well as chemical and biological contaminants in water. The UAVs collect real-time aerial imagery and sensor data, offering efficient monitoring of large and hard-to-reach areas. Compared to traditional methods, drone mapping systems are cost-effective, scalable, and capable of delivering precise and comprehensive data across urban and rural environments. This mobility and precision allow timely detection and response to pollution issues, significantly enhancing environmental management practices. Furthermore, the system's ability to monitor extensive areas with accuracy supports proactive decision-making and policy implementation to mitigate pollution. By integrating cutting-edge technology with environmental monitoring, drone mapping systems revolutionize pollution detection and tracking, offering a sustainable and efficient solution to address ecological challenges. Ultimately, this innovation contributes to healthier, more sustainable communities by enabling better resource allocation and fostering cleaner urban and rural environments.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACRONYM	ABBREVIATION
PM	Particle Matter
CO2	Carbon dioxide
GIS	Geographic Information System
IOT	Internet of Things
RGB	Red, Green, Blue sensor
LIDAR	Light Detection and Ranging

CHAPTER 1

INTRODUCTION

Environmental pollution has become a major worldwide concern that endangers biodiversity and human health, especially in urban streets and rivers. Industrial emissions, vehicle exhaust, agricultural runoff, untreated sewage, and unlawful dumping are some of the causes of pollution in these locations. The quality of the air and water can be negatively impacted by these contaminants, which can result in respiratory issues, waterborne illnesses, and ecological destruction. Conventional pollution monitoring techniques, including physical inspections or ground-based sensors, are frequently time-consuming, labour-intensive, and have a restricted geographic coverage. Innovative and effective methods for detecting and tracking pollution in both major urban and rural regions are therefore desperately needed.

Drone technology is one of the most promising developments in environmental monitoring. Unmanned aerial vehicles, or drones, with a variety of sensors provide an economical, scalable, and effective way to detect pollution in difficult-to-reach places, like crowded city streets and isolated riverbanks. With little assistance from humans, these aircraft systems can gather data in real time and provide a thorough picture of pollution levels across wide geographic areas. The accuracy and coverage of pollution detection can be greatly increased by fusing drone technology with cutting-edge sensor systems.

Vehicle emissions are one of the main causes of pollution in urban streets, contributing to the concentration of gases such as carbon monoxide (CO) and nitrogen dioxide (NO2) as well as particle matter (PM). In addition to air pollution, contaminants from trash disposal, construction sites, and industry can build up on roadway surfaces. Conventional techniques for evaluating these pollutants frequently depend on manual sampling or stationary ground sensors, which may not cover large areas or may miss localized pollution episodes. However, dynamic, real-time pollution mapping provided by drone-based technologies can help authorities locate pollution hotspots with speed and efficiency.

The primary objective of this study is to demonstrate the viability of drone-based systems for pollution detection and mapping, offering an innovative and scalable solution to the growing environmental challenges in urban and rural areas. By enabling faster, more accurate detection of pollution, this system can help local authorities, environmental agencies, and urban planners better manage pollution control efforts, leading to healthier environments and improved quality of life for affected communities.

The potential of drone mapping systems to identify and evaluate pollution levels in river and street environments is investigated in this study. A thorough grasp of air and water pollution is provided by the system's integration of high-resolution cameras, infrared sensors, gas detectors, and water quality sensors. To locate and map pollution hotspots, data gathered from drones is examined using machine learning algorithms and image processing techniques. Following visualization and integration into a Geographic Information System (GIS), the outcomes offer a potent instrument for environmental monitoring and decision-making in real time.

1.1 OBJECTIVE

The objective of this study is to design an innovative drone mapping system equipped with advanced sensors, including high-resolution cameras, infrared detectors, and gas and water quality sensors, to efficiently detect and monitor environmental pollution in metropolitan streets and rivers. By capturing real-time data on air pollutants, chemical contaminants, and biological waste, the system offers a cost-effective, scalable, and accurate solution for assessing large and hard-to-reach areas. This approach overcomes the limitations of conventional methods, such as high costs and limited coverage, enabling timely pollution detection and management. By integrating cutting-edge technology, the system promotes sustainable environmental practices, healthier urban and rural communities, and proactive resource allocation to address ecological challenges effectively.

CHAPTER 2

LITERATURE SURVEY

- **Zhang et al. (2016):**

2.1"Drone-Based Monitoring of Air Pollution: Tracking Gas Emissions and Particulate Matter in Urban Environments"

This study demonstrates the ability of drones equipped with optical and infrared cameras to detect air pollution in urban areas. The drones are used to track gas emissions from automobiles and industrial sites, as well as monitor particulate matter concentrations. The study highlights how infrared footage captured by UAVs with multispectral cameras can be used to identify pollution hotspots in cities.

- **Wang et al. (2020):**

2.2"Utilizing UAVs for River Ecosystem Monitoring: Assessing Vegetation Health, Water Flow, and Turbidity Levels"

This research investigates the use of drones to monitor environmental changes along rivers, including assessing water quality indicators such as turbidity levels, vegetation health, and water flow. The study shows how UAVs can provide valuable data on river pollution and ecosystem health, particularly in hard-to-reach areas that are difficult to monitor using traditional methods.

- **El Hadi et al. (2018):**

2.3"Urban Air Quality Assessment Using UAV-Mounted Gas Sensors: A Case Study of Traffic and Industrial Pollution"

In this study, UAVs equipped with gas sensors were used to assess air quality in urban streets. The UAVs measured concentrations of nitrogen dioxide (NO_2), carbon dioxide (CO_2), and ozone (O_3) at different altitudes in various urban locations. The results revealed pollution patterns linked to traffic congestion and industrial zones, offering useful insights for urban planners and environmental agencies.

- **Guerra et al. (2021):**

2.4"Real-Time Air Quality Monitoring with UAVs: Detecting Particulate Matter and Predicting Pollution Trends Using Machine Learning"

This study presents a drone-based air quality monitoring system for detecting particulate matter ($PM_{2.5}$ and PM_{10}) in real-time. The UAVs are equipped with sensors and combined with machine learning algorithms to identify high pollution areas and predict future trends in air quality. The approach offers a dynamic and flexible alternative to traditional fixed air quality monitoring stations.

- **Liu et al. (2019):**

2.5"Drone-Based Monitoring of Water Turbidity and Chlorophyll Levels in Lakes and Rivers: A Multispectral Approach"

This research explores the use of UAVs with multispectral sensors to monitor water quality in lakes and rivers. The study tracks changes in water turbidity and chlorophyll concentration, both indicators of pollution levels. The UAVs allow for large-scale monitoring of water bodies, eliminating the need for manual testing at multiple sites and providing more efficient and accurate data.

- **Liu et al. (2020):**

2.6"Advanced UAV Systems for Detecting Pesticides and Heavy Metals in River Water"

In this study, drones equipped with sophisticated sensors were used to detect pollutants such as pesticides and heavy metals in river water. The UAVs provide real-time data on water quality, allowing for rapid identification of contamination sources. This technique enhances water monitoring capabilities, particularly in detecting pollutants that are difficult to assess using traditional methods.

- **Sheng et al. (2020):**

2.1"Tracking Wastewater Impact on Rivers Using Drones: Identifying Contaminated Sites and Pollution Sources"

This study demonstrates the use of drones to monitor the impact of wastewater discharges into rivers. Drones are used to quickly detect areas with low dissolved oxygen levels, high turbidity, or abnormal pH, all indicators of water contamination. The ability of drones to track pollution sources over time provides valuable insights for decision-makers regarding pollution management and cleanup efforts.

CHAPTER 3

EXISTING SYSTEM

Drone mapping systems have emerged as a transformative technology for detecting and monitoring pollution in streets and rivers, providing an efficient and scalable solution to environmental challenges. These systems utilize drones equipped with advanced sensors and cameras to capture real-time data on pollution levels, enabling authorities to identify and map polluted areas with high precision. Drones commonly used in such systems include quadcopters and fixed-wing models, which carry various payloads like high-resolution cameras, multispectral sensors, thermal imaging devices, gas detectors, and water quality sensors. These tools collect data on visible waste, such as plastics and garbage, as well as invisible pollutants like oil spills, chemical contaminants, and harmful gases.

The data collected by drones is geotagged, enabling precise mapping of pollution hotspots. High-resolution imaging provides clear visuals of the affected areas, while multispectral and thermal sensors detect anomalies in vegetation health, water quality, and temperature. Water quality sensors measure critical parameters like pH, turbidity, and dissolved oxygen levels to assess river pollution, while gas detectors monitor harmful emissions such as methane and carbon dioxide. The integration of artificial intelligence (AI) and machine learning further enhances these systems by automating the analysis of collected data. AI algorithms classify waste, identify pollution patterns, and even predict the spread of pollutants, making the process faster and more reliable.

Additionally, drone mapping systems are equipped with communication technologies such as Wi-Fi, LoRa, and ZigBee to transmit data in real-time to ground control stations or cloud platforms. Cloud integration facilitates collaborative cleanup operations by sharing data with multiple stakeholders, enabling effective planning and decision-making. These systems also utilize 3D mapping to visualize polluted areas, providing a detailed understanding of the scope and severity of pollution. Such advanced tools are invaluable in urban settings for monitoring garbage accumulation and tracking industrial waste disposal, as well as in natural environments for assessing river health and mitigating the impact of chemical spills.

Despite their numerous advantages, drone mapping systems face several challenges. The high cost of purchasing and maintaining drones and sensors limits their widespread adoption. Drones have limited battery life, restricting their flight range and operational time. Additionally, adverse weather conditions, such as rain or strong winds, can hinder drone performance and data collection. Another limitation lies in the accuracy of AI models, which may struggle to differentiate between natural debris and man-made pollutants. Nevertheless, ongoing advancements in technology are addressing these issues, paving the way for more efficient and cost-effective systems.

Looking to the future, drone mapping systems are expected to incorporate autonomous operation, allowing drones to navigate and collect data without human intervention. Solar-powered drones could solve the problem of limited battery life, enabling longer missions. Integration with the Internet of Things (IoT) could enhance real-time monitoring capabilities, connecting drones to a network of environmental sensors for comprehensive pollution assessment. These advancements, combined with improved AI algorithms, will make drone mapping systems indispensable tools in environmental conservation and sustainable development.

Drone mapping systems represent a cutting-edge approach to detecting and managing pollution in streets and rivers. By combining high-resolution imaging, advanced sensors, AI-driven analysis, and real-time communication, these systems offer a powerful solution for addressing environmental challenges. While challenges such as cost and operational constraints persist, the potential benefits of these systems far outweigh the limitations, making them a critical component of modern environmental monitoring strategies.

Drone mapping systems provide a revolutionary approach to addressing environmental pollution by leveraging advanced technologies to monitor and detect polluted areas in streets and rivers. These systems utilize drones equipped with a range of sensors, including high-resolution RGB cameras for visible waste detection, thermal sensors for identifying heat-based anomalies, multispectral sensors for monitoring vegetation stress, and LIDAR for precise topographical mapping. Gas sensors detect harmful emissions such as methane, carbon monoxide, and other industrial pollutants, while water quality sensors measure key parameters like turbidity, conductivity, pH, temperature, and dissolved oxygen. Together, these tools enable the collection of comprehensive data about the extent and nature of pollution.

Drone systems use geotagging to associate captured data with specific geographic locations, allowing for the creation of highly accurate pollution maps. Advanced software processes this data using artificial intelligence (AI) and machine learning (ML) algorithms. These algorithms not only classify pollutants but also predict their potential spread and assess the severity of contamination, enabling authorities to prioritize cleanup efforts. Furthermore, drones equipped with advanced imaging technologies like 3D mapping and GIS integration provide detailed visualizations of polluted areas, facilitating effective planning for mitigation strategies.

The flexibility and mobility of drones make them ideal for monitoring inaccessible or hazardous areas, such as remote rivers, dense urban zones, or industrial sites, where manual inspections are impractical. Real-time communication systems, including wireless technologies like LoRa, ZigBee, and 5G, enable drones to transmit data instantly to ground stations or cloud platforms. Cloud integration ensures seamless data sharing among stakeholders, such as environmental agencies, local governments, and private organizations, enabling coordinated action against pollution.

Drone mapping systems also support large-scale environmental initiatives, such as tracking illegal dumping, monitoring seasonal changes in pollution levels, and assessing the impact of natural disasters on ecosystems. These systems have been successfully employed in various case studies, including monitoring plastic waste in rivers, detecting oil spills in coastal regions, and analyzing air pollution in urban environments. The data collected by drones is often used to develop predictive models, enabling proactive measures to prevent pollution in vulnerable areas.

However, several challenges remain in the implementation of drone mapping systems. High initial costs for drones and sensors, coupled with the expense of maintaining and upgrading the technology, pose significant financial barriers. Additionally, drones have limited battery life, which restricts their operational range and flight duration, particularly in large areas. Adverse weather conditions such as rain, strong winds, or extreme temperatures can disrupt drone performance and data accuracy. Regulatory restrictions on drone usage, including airspace limitations and licensing requirements, further complicate deployment.

Future advancements in drone technology aim to overcome these challenges. Solar-powered drones and extended battery solutions are being developed to enhance flight duration. Autonomous drones with advanced AI capabilities are expected to reduce dependency on human operators, enabling large-scale deployment. Integration with Internet of Things (IoT) devices will create a connected network of drones and ground sensors, offering real-time monitoring on an unprecedented scale. Additionally, improvements in AI algorithms will increase the accuracy of pollution detection and classification, ensuring reliable data for decision-making.

In conclusion, drone mapping systems offer immense potential in combating pollution in streets and rivers. By combining cutting-edge sensor technology, geospatial mapping, AI-driven analysis, and real-time data communication, these systems provide a comprehensive solution for environmental monitoring and management. While challenges such as cost, weather dependency, and regulatory constraints persist, ongoing innovations are set to make these systems more accessible, efficient, and impactful in promoting sustainability and environmental protection.

CHAPTER 4

PROPOSED SYSTEM

Pollution in streets and rivers has become a critical concern worldwide, threatening ecosystems, public health, and the overall quality of life. Traditional methods of monitoring pollution, such as on-foot surveys or stationary sensors, are often labor-intensive, time-consuming, and limited in scope. To address these challenges, innovative technologies like drone mapping systems offer an efficient and scalable solution for detecting and monitoring polluted areas. This system integrates advanced hardware and software, including drones equipped with high-resolution cameras, air and water quality sensors, and Geographic Information System (GIS) tools. The proposed system leverages drones' mobility and advanced data processing capabilities to identify and map pollution hotspots in streets and rivers, providing actionable insights for environmental agencies, urban planners, and policymakers.

The foundation of this system is the drone, a versatile and agile device capable of capturing aerial images and collecting data from hard-to-reach areas. Modern drones can be equipped with high-resolution cameras to record visual evidence of pollution, such as garbage piles, oil spills, and clogged drainage systems. Additionally, sensors for measuring air quality indicators like particulate matter (PM2.5), carbon dioxide (CO2), and nitrogen oxides (NOx), as well as water quality parameters like pH, turbidity, and dissolved oxygen, can be integrated into these drones. These sensors provide real-time quantitative data on environmental pollutants, which, when combined with visual evidence, create a comprehensive picture of the pollution levels in a given area. The use of GPS technology further enhances the system's accuracy by geo tagging all collected data, enabling the precise localization of pollution hotspots.

The operation of the drone mapping system begins with the planning and deployment phase. Drones are pre-programmed with optimized flight paths to cover targeted streets and river stretches efficiently. These flight paths are designed to maximize coverage while minimizing flight time and battery usage. In areas where predefined paths are insufficient, manual control options can be used to navigate drones to critical or inaccessible regions. Once deployed, drones begin collecting data through their cameras and sensors. High-resolution images capture visible signs of pollution, while the sensors measure air and water quality at multiple waypoints. This dual data collection process ensures a thorough assessment of both visible and invisible pollutants.

After data collection, the next critical step is data analysis. Advanced AI and machine learning algorithms are employed to process the captured images and sensor readings. For instance, image recognition algorithms can identify specific types of waste, such as plastic bottles, industrial discharge, or oil slicks, based on their shapes, colors, and textures. Similarly, sensor data is analyzed to detect anomalies or exceedances of pollution thresholds. By combining visual and quantitative data, the system generates a detailed report highlighting the severity and types of pollution present in each location. These reports are invaluable for prioritizing cleanup efforts and designing targeted interventions.

The processed data is then integrated into a GIS-based mapping platform, which provides a visual representation of pollution distribution across the surveyed area. Heatmaps are commonly used to indicate pollution intensity, with different colors representing varying levels of severity. For example, red areas on the map might indicate highly polluted zones, while green areas signify relatively clean regions. These maps are not only easy to interpret but also serve as a powerful tool for engaging stakeholders, including government agencies, non-governmental organizations (NGOs), and local communities. The maps can be accessed in real-time through cloud-based platforms, allowing for immediate action in case of severe pollution incidents.

The applications of this drone mapping system are extensive and multifaceted. In urban areas, the system can identify illegal dumping sites, overflowing garbage bins, and regions with poor air quality. In rural areas, it can be used to monitor agricultural runoff and its impact on nearby water bodies. For river pollution monitoring, drones can detect oil spills, plastic waste accumulation, and industrial discharge points. These insights help authorities enforce environmental regulations, optimize waste management practices, and design sustainable urban and rural development plans. Moreover, the system can be used for periodic monitoring to track the effectiveness of pollution control measures over time.

Despite its numerous advantages, the proposed system does face certain challenges. One of the primary issues is its dependency on weather conditions. Rain, strong winds, or fog can hinder drone operations, affecting the quality and reliability of data collection. Additionally, maintaining and calibrating the sensors is essential to ensure accurate readings, which can increase operational costs. Privacy concerns also arise when drones fly over residential or private areas, making it crucial to establish strict guidelines to protect individuals' rights. Finally, the initial setup cost for procuring drones, sensors, and software may be high, posing a barrier for smaller organizations or developing regions.

To address these challenges, ongoing research and development are essential. For instance, integrating drones with advanced machine learning algorithms can enable automated flight path adjustments based on pollution density, improving efficiency and adaptability. Furthermore, the development of more robust and weather-resistant drones would enhance operational reliability in diverse environmental conditions. Additional sensors capable of detecting microplastics, heavy metals, and other emerging pollutants could further expand the system’s capabilities. Collaboration with regulatory bodies and communities is also vital to ensure the ethical and effective deployment of this technology.

In conclusion, a drone mapping system for detecting street and river pollution offers a transformative approach to environmental monitoring and management. By combining mobility, advanced sensing technologies, and powerful data analysis tools, this system can provide rapid, accurate, and actionable insights into pollution levels. It not only enhances the efficiency of identifying pollution hotspots but also supports informed decision-making for sustainable development and environmental protection. While challenges such as weather dependency and privacy concerns need to be addressed, the potential benefits of this system far outweigh its limitations, making it a valuable asset in the fight against pollution.

CHAPTER 5

PRINCIPLE AND METHODOLOGY

Using a drone mapping system to identify contaminated regions in streets and rivers entails a number of procedures, from deploying drones fitted with particular sensors to gathering, processing, and analysing data. Modern drone technology, sensors, image processing, and Geographic Information Systems (GIS) are all integrated into this method to give real-time mapping and pollution identification. The main goal is to develop a scalable, economical, and effective system for tracking environmental contamination in riverine and urban environments. A thorough explanation of the process may be found below.

A. Selection of UAVs and Sensors

Choosing the right unmanned aerial vehicles (UAVs) and sensors for the job is the first stage in the technique. To guarantee steady flight and trustworthy data collection, drones with high endurance, payload capacity, and GPS accuracy are used. Multiple sensor-carrying UAVs that can fly at different altitudes to cover a range of sites are preferred.The following sensors are commonly seen on UAVs used for street pollution detection.Particulate matter (PM2.5, PM10), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), and ozone (O_3) can all be measured using air quality monitors. These sensors aid in the collection of pollutants from industrial sources, building sites, and automobile emissions. Infrared and visible cameras are used to identify visual pollution indicators, like dust, smoke, and locations with high traffic.

UAVs are outfitted with water quality sensors to detect river contamination, such as:

1. **Turbidity sensors** are used to monitor the water's clarity since higher turbidity might be a sign of chemical or sediment pollution.

2. **pH sensors** to measure the water's acidity or alkalinity, which can reveal contamination from agricultural or industrial runoff.

3. Use of **dissolved oxygen sensors** to measure the water's oxygen content because low levels could be a sign of eutrophication or organic pollution.

4. **Chemical sensors** to identify the presence of particular pollutants, such as pesticides or heavy metals (such as lead or mercury).

B. FLIGHT PLANNING AND DATA COLLECTION

For drones to efficiently cover the assigned areas, flight planning is essential. Depending on the drone's size and flying duration, the area of interest (AOI) is separated into more manageable, smaller portions. The UAV is configured to fly over the streets or river segments of interest along present flight routes. The UAVs are flown over busy streets, industrial zones, and locations with possible pollution sources at low to medium altitudes (50–150 meters). While flying over several traffic hotspots and industrial complexes, the drone records environmental data in real time .Drones fly at significantly higher altitudes (between 50 and 200 meters) over rivers, depending on the river's accessibility and width. The UAVs record information along the whole river or in particular areas where pollution is thought to be present. Furthermore, UAVs have the ability to hover over certain objects of interest, like agricultural runoff zones or discharge pipes.

C. DATA PROCESSING AND IMAGE ANALYSIS

After data is collected, it is processed using image analysis and environmental data analysis techniques to detect pollution. The following steps outline the data processing approach.

1. IMAGE PROCESSING FOR STREET POLLUTION

Specialized image processing methods are used to process the UAV's visible and infrared imagery. These algorithms pinpoint locations with obvious pollution indicators, such excessive traffic, dust from construction, and smoke emissions. Using visual cues like colour changes and air particle density, image segmentation algorithms are utilized to differentiate between clean and polluted locations. The heat signatures of pollution sources, such vehicle emissions, can be found using the infrared photographs. Furthermore, machine learning techniques (such deep learning models or supervised classification) are used to categorize pollution levels in various locations. These algorithms provide automated pollution identification by identifying patterns of pollution in the photos after being trained on labelled datasets.

2. WATER QUALITY DATA ANALYSIS FOR RIVER POLLUTION

The drones' water quality sensors gather data, which is then analysed to evaluate the water's physical and chemical characteristics.

The analysis involves the following steps:

1. Higher turbidity levels in water : Higher turbidity levels in water are indicative of suspended particles, which are frequently caused by contaminants such as chemicals, sediments, or oils. To determine which areas are polluted, a threshold level is established.

1. **Analysis of pH and Dissolved Oxygen:** Considerable departures from typical pH and dissolved oxygen levels indicate potential chemical contamination, including organic waste and industrial discharges. To determine pollution hazards, the data is compared to accepted water quality requirements.

2. **Chemical Contaminants:** Chemical sensors identify the existence of particular contaminants, including pesticides or heavy metals. To ascertain whether concentrations surpass safe limits, the data is examined.

D. GEOSPATIAL MAPPING AND INTEGRATION WITH GIS

The processed data is included into a Geographic Information System (GIS), which includes both sensor readings and imagery. Data about pollution may be visualized, mapped, and spatially analyzed thanks to GIS. Using the GPS data gathered during the flight, each identified pollution hotspot is georeferenced. Real-time pollution maps that show the distribution and intensity of pollutants throughout the monitored area are produced by the system.

The GIS maps for street pollution show where there are high levels of gas emissions, particulate matter, and other pollutants. These maps are useful for locating industrial locations, areas with high traffic volumes.

The GIS mapping method helps identify pollution sources and monitor water quality by highlighting areas of the river with high turbidity, low dissolved oxygen, and chemical contamination.

E.REPORTING AND DECISION-MAKING

Following the identification and mapping of the pollution hotspots, stakeholders, urban planners, and environmental authorities are shown the findings. The information is disseminated via interactive dashboards or comprehensive reports that offer insights into patterns and pollutant levels. With this data, decision-makers can rank the importance of intervention areas, such implementing pollution control strategies, improving waste management, or enforcing laws.

E.CONTINUOUS MONITORING AND UPDATES

The purpose of the drone mapping system is to provide ongoing monitoring capabilities. Authorities can monitor changes in pollution levels over time by deploying drones periodically or as needed. Long-term monitoring aids in identifying new sources of pollution, assessing how well mitigation strategies are working, and guaranteeing sustainable environmental management.

IV. FUTURE WORK

Future research on drone mapping systems for river and street pollution detection has a lot of promise for improving scalability and efficacy. Sensor technology advancements will increase accuracy and expand the range of contaminants that may be detected, such as the incorporation of more specialized and sensitive sensors for the detection of pollutants including microplastics and volatile organic compounds (VOCs). Drones will also be able to cover more ground with longer flying times because to the addition of smaller sensors and greater battery life. Drones will be able to assess pollution patterns on their own by combining real-time data processing with artificial intelligence (AI) and machine learning (ML) algorithms. This will enable them to identify pollution sources and trends in real-time, which will expedite decision-making. Future technologies might also be able to track other environmental elements like heavy metals and noise pollution.

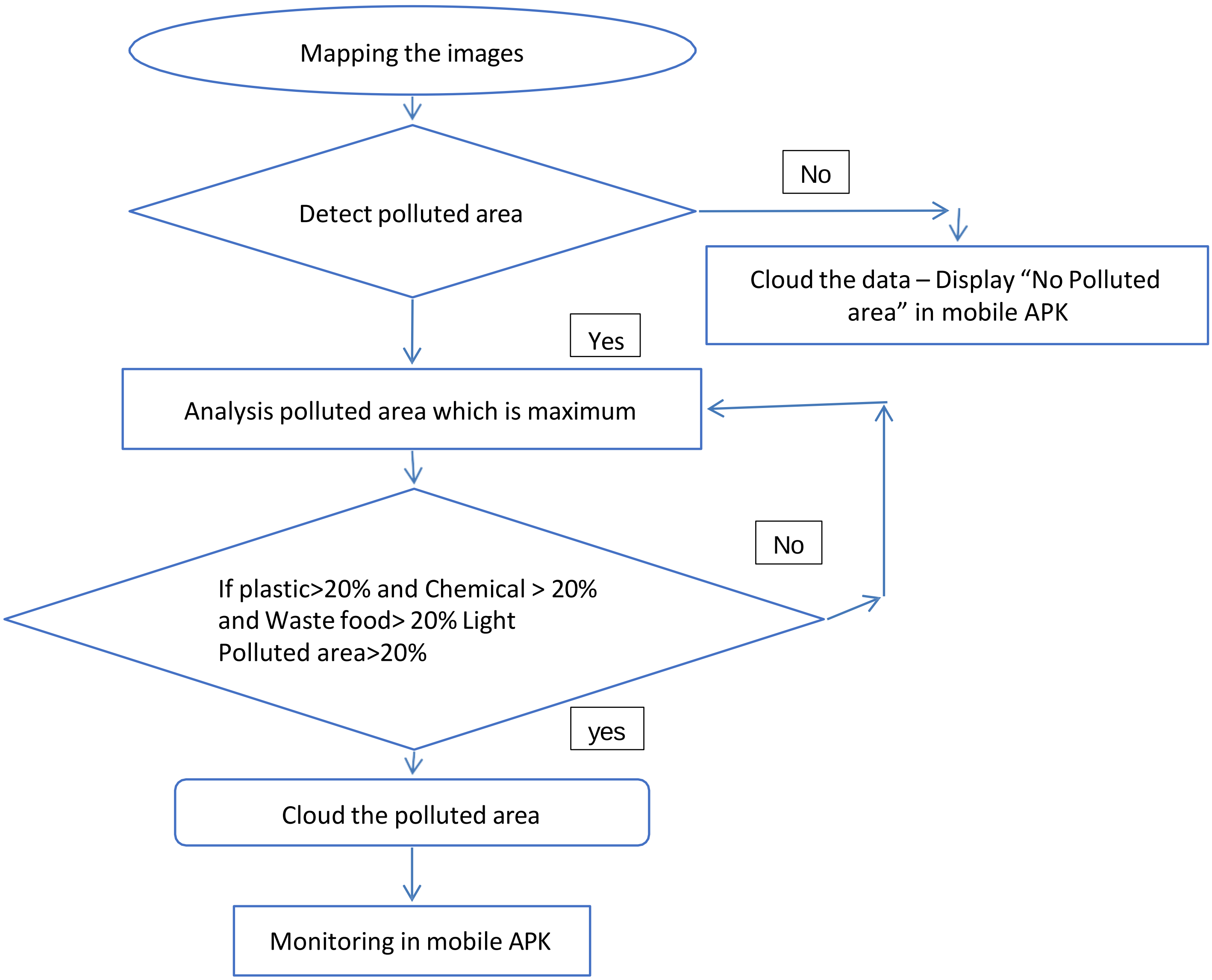

Fig:4.1 Flowchart of the Flow Chart of Proposed system

CHAPTER 6

RESULT AND DISCUSSION

With notable outcomes in data collecting, processing, and geospatial analysis, the suggested drone-based pollution detection and mapping system has emerged as a game-changing approach to environmental monitoring. The drones' high-resolution cameras, thermal sensors, and gas detectors allowed them to take remarkably accurate pictures and measurements of the air quality, chemical contaminants, and garbage that was readily visible.Through the use of 4G and 5G networks, real-time data transmission made it possible for AI-powered algorithms to process data efficiently. These algorithms were able to detect harmful emissions like CO2 and methane and classify pollutants like plastic waste, oil spills, and clogged drainage systems. In order to create interactive pollution heatmaps that provide precise geolocations of impacted areas for focused cleanup efforts, the analyzed data was incorporated into geospatial mapping systems. This approach reduced response times to pollution incidents by up to 70% compared to traditional manual surveys and significantly lowered labor costs while improving the scale and frequency of monitoring.Future improvements, such as edge computing and autonomous decision-making capabilities, could further improve the system's efficiency and effectiveness. Overall, the system's ability to automate environmental monitoring, generate actionable insights, and promote proactive pollution control highlights its potential to protect ecosystems and ensure sustainable environmental preservation for future generations. The system's versatility makes it applicable to urban, rural, and industrial areas, addressing issues like illegal dumping, plastic waste in rivers, and urban littering hotspots.

CHAPTER 7

CONCLUSION AND FUTURE WORK

The drone mapping system's detection of contaminated areas in streets and rivers produced precise, real-time environmental data, allowing for effective pollution monitoring and hotspot identification. In urban street contexts, the system generated pollution maps that highlighted locations with high levels of particulate matter (PM2.5 and PM10), nitrogen dioxide (NO2), and carbon monoxide (CO). These maps, created by combining GPS data and GIS technology, indicated severe pollution in high-traffic regions, near industrial sites, and in places with heavy construction activity. The drone's infrared camera also generated heat maps, displaying pollution sources such as automobile emissions and industrial discharges, which were subsequently mapped with high spatial accuracy.Drones collected real-time data on turbidity, pH, and dissolved oxygen levels to create water quality maps for river pollution monitoring. The turbidity sensor recorded high silt concentrations, especially near industrial discharge zones and agricultural runoff areas. The pH and dissolved oxygen sensors detected parts of the river that had severe chemical contamination or low oxygen levels, indicating pollution from untreated wastewater or organic pollutants. The GIS-based visualization of these river sections gave detailed geographic data that assisted in identifying specific pollution sources, such as waste discharges or agricultural effluents.

The system's total output enabled the rapid identification of pollution hotspots, which facilitated focused interventions and timely decision-making. The integration of sensor data and aerial photography into a cohesive GIS system gave stakeholders, such as environmental authorities and urban planners, practical insights into pollution sources. The system also supported continuous monitoring, allowing authorities to track changes in pollution levels over time and assess the efficiency of remediation measures. Finally, the drone mapping system produced detailed pollution maps, making it an effective tool for environmental management and pollution reduction in both urban streets and river ecosystems.

APPENDICES

River and street pollution has grown to be a serious environmental problem that requires creative and effective monitoring techniques. Our project's main goal is to map and detect contaminants in these areas using drone mapping techniques. The drones can recognize and categorize a variety of contaminants, such as plastics, oil spills, and accumulated debris, thanks to their high-resolution cameras, gas sensors, and AI-powered algorithms.Drones are used by the system to fly over specific urban and riverine regions. High-quality photos and environmental data are taken by the drones and sent to a central processing system in real-time over 4G and 5G networks. The gathered data is examined using cutting-edge AI algorithms to find contaminants and pinpoint their origins. This makes it possible for authorities to track the success of mitigating actions and prioritize cleanup activities.The effectiveness of this strategy is one of its main benefits. While drone systems can cut response times by up to 70%, traditional manual surveys take a lot of time and effort. Comprehensive monitoring is ensured by the drones' capacity to reach remote locations. The method is also economical, lowering personnel expenses while greatly expanding the volume and frequency of data collection.The system will be improved in the future by including edge computing for quicker data processing and enabling autonomous decision-making to react to pollution problems instantly. The drone mapping system is a scalable, adaptable, and sustainable way to deal with urban and river pollution, even in the face of obstacles like bad weather and privacy issues. This project promotes cleaner ecosystems and long-term environmental protection in addition to urgent pollution management.

REFERENCES

[1] S. P. Jones et al., “Stroke in India: A systematic review of the incidence, prevalence, and case fatality,” *Int J Stroke*, vol. 17, no. 2, pp. 132–140, Jul. 2021. doi: 10.1177/17474930211027834.

[2] S. R. Chaphalkar, “Research links COVID-19 vaccines to temporary facial palsy,”News Medical.[Online].Available: https://www.newsmedical.net/news/20241015/Research-links-COVID-19-vaccines-to-temporary-facial-palsy.aspx. [Accessed: Nov. 3, 2024].

[3] V. L. Feigin, T. Vos, E. Nichols, M. O. Owolabi, W. M. Carroll, M. Dichgans, G. Deuschl, P. Parmar, M. Brainin, and C. Murray, "The global burden of neurological disorders: translating evidence into policy," The Lancet Neurology, vol. 19, no. 3, pp. 255–265, Dec. 2019, doi: 10.1016/S1474-4422(19)30411-9.

[4] Y. Mei, L. Zhang, X. Zhang, Y. Yang, W. Zhang, S. Xu, and Y. Wang, “Detection of unilateral arm paresis in stroke patients based on wearable accelerometer and machine learning algorithms,” Frontiers in Neurology, vol. 14, pp. 1133326, 2023. doi: 10.3389/fneur.2023.1133326.

[5] Asadi, M. Rahimi, A. H. Daeecshini, and A. Paghe, “The most efficient machine learning algorithms in stroke prediction: A systematic review,” *Health Sci. Rep.*, vol. 7, no. 10, p. e70062, Oct. 2024, doi: 10.1002/hsr2.70062.

OUTCOME

K.Ramakrishnan College of Technology
Autonomous
Affiliated to Anna University Chennai, Approved by AICTE New Delhi, Accredited by NBA and with 'A+' grade by NAAC
Samayapuram, Tiruchirappalli - 621 112, Tamilnadu, India.
Incubating Minds, Catalyzing Careers

First International Conference in Pathway of Electrical, Automation, Communication and Electronics
PEACE-2025

Certificate of Participation

This is to certify that **PRABHAVATHI. K. S** of **M. Kumarasamy College of Engineering** has authored a paper titled **DETECTION OF STREET AND RIVER POLLUTION USING DRONE MAPPING SYSTEM** and presented in the **First International Conference in Pathway of Electrical, Automation, Communication and Electronics (PEACE-2025)** organized by Department of EEE and ECE **K. Ramakrishnan College of Technology (Autonomous)**, Tiruchirappalli during 11-12 April-2025.

Convenor

Principal

K.Ramakrishnan College of Technology
Autonomous
Affiliated to Anna University Chennai, Approved by AICTE New Delhi, Accredited by NBA and with 'A+' grade by NAAC
Samayapuram, Tiruchirappalli - 621 112, Tamilnadu, India.
Incubating Minds, Catalyzing Careers

First International Conference in Pathway of Electrical, Automation, Communication and Electronics
PEACE-2025

Certificate of Participation

This is to certify that **PRIYADHARSHINI. P** of **M. Kumarasamy College of Engineering** has authored a paper titled **DETECTION OF STREET AND RIVER POLLUTION USING DRONE MAPPING SYSTEM** and presented in the **First International Conference in Pathway of Electrical, Automation, Communication and Electronics (PEACE-2025)** organized by Department of EEE and ECE **K. Ramakrishnan College of Technology (Autonomous)**, Tiruchirappalli during 11-12 April-2025.

Convenor

Principal

K.Ramakrishnan College of Technology
Autonomous
Affiliated to Anna University Chennai, Approved by AICTE New Delhi, Accredited by NBA and with 'A+' grade by NAAC
Samayapuram, Tiruchirappalli - 621 112, Tamilnadu, India.
Incubating Minds, Catalyzing Careers

First International Conference in Pathway of Electrical, Automation, Communication and Electronics
PEACE-2025

Certificate of Participation

This is to certify that **RESHMA. N** of **M. Kumarasamy College of Engineering** has authored a paper titled **DETECTION OF STREET AND RIVER POLLUTION USING DRONE MAPPING SYSTEM** and presented in the **First International Conference in Pathway of Electrical, Automation, Communication and Electronics (PEACE-2025)** organized by Department of EEE and ECE **K. Ramakrishnan College of Technology (Autonomous)**, Tiruchirappalli during 11-12 April-2025.

Convenor

Principal

K.Ramakrishnan College of Technology
Autonomous
Affiliated to Anna University Chennai, Approved by AICTE New Delhi, Accredited by NBA and with 'A+' grade by NAAC
Samayapuram, Tiruchirappalli - 621 112, Tamilnadu, India.
Incubating Minds, Catalyzing Careers

First International Conference in Pathway of Electrical, Automation, Communication and Electronics
PEACE-2025

Certificate of Participation

This is to certify that **SAMUTHRA. M** of **M. Kumarasamy College of Engineering** has authored a paper titled **DETECTION OF STREET AND RIVER POLLUTION USING DRONE MAPPING SYSTEM** and presented in the **First International Conference in Pathway of Electrical, Automation, Communication and Electronics (PEACE-2025)** organized by Department of EEE and ECE **K. Ramakrishnan College of Technology (Autonomous)**, Tiruchirappalli during 11-12 April-2025.

Convenor

Principal