FOREST SECURITY IN SAVING TREES

Minor project-II report submitted
in partial fulfillment of the requirement for award of the degree of

Bachelor of Technology
in
Computer Science & Engineering

By

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(Deemed to be University Estd u/s 3 of UGC Act, 1956)
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CHENNAI 600 062, TAMILNADU, INDIA

October, 2024

PROJECT TITLE

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CERTIFICATE

It is certified that the work contained in the project report titled "FOREST SECURITY IN SAVING TREES" by "M.CHATURYA (21UECM0161), Y.ABHINAI (21UECT0049) " has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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DECLARATION

We declare that this written submission represents my ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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APPROVAL SHEET

This project report entitled “FOREST SECURITY IN SAVING TREES” by “M.CHATURYA (21UECM0161), Y.ABHINAI (21UECT0049)” is approved for the degree of B.Tech in Computer Science & Engineering.

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ABSTRACT

Forest security to save trees focuses on the implementation of advanced monitoring and protection systems to safeguard forest ecosystems from illegal logging, poaching, and environmental degradation. Utilizing devices, remote sensing technology, and drones equipped with high-resolution cameras, these systems enable real-time surveillance and data collection. This data is analysed using artificial intelligence to detect suspicious activities and potential threats, triggering immediate alerts to forest rangers and conservation authorities. Additionally, community engagement and education programs are integrated to raise awareness and promote sustainable practices among local populations. By combining technological innovation with grassroots involvement, forest security initiatives aim to preserve biodiversity, combat climate change, and ensure the long-term health of vital forest habitats, able to take precautionary measures in order to prevent the fire which may occur in near future. This system combines motion detection and metal detection for the active monitoring of trees at high-risk areas The solution involves a small, self-contained sensor that hangs from specific trees. The motion detection part is triggered by movements at the base of this tree, suggesting possible human presence. At the same time, detecting metals in a given area can indicate the presence of cutting tools like chainsaws and axes frequently used by illegal loggers. Combining the two technologies gives a comprehensive approach to protecting forests. Sensor module detects suspicious activity it sends an alert wirelessly to a central monitoring system which can then initiate immediate response actions including deploying forest rangers or dispatching drone surveillance. This real-time notification facility at the very point of entry improves vigilance, discouraging illicit activities before a major loss happens.

Keywords:

wireless sensor networks (WSNs), Light Detection and Ranging (LiDAR), Conference on Computer Vision and Pattern Recognition (CVPR), Machine Learning (ML).

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LIST OF ACRONYMS AND ABBREVIATIONS

DSS	Decision Support System
IoT	Internet of Thnigs
LCD	Liquid Crystal Display
ML	Machine Learning
MCU	Micro Controller Unit
SML	Soil Moisture Level
SIS	Smart Irrigation System

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Chapter 1

INTRODUCTION

1.1 Introduction

We will explore the importance of Forest security in saving trees and preserving our planets biodiversity's. We will discuss various measures that can be taken to protect forest by including some technologies and community engagements. Technologies like IOT and sensor-based components are used to generate a sensor that detects the metal efficiency in the surroundings.In the critical fight against deforestation and environmental degradation with forests, playing a vital role in carbon sequestration, biodiversity conservation, and supporting livelihoods, protecting these natural resources has never been more urgent. Modern technology offers innovative solutions to monitor and secure forested areas, preventing illegal activities and ensuring sustainable management practices. Trees play a vital role in our ecosystem, and their importance cannot be overstated. Not only do they provide us with oxygen, but they also help to combat climate change by absorbing carbon dioxide from the atmosphere.

In addition, trees help keep air clean combat climate change.Massive carbon-dioxide capture in the air is absorbed by dense forests and its foliage converts this CO2 to breathable O2 as a result curbing pollution. Despite the fact that forests and biodiversity are essential in order to maintain the ecological balance, illegal logging activities still make it into fragile ecosystems. One way of selling to these threats is by developing an all-inclusive reflexive monitoring system based on sensors capable of detecting and preventing deforestation processes. That makes it even more important for us to act so that trees in the forest and infected by this disease. We must do our part in order to make this earth beautiful and leave a living legacy that is sustainable for future generations.

1.2 Aim of the project

The aim of this project is to design and implement a robust forest security system utilizing advanced technology to monitor and prevent illegal logging and poaching activities.To integrate motion detection, metal detection, and AI-based analysis for real-time identification of suspicious activities in forest areas. To ensure rapid response through automated alerts to forest rangers and authorities for immediate action against deforestation threats. To contribute to forest conservation by developing a scalable solution that can adapt to various environmental conditions and forest regions.

1.3 Project Domain

In the realm of saving trees with a sensor system is the application of a SVM Algorithm, a subset of Machine Learning (ML), plays a crucial role in used for classification and regression tasks. This advanced ML model can classify the detected movements into categories (e.g., human, animal, weapon) based on features extracted from the sensor data. This helps in accurately identifying potential threats.By using SVM with appropriate feature extraction techniques (e.g., movement speed, direction, patterns), you can enhance the algorithm's ability to distinguish between different types of movements.We use pattern recognition algorithms like Dynamic Time Warping (DTW) to analyze the patterns of motion detected by the IR sensor. DTW is used to measure similarity between two temporal sequences that may vary in speed. It can align and compare motion patterns over time.

Anolomy detection algorithms such as Local Outlier Factor (LOF) and Isolation Forest helps in detecting anomalous motion patterns that deviate from the norm, which might be indicative of human activity.These algorithms can provide real-time alerts when anomalies are detected, allowing forest department personnel to respond quickly to potential threats or illegal activities.Forest environments can be unpredictable. Anomaly detection algorithms can effectively handle variations in data, such as changes in movement patterns due to weather or wildlife, making them robust in dynamic settings.Features are used in classification algorithms to improve the accuracy of distinguishing human motion from other types. Fourier Transform converts time-domain data into the frequency domain, allowing analysis of periodic motion patterns.

1.4 Scope of the Project

The proposed forest security system to save trees involves an integrated solution utilizing Arduino, LCD, metal detector, IR sensor, buzzer, power supply, LEDs, and a 12V adapter.This method combines real-time monitoring, immediate threat detection, and alert mechanisms to enhance forest security and protect trees from illegal activities effectively. Placed amidst trees, their purpose was to detect sounds such as chainsaws, vehicles, and other indications of human activity connected to illicit logging. After analysing a real-time audio stream, an algorithm looks for anomalies and notifies the user when it finds anything. Several countries, including Brazil, Indonesia, and Peru, are using this work, which has shown promising results in terms of stopping illicit logging. Using Internet of Things sensors to monitor the surroundings and identify human activity in woods is being done by the Smart woods work. Traditionally, these sensors have only been available as acoustic, motion, and camera sensors.

Machine learning techniques are used to examine the sensor data and look for any changes or anomalies that might point to illicit logging. to establish the forest rangers' capabilities and enable real-time monitoring so they can respond quickly to any illegal activity. WWF rolled out a program called Forest Guardian that uses drones and ground-based sensors to monitor forests. The sensors can detect human presence and activity, while drones make high-resolution images. AI and ML systems verify the information collected by sensors and drones to detect illegal forestry activity.The project involves deploying sensor-based systems and drones for continuous surveillance in high-risk forest zones.It includes the development of self-contained, easily deployable sensor units for detecting movement and metal-based cutting tools used by illegal loggers. The project will support forest rangers with real-time data and alerts, enhancing the effectiveness of forest monitoring efforts. The scope extends to integrating AI-driven predictive analysis and satellite monitoring for future expansion and improved forest security measures.

Chapter 2

LITERATURE REVIEW

2.1 Literature Review

[1] Nelson, R. (2020) Untamedscience.com. April 2019. [Online]. Available: https://untamedscience.com/blog/the-environmental-impact-of-forest-fires/. Accessed 30 December 2020.This system integrates Internet of Things (IoT) technology to enable precise and data-driven irrigation decisions. By collecting and analyzing various environmental data, including weather conditions, soil quality, and historical crop yield patterns, the system can optimize irrigation schedules and resource allocation. This approach not only enhances water efficiency but also contributes to improved crop productivity and economic gains for farmers. The research by Li et al. serves as a notable contribution to the field of precision agriculture, highlighting the potential of IoT technologies to revolutionize farming practices and promote sustainable resource management.

[2] J. Bravo et al.Deploying Wireless Sensor Networks for Real-Time Monitoring of Forest AreasPublished in Sensors Journal, IEEE.2011 This paper explores using wireless sensor networks (WSNs) for real-time forest monitoring to detect changes in temperature, humidity, and sound patterns indicative of illegal activities such as logging or poaching.Smith discusses the integration of sensors, automation, and data analysis tools . The paper emphasizes the significance of these technologies in achieving both environmental and economic sustainability in forest areas. By offering insights into the latest advancements, Smith's work provides valuable guidance for the adoption of smart irrigation practices in modern farming, aligning with the global push for sustainable food production.

[3].R. Lucas et al.Utilizing Satellite Imagery for Large-Scale Monitoring and Detection of Deforestation ActivitiesPublished in Remote Sensing of Environment 2018.The paper presents the application of satellite imagery to monitor large forest areas and detect deforestation activities, offering a broad overview to identify regions at risk.The authors discuss the potential benefits, including water conservation and increased crop yields, which stem from the implementation of these intelligent

systems in areas. Kumar and Gupta's work underscores the role of machine learning in advancing the efficiency and sustainability of irrigation practices, offering a promising path for the forest sectors.

[4] M. Hansen et al.Integration of Remote Sensing Techniques for Detailed Mapping of Forested AreasPublished in Global Forest Watch Journal (2016) study highlights the significant advancements in sensor technology, particularly in the context of precision agriculture and efficient water management. This paper also explores the use of LiDAR technology for detailed mapping of forested regions, focusing on detecting changes in vegetation density and enabling early detection of potential threats. By providing real-time and accurate information, these advancements empower smart forest systems to make data-driven decisions, optimizing water usage and enhancing survilance. Garcia and Martinez's research underscores the vital role of sensor technologies in modernizing agriculture and promoting sustainable practices.

[5] J. Pan et al. (2020) Implementing IoT Devices and Edge Computing for Forest Threat Detection and ResponsePublished in the Journal of IoT and Smart Environments. The paper discusses the implementation of Internet of Things (IoT) devices combined with edge computing to provide localized data processing, improving response times to forest threats by reducing latency in detection. White and Clark's research underscores how the synergy between weather data and smart technologies contributes to more sustainable and efficient practices.

[6] H. Patel et al. (2019) presentation delves into the application of Internet of Things (IoT) technology in agriculture, highlighting its potential to transform farm ing practices. By connecting various sensors, devices, and data sources, IoT-based precision agriculture aims to enhance decision-making in areas such as irrigation, crop monitoring, and resource management. Patel and Shah's work underscores the significance of IoT in modernizing agriculture, offering a promising pathway toward more efficient and data-driven farming practices.

[7] L.Chen et al. (2017) research focuses on the crucial role of wireless communication in enabling real-time monitoring within smart irrigation systems. By utilizing wireless technologies, these systems can efficiently transmit and receive data from various sensors and devices, facilitating timely decision-making in irrigation management. Chen and Wu's study underscores the significance of robust wireless communication in advancing the capabilities of smart irrigation systems, contributing to improved water conservation and crop health in agriculture.

[8] M.Rodriguez et al. (2019) study focuses on the design of algorithms aimed at optimizing the energy usage within smart irrigation systems. By implementing energy-efficient algorithms, these systems can make more economical and sustainable choices in irrigation scheduling and resource allocation. Rodriguez and Lopez's work underscores the importance of energy-efficient strategies in smart irrigation, which not only contribute to environmental conservation but also promote costeffective practices.

[9] H.Wang et al. (2022) research the potential of Internet of Things (IoT) technologies in revolutionizing precision for trees by providing real-time data and insights for more informed decision-making. However, it also addresses the challenges associated with data management, security, and scalability. Wang and Li's work offers valuable insights into the evolving landscape of IoT in forest sector, emphasizing its potential to enhance productivity while navigating the complexities of this dynamic field.

[10] S.Kim et al. (2018) worked on illuminates the substantial advancements within the field of soil moisture sensing technologies, demonstrating their critical role in reshaping the landscape of smart survilance systems. These breakthroughs offer a novel way to provide precise and real-time data on , presenting a game changing approach to optimizing water resource management in forest areas. Kim and Lee's work serves as a compelling testament to the transformative influence of sensor technology, heralding not only forest conservation but also a paradigm shift in the quest for improved crop yields and sustainable practices.

2.2 Gap Identification

Forests are facing escalating threats from illegal activities, including logging, poaching, and deforestation, which highlight the urgent need for effective security and preservation measures. While various technologies for forest monitoring have been developed, there are notable limitations that compromise their overall effectiveness. The project titled "Forest Security in Saving Trees" seeks to bridge these gaps by introducing an advanced sensor system designed to detect human movement, identify potential weapons, and deliver real-time alerts to forest management authorities when suspicious activities are detected. This initiative aims to enhance the protection of forest ecosystems and promote sustainable conservation efforts.

Current forest surveillance methods primarily include manual patrolling, camera traps, and drones. However, these approaches can be labor-intensive, costly, or insufficient for providing consistent, real-time monitoring. The absence of real-time data and alert mechanisms allows illegal activities to remain undetected for prolonged periods, which diminishes the likelihood of timely intervention. This highlights the necessity for automated systems capable of continuous monitoring and delivering instant alerts.This innovative approach aims to enhance the protection of forested areas and promote sustainable conservation efforts. Detect human motion while distinguishing between typical and suspicious behavior. Incorporate weapon detection features to identify potential illegal activities effectively. Offer real-time alerts to forest authorities, facilitating prompt responses to threats. Be adaptable to diverse forest environments, even those with limited infrastructure. Remain cost-effective and scalable, allowing for extensive deployment across various regions. This solution aims to significantly enhance forest security by overcoming the limitations of existing monitoring systems, reducing illegal activities, and aiding in the long-term preservation of forest ecosystems.

Chapter 3

PROJECT DESCRIPTION

3.1 Existing System

For centuries, traditional survilanve methods have served as the backbone of forest areas, relying on manual practices and intuitive knowledge passed down through generations. Despite their historical significance, these methods encounter several limitations that pose challenges to modern practices. One significant drawback is the inefficiency, often resulting in risk, which can adversely affect human health and life. The reliance on manual labor for survilance tasks also introduces a level of inconsistency and variability in the application of forest resources.

Many systems utilize motion sensors and cameras to monitor wildlife and human activity in forests. Research in this area focuses on understanding animal behaviors and managing human interference.Various types of metal detection technologies exist, ranging from handheld devices to ground-penetrating radar. These are often used in archaeological sites and security applications, but their adaptation for environmental monitoring is less common.

Research on human impact on forest ecosystems often involves tracking human activity using various sensors. Understanding existing methodologies can enhance your project's effectiveness.Many current projects employ machine learning to analyze data from sensors for detecting patterns of human and animal movements, potentially improving the accuracy of your detection systems.Existing systems for alerting authorities about unusual activity can serve as a model for your alert mechanism. These can be integrated with mobile apps or SMS notifications.

Disadvantages:

1. Limited Range and Coverage.
2. Vandalism and Theft.
3. Resource Inefficiency.
4. Maintenance Issues.

3.2 Problem statement

Forests worldwide are increasingly threatened by illegal logging, poaching, and other unauthorized human activities. These actions lead to deforestation and loss of biodiversity, while also disrupting ecosystems that are crucial for climate regulation. Although there are forest monitoring technologies available, many current solutions fail to provide real-time, comprehensive detection of human encroachment and illegal activities, particularly in remote and dense forest areas.Additionally, most existing systems are unable to detect the presence of weapons, a key indicator of poaching or illegal logging, which hampers forest departments' ability to respond to threats before severe damage occurs.

To address this challenge, there is a growing need for a more reliable and automated security system. The project titled "Forest Security in Saving Trees" aims to fulfill this need by providing an advanced, sensor-based solution that detects human movement and weapon presence when installed in trees.This system offers real-time alerts to forest authorities upon identifying unusual activities, facilitating quicker response times and helping to reduce illegal actions that endanger forest ecosystems.

Advantages:

1. Real-Time Detection and Alerts.
2. Weapon Detection Capability.
3. Adaptable to Dense and Remote Forests.
4. Reduced Human Risk.
5. Long-Term Data Collection.

3.3 System Specification

3.3.1 Hardware Specification

- Arduino Uno.
- Buzzer.
- Connecting wires.
- IR Sensor.
- LCD.
- LED.
- Metal Sensor.
- Regulated Power Supply.
- 12V adapter

3.3.2 Software Specification

- ARDUINO-C Programming language
- Arduino IDE
- IDLE
- ML Algorithm
- Python Scripting Language

3.3.3 Standards and Policies

Data Security Standard Prompt

This standard outlines a comprehensive framework for effectively establishing, implementing, maintaining, and continuously enhancing information security management. It is crucial for the responsible handling of sensitive data gathered from sensors, ensuring both security and integrity throughout the process.

Standard Used: ISO/IEC 27001

Security and Privacy Controls for Information System Prompt

Offers comprehensive guidance on securing systems, ensuring that the data collected and transmitted by sensors is adequately protected.

Standard Used: NIST SP 800-53

Environmental Management System Prompt

Ensures that the sensor minimizes its environmental impact. This is particularly important for protecting forest ecosystems and reducing sensor waste or pollution.

Standard Used: ISO 14001

Reference Architecture for IoT

This is important for building reliable IoT systems for forest monitoring, supporting real-time alerts, and efficient data processing. Provides guidelines for alarm systems, covering detection and response, to ensure reliable and effective alerting mechanisms.

Standard Used: ISO/IEC 30141

Chapter 4

METHODOLOGY

4.1 Proposed System

The proposed forest security system to save trees involves an integrated solution utilizing Arduino, LCD, metal detector, IR sensor, buzzer, power supply, LEDs, and a 12V adapter. The Arduino microcontroller serves as the central unit, coordinating all components. The metal detector is strategically placed to identify unauthorized equipment used for logging, while IR sensors detect human presence and movement in restricted areas. Upon detecting a threat, the system triggers an audible buzzer and activates LEDs as visual alerts, signalling an immediate threat. The LCD screen displays real-time information and alerts, providing forest rangers with instant updates. The entire system is powered by a robust power supply and stabilized using a 12V adapter, ensuring continuous operation in remote forest areas.

This method combines real-time monitoring, immediate threat detection, and alert mechanisms to enhance forest security and protect trees from illegal activities effectively. Placed amidst trees, their purpose was to detect sounds such as chainsaws, vehicles, and other indications of human activity connected to illicit logging. After analysing a real-time audio stream, an algorithm looks for anomalies and notifies the user when it finds anything. Several countries, including Brazil, Indonesia, and Peru, are using this work, which has shown promising results in terms of stopping illicit logging. Using Internet of Things sensors to monitor the surroundings and identify human activity in woods is being done by the Smart woods work. Traditionally, these sensors have only been available as acoustic, motion, and camera sensors. Machine learning techniques are used to examine the sensor data and look for any changes or anomalies that might point to illicit logging.

To establish the forest rangers' capabilities and enable real-time monitoring so they can respond quickly to any illegal activity. WWF rolled out a program called Forest Guardian that uses drones and ground-based sensors to monitor forests. The sensors can detect human presence and activity, while drones make high-resolution images. AI and ML systems verify the information collected by sensors and drones to detect illegal forestry activity. However, the lack of continuous monitoring and rapid response capabilities in these existing methods limits their overall effectiveness in protecting forests. While SMART's data-driven strategy has improved the management and protection of forest areas a lot, it is not very efficient because there is no continuous monitoring in place. Illegal activities such as poaching and unauthorized logging can go unnoticed for long periods of time without real-time surveillance, enabling offenders to slip by undetected causing great harm.

In addition, this gap in immediate response hinders the quick mobilization of enforcement or conservation measures thus reducing the program's overall effectiveness in stopping deforestation. It is therefore urgent that technology advances to enable constant real-time monitoring and rapid response mechanisms to enhance protection of these vital ecosystems.

Advantages:

1. Enhanced Security
2. Comprehensive Monitoring
3.Cost-Effectiveness
4. Remote Operation
5. Real-time Alerts
6. Predictive Analytics.

4.2 General Architecture

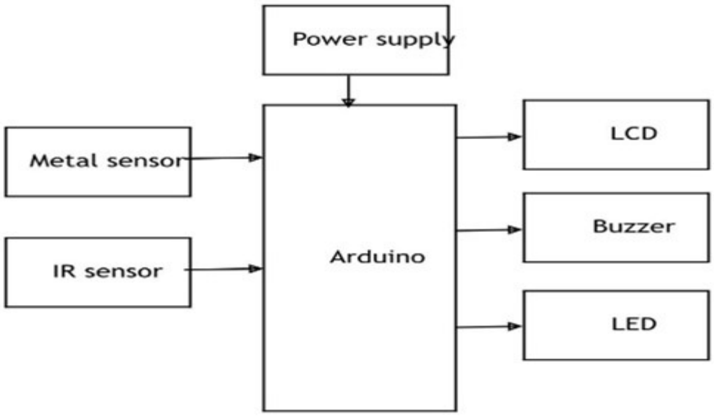

Figure 4.1: **Architecture diagram for Forest Security In Saving Trees**

Fig 4.1 the architecture of proposed work. Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. In LCD display, it consists of millions of pixels made of crystal and arranged in a rectangular grid. In LCD it has backlights that provide light to each pixel. Each pixel has a red, green, and blue (RGB) sub-pixel that can be turned on or off. Inductive proximity sensors are widely used in industrial automation and manufacturing due to their non-contact detection of metallic objects. An infrared sensor is an electronic device, which emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion.

4.3 Design Phase

4.3.1 Data Flow Diagram

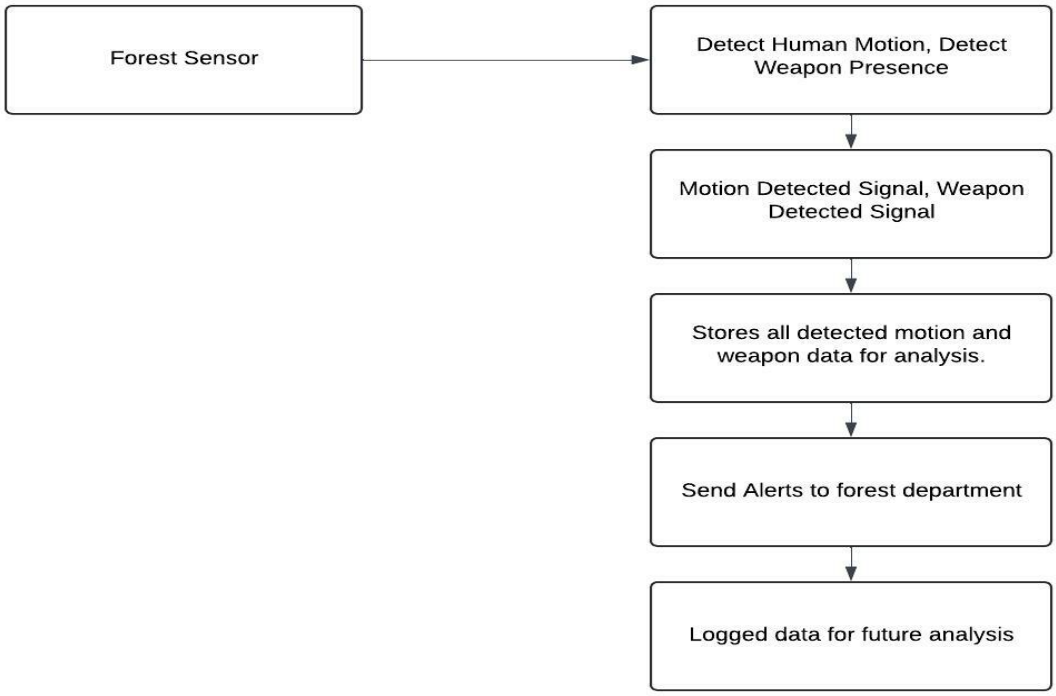

Figure 4.2: **Data Flow Diagran for Forest Security In Saving Trees**

Fig 4.2 shows the Forest Security In Saving Trees project, specialized sensors detects the human motion and metals around the forest region, relaying crucial environmental data to a central microcontroller. This compact unit processes real-time metrics, informing the system's decisions on data detected. The integration of these sensors and the microcontroller ensures precise and accuracy in detection in precision forest areas.DTW is used to measure similarity between two temporal sequences that may vary in speed. It can align and compare motion patterns over time. Human motion has distinct patterns compared to animals or wind. Machine learning algorithms like Support Vector Machine (SVM) is used as a classification algorithm that finds the optimal hyperplane separating different classes of data.

4.3.2 Use Case Diagram

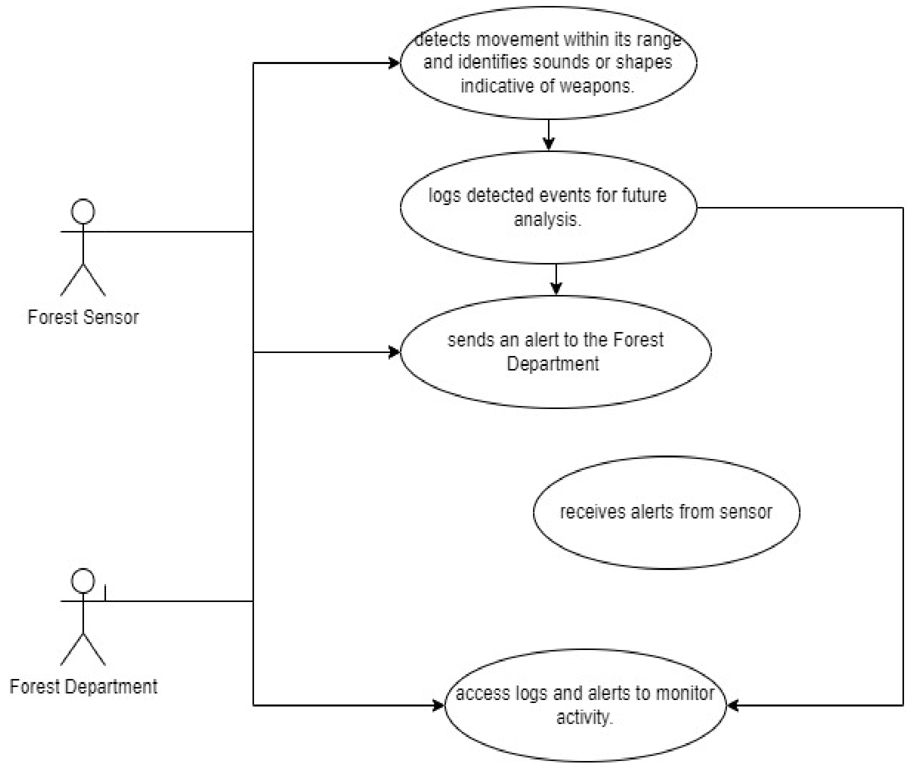

Figure 4.3: **Use Case diagram for Forest Security In Saving Trees**

Fig 4.3 shows the use case starts when the context-aware service receives an event from the environment, such as a change in motion speed. The service then processes the event and determines what action to take. This use case shows that the context-aware service filters the data it receives from the sensor before using it. This is important to ensure that the service only uses accurate and relevant data. The use case diagram shows how a context-aware service can use data from the environment to control a facility and interact with a sensor. This type of service could be used in a variety of applications, such as home services, smart buildings, and precision areas.

4.3.3 Class Diagram

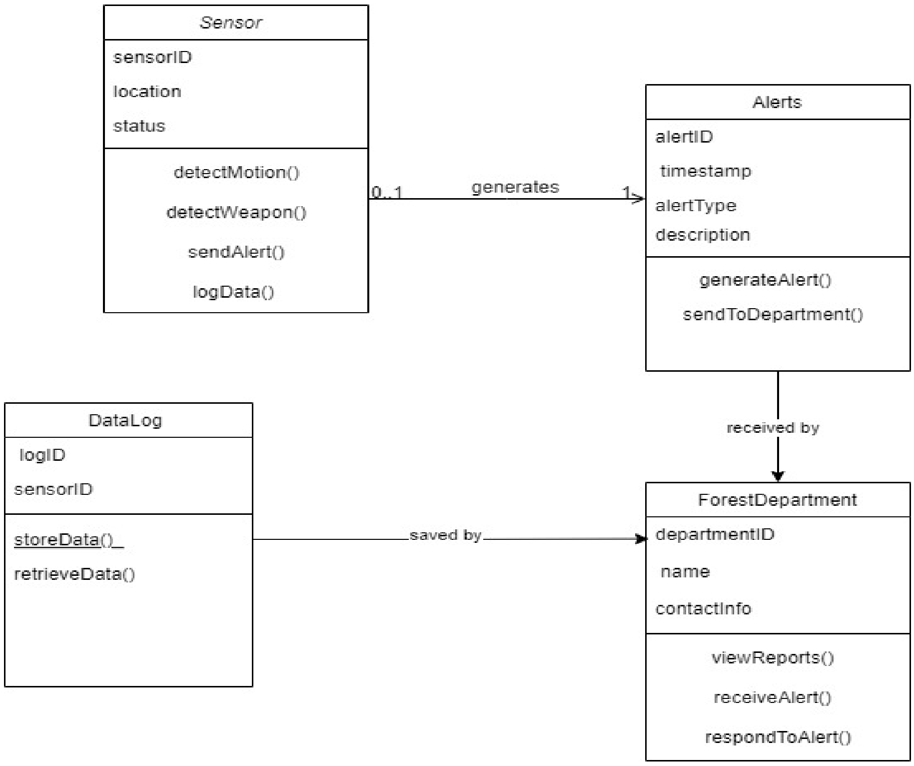

Figure 4.4: **Class Diagram for Forest Security in Saving Trees**

Fig 4.4 shows the human and metal monitoring system diagram showcases a network of sensors capturing critical data. Filtered data then flows through an event processing service, triggering alerts or actions based on specific thresholds. A context-aware service analyzes the data further, offering insights and recommendations, like optimal times or fertilizer use. The system even controls motion based on real-time conditions, maximizing efficiency and moment. An admin panel allows for configuration and data visualization, completing this robust, data-driven forest management solution.

4.3.4 Sequence Diagram

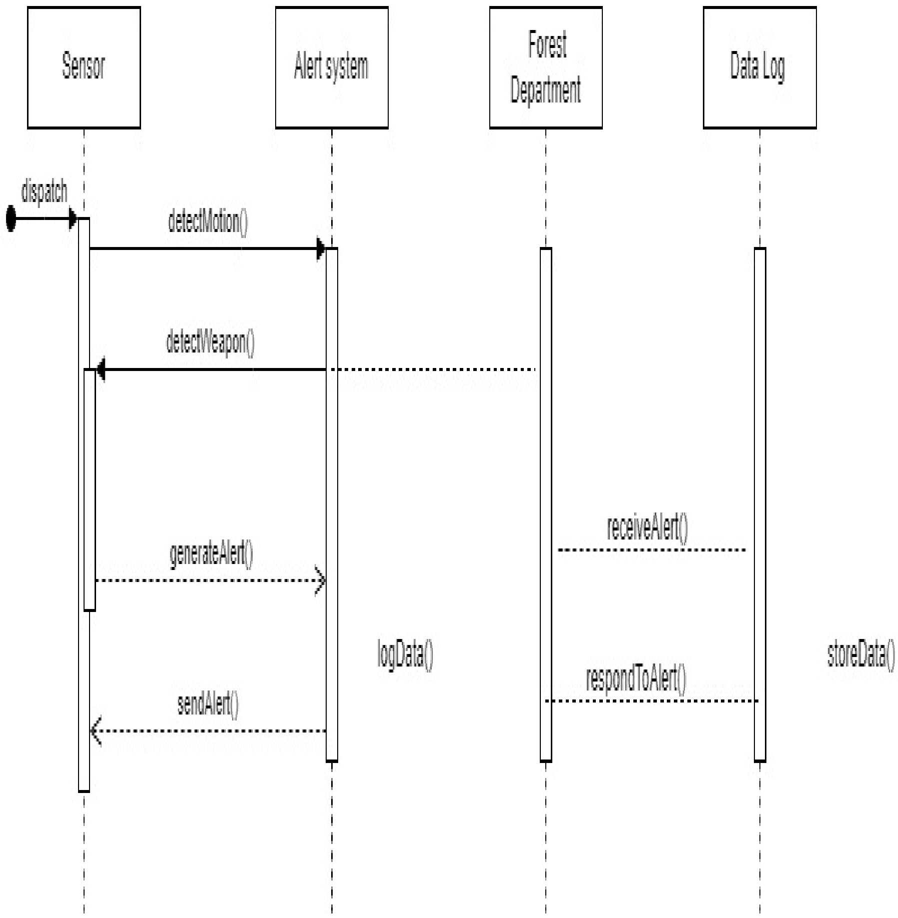

Figure 4.5: **Sequence Diagram for Forest Security in Saving Trees**

Fig 4.5 provides the system incorporates a range of sensors, including admin, temperature, ultrasonic, and limit switch sensors, to collect data on both the environment and the operation of the robotic arm. A central microcontroller unit (MCU) processes the sensor data to control the movements of the robotic arm. The motor driver circuit amplifies control signals from the MCU to drive the DC motors powering the robotic arm's joints, converting electrical energy into mechanical energy for movement. The farmer interacts with the system through a dispatch unit, sending commands that the MCU executes. The system manages motor power, turning them on or off as needed. Decision signals from the MCU guide the motor driver in controlling the arm's movements.

4.3.5 Collaboration diagram

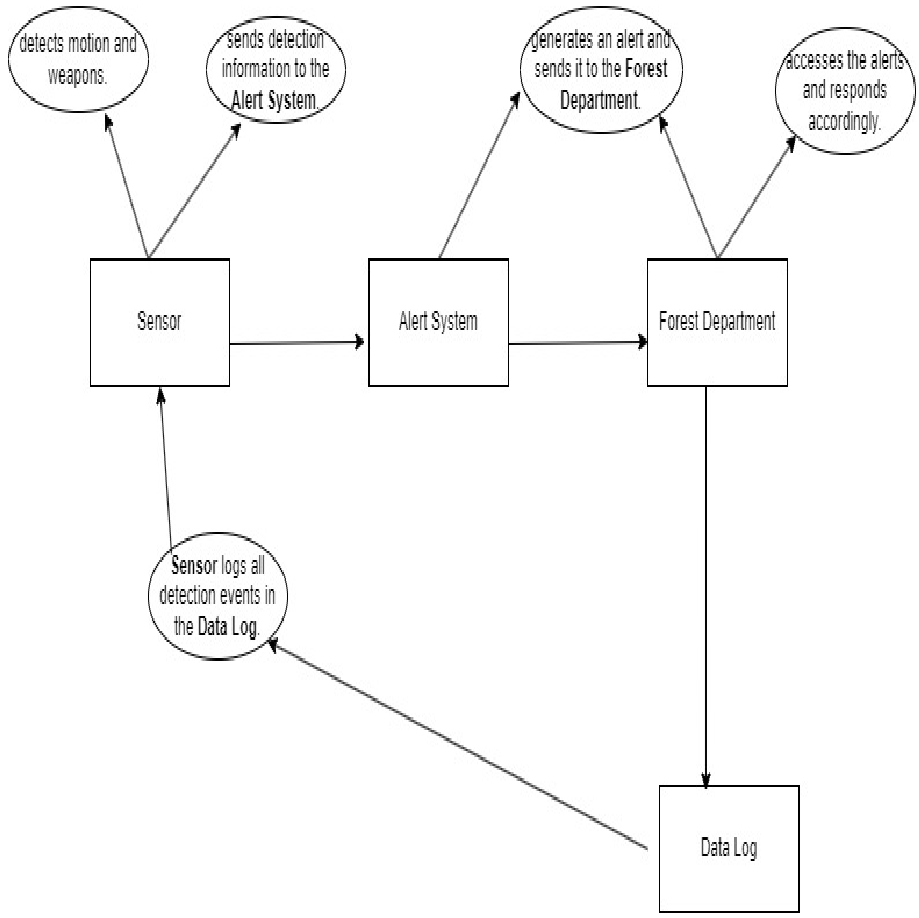

Figure 4.6: **Collaboration Diagram for Forest Security in Saving Trees**

Fig 4.6 The collaboration diagram illustrates how well the components are integrated to form a cohesive system aimed at protecting forests. It underscores the inter dependencies between the components and the importance of their interactions for effective forest security.This highlights the flow of information and the roles each component plays.he diagram outlines the sequence of interactions. For example, when the Sensor detects motion or a weapon, it communicates this information to the Alert System, which then generates an alert for the Forest Department. This clearly depicts the operational flow from detection to response.

4.3.6 Activity Diagram

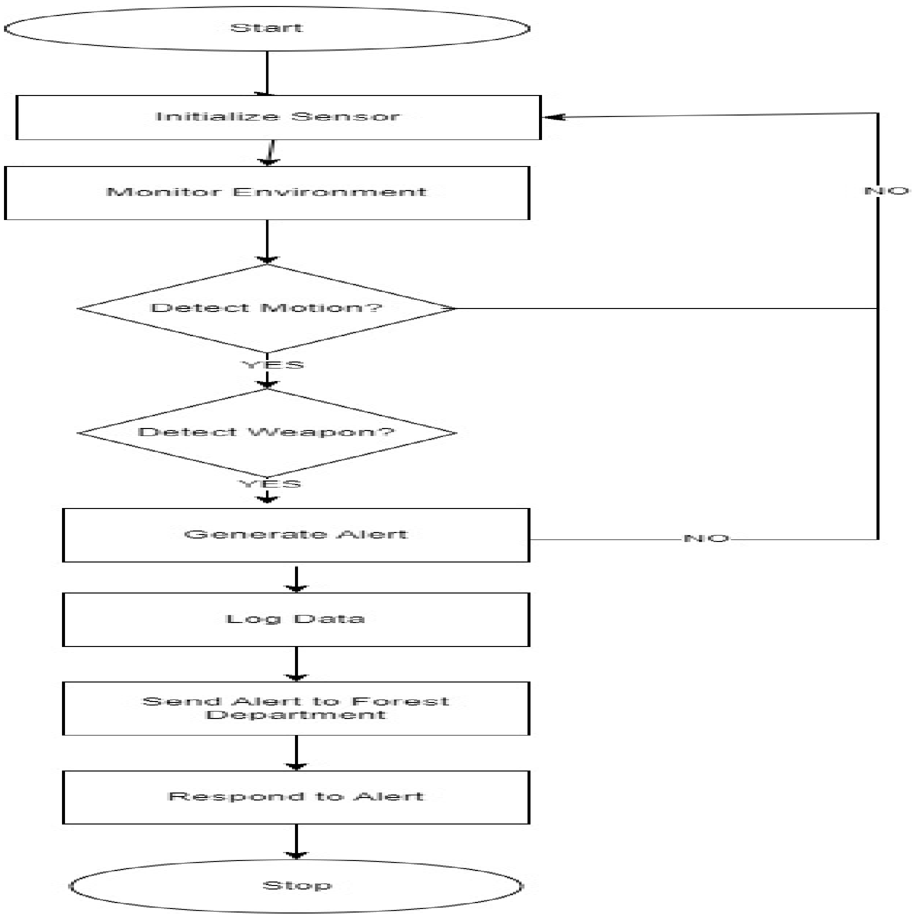

Figure 4.7: **Activity Diagram for forest security in saving trees**

Fig 4.7 provides to illustrate the process flow for a system involving a controller, network connection, sensor reading, LCD display, and motor pump control based on comparing sensor values to a threshold. It includes steps such as establishing a connection, reading the sensor value, displaying it on an LCD, and making decisions based on the comparison to the threshold value.

4.4 Algorithm & Pseudo Code

4.4.1 Linear Regression Algorithm

1. import Libraries: Import ne libraries, including NumPy, pandas, Matplotlib, and scikit-learn modules.

2. Read Data: Read data from the CSV file (”mydata.csv”) using pandas.

3. Data Preprocessing: Split the data into features (X) and target variable (y). Split the data into training and testing sets. Train Machine Learning Models: Train three classification models: Support Vector Machine (SVM), Support Vector Classifier (SVC), and Logistic Regression. Evaluate the accuracy of each model on the testing set.

4. Evaluate Performance: Print and display the accuracy of each model. Compute confusion matrices for binary classification data. Plot the accuracy-precision curve.

5. Serial Communication Setup: Establish serial communication with a device (COM5 at 9600 baud rate).

6. Define Input Handling Function: Continuously read data from the serial port. Preprocess the data and make predictions using the trained KNN classifier. Send appropriate responses (1 for good condition, 2 for moderate, for immediate action) back to the device.

4.4.2 Pseudo Code

```

START ForestSecuritySystem

FUNCTION InitializeSensor()
    SET sensorID = GenerateUniqueID()
    SET location = GetLocationFromGPS()
    SET status = "Active"
    RETURN sensorID, location, status
END FUNCTION

FUNCTION MonitorEnvironment(sensorID)
    WHILE status == "Active"
        data = CollectSensorData() // Collect data for analysis
        processedData = PreprocessData(data) // Preprocess the data
        prediction = SVMClassify(processedData) // Classify using SVM

        IF prediction == "Suspicious" THEN
            alertType = "Suspicious Activity Detected"
            GenerateAlert(alertType, sensorID)
            LogData(sensorID, alertType)
        END IF
```

```
    END WHILE
END FUNCTION

FUNCTION CollectSensorData()
    // Code to gather data from motion and weapon sensors
    RETURN sensorData
END FUNCTION

FUNCTION PreprocessData(sensorData)
    // Normalize and format the data for SVM
    RETURN preprocessedData
END FUNCTION

FUNCTION SVMClassify(data)
    model = LoadTrainedSVMModel() // Load pre-trained SVM model
    prediction = model.Predict(data) // Predict using the SVM model
    RETURN prediction
END FUNCTION

FUNCTION GenerateAlert(alertType, sensorID)
    alertID = CreateAlertID()
    timestamp = GetCurrentTimestamp()
    alert = CreateAlert(alertID, alertType, timestamp, sensorID)
    SendAlertToForestDepartment(alert)
END FUNCTION

FUNCTION LogData(sensorID, alertType)
    timestamp = GetCurrentTimestamp()
    LogEntry = CreateLogEntry(sensorID, alertType, timestamp)
    StoreInDataLog(LogEntry)
END FUNCTION

FUNCTION SendAlertToForestDepartment(alert)
    // Code to send alert via SMS/email to forest department
END FUNCTION

// Main execution
sensorID, location, status = InitializeSensor()
MonitorEnvironment(sensorID)

END ForestSecuritySystem
```

4.4.3 Data Set / Generation of Data

The sensor system is engineered to identify human motion and weapon presence when deployed in trees within forested areas. The data acquired from these sensors plays a vital role in providing real-time alerts and improving long-term forest security.The system generates various data types essential for detecting unusual activities in the forest environment. It captures information regarding human movement, including presence, direction, speed, and frequency. To gather this data, technologies such as infrared and ultrasonic sensors are employed, which are sensitive to body heat and movement.Additionally, a specialized sensor module is incorporated to detect weapons. This module may utilize metal detectors, image recognition technology, or other sensors capable of identifying specific shapes or materials associated with weapons.

4.5 Module Description

4.5.1 Sensor Integration:

The integration of various sensors into your ”Forest Security” project enhances the ability to detect and respond to threats in real-time. By utilizing a combination of motion and weapon detection technologies, along with effective data processing and alerting mechanisms, the system can significantly contribute to the protection of forests and their ecosystems.The integration of sensors in the ”Forest Security” project is crucial for effectively monitoring and protecting trees from potential threats. This system employs various types of sensors, including motion sensors that detect human movement, weapon detection sensors that identify sounds or visual signatures associated with firearms, and environmental sensors that monitor conditions like temperature and humidity. These sensors communicate with a central processing unit (CPU), which collects and preprocesses the data, filtering out noise to ensure accurate readings. Advanced algorithms, such as Support Vector Machines (SVM), analyze this processed data to identify unusual patterns indicative of suspicious activities. When a threat is detected, the system generates real-time alerts that are transmitted to the forest department via SMS or email, allowing for prompt action. Additionally, all events are logged for historical analysis, facilitating trend monitoring and resource allocation. The integration also includes a user-friendly dashboard for monitoring real-time data and alerts, further enhancing the system’s efficiency. Overall, this robust sensor integration significantly contributes to the safeguarding of forested areas by providing timely and accurate detection of potential threats.

Motion Sensors: Detect human movement in the vicinity of trees. Common technologies include passive infrared (PIR) sensors and ultrasonic sensors.

Weapon Detection Sensors: Identify sounds or visual signatures associated with weapons. Acoustic sensors to detect gunshots or other sounds. Image recognition cameras to identify shapes resembling weapons.

Environmental Sensors: Monitor factors like temperature, humidity, and light levels. These can help in understanding forest conditions and can also serve as supplementary data for anomaly detection.

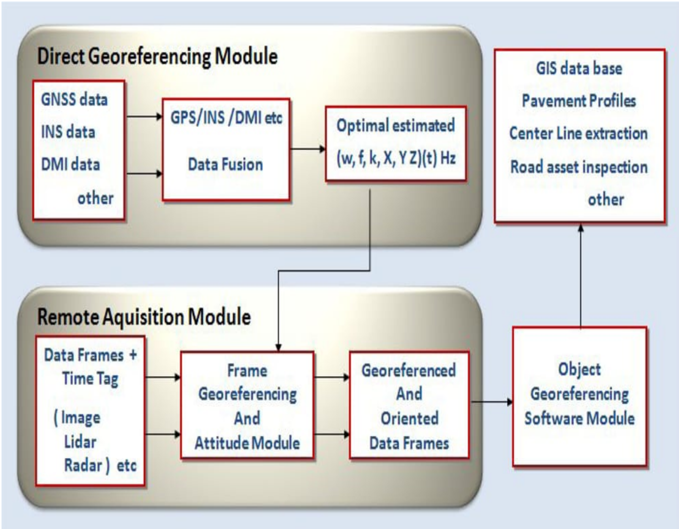

Figure 4.8: **Sensor Integration**

Fig 4.8 illustrates a sophisticated data acquisition and georeferencing system, comprised of two distinct modules.Modules work in tandem to produce highly accurate georeferenced data, enhancing the effectiveness of the overall system.These modules work in tandem to produce highly accurate georeferenced data, enhancing the effectiveness of the overall system. can be used for various applications like pavement profiles, centerline extraction, road asset inspection, and more.Remote Acquisition Module Captures frames from various sensors (e.g., camera images, LiDAR, radar) along with a time tag to synchronize the data.

4.5.2 Data Acquisition and Pre-processing:

Data acquisition and pre-processing are essential components of the ”Forest Security” project, enabling effective monitoring and detection of potential threats to trees. The data acquisition process begins with the deployment of various sensors, including motion detectors, weapon detection sensors, and environmental sensors, strategically placed throughout the forest. These sensors continuously collect data on human movement patterns, weapon presence, and environmental conditions such as temperature and humidity. This real-time data is transmitted wirelessly to a central processing unit (CPU) for immediate analysis. Following data acquisition, pre-processing is crucial for ensuring the accuracy and reliability of the collected data. This phase involves cleaning the data to remove noise and erroneous readings, handling any missing values, and normalizing the data to maintain consistency across different sensor inputs. Feature extraction is also performed to identify relevant indicators of suspicious activity, such as the frequency and duration of detected movements or the types of weapons identified. Additionally, if supervised learning is employed, the data is labeled to facilitate training of machine learning models. Finally, the cleaned and formatted data is prepared for machine learning algorithms, ensuring that the system can accurately detect and respond to threats in a timely manner.

4.5.3 Linear Regression Algorithm and Logistic Regression Algorithm:

Linear regression is a fundamental statistical method used to model the relationship between a dependent variable and one or more independent variables. It assumes a linear relationship, meaning that changes in the independent variables are associated with proportional changes in the dependent variable. In the context of the ”Forest Security” project, linear regression can be applied to predict continuous outcomes, such as the likelihood of suspicious activity based on environmental factors like temperature and humidity.In the context of the ”Forest Security” project, linear regression can be applied to predict continuous outcomes, such as the likelihood of suspicious activity based on environmental factors like temperature and humidity. By fitting a line to the observed data points, linear regression enables the identification of trends and can help in making informed decisions regarding forest security measures.Once the sensors collect data, it is transmitted wirelessly to a central processing unit (CPU) for immediate analysis. Here, the decision-making logic kicks in, guided by the algorithms employed in the system, such as logistic regression for classification and linear regression for predictive analysis.

Logistic regression is a statistical method used for binary classification tasks, where the outcome variable is categorical with two possible outcomes, such as ”suspicious” or ”not suspicious.” Unlike linear regression, logistic regression models the probability that a given input belongs to a particular category by using a logistic function. In the ”Forest Security” project, logistic regression can be employed to assess the likelihood of detecting suspicious activity based on various sensor readings.This method provides valuable insights by transforming continuous input features into probabilities, allowing for effective decision-making and timely responses to potential threats in forest areas.To further refine decision-making, the system employs machine learning algorithms that have been trained on historical data to recognize patterns indicative of unusual behavior.

Chapter 5

IMPLEMENTATION AND TESTING

5.1 Input and Output

5.1.1 Input Design

Sensor Features	Typical Range
Human Motion detectable range	5 – 30 m
Metal Detection range	10 cm – 3 m
Sensor Accuracy for Human detection	+-0.1 m/s
Sensor Accuracy for Metal detection	+- 5 percent Maximum based upon metal type Range
Maximum possible Range	Maximum 50 meters depending upon temperature and Humidity in that area.

Table 5.1: **Data Set Input**

The table 5.1 illustrates the data set related to Smart Sensor System(SSS) values for different ranges. This data set has been sourced based upon the ranges for both human and weapon detection in forest.Diverse environmental scenarios, each representing the human and weapon detection from different ranges and sensor accuracy of detection. The data set serves as a pivotal component in the development of a model for detecting and predicting human motions and weapons around forest.All through regression methods. Each entry in the data set corresponds to specific range, capturing variations in sensor values. Building upon this dataset, the Smart Sensor System (SSS) captures nuanced variations in sensor readings across different environmental and situational contexts, which are crucial for creating a reliable and effective forest security model. By focusing on human and weapon detection in forested areas, the SSS addresses a key challenge in forest protection: identifying unauthorized human presence and potential threats from weapons while filtering out non-threatening activity or wildlife movements.

5.1.2 Output Design

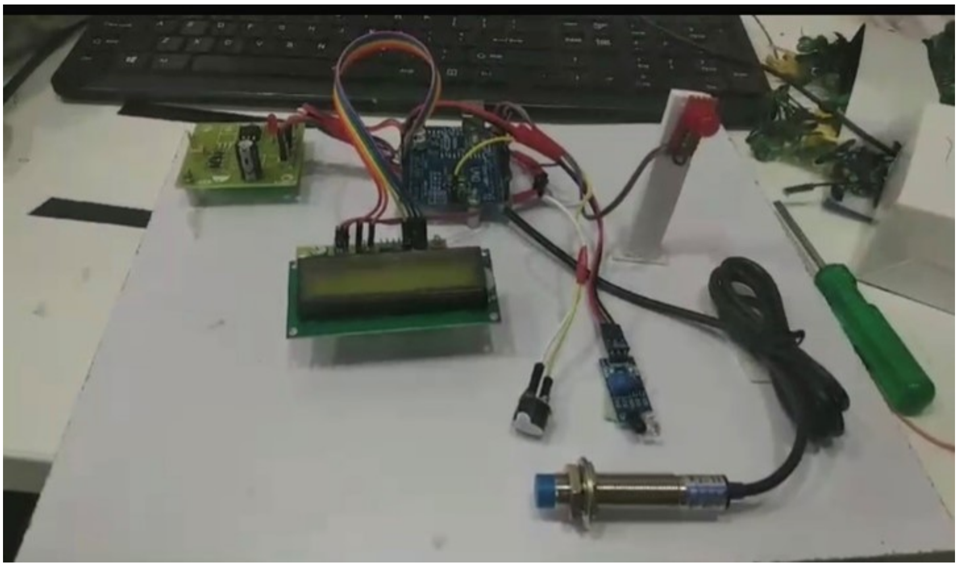

Figure 5.1: **Output Design**

In the realm of predicting Human motion the System values through machine learning models, accuracy has shown promise in controlled challenges faced in forests in robustness under diverse conditions. Particularly, the models exhibit reduced accuracy when confronted with complex backgrounds in real-world settings. Unlike traditional models, which predominantly focus on visual information, our approach integrates various modalities, acknowledging the importance of non-image data expressions. This holistic strategy aims to enhance the model's robustness and predictive capabilities, offering a more comprehensive solution for accurate SSS prediction across diverse scenarios.

5.2 Testing

5.3 Types of Testing

5.3.1 Unit testing

Unit testing for Motion detection: Each individual component or subsystem of the project is tested separately.Test whether the motion sensor can detect human movement accurately in isolation.

Input

Test ID	Input Condition	Expected Output	Description
MS-001	No motion (static environment)	No motion detected	Tests baseline behaviour
MS-002	Human walking within 5 meters	Motion detected	Tests motion detection range
MS-003	Animal movement	No motion detected	False positives are reduced
MS-004	Human running within 10 meters	Motion detected	Tests detection at faster speeds
MS-005	Human crawling	Motion detected	Detect slow and close movement
MS-006	Human outside detection range	No motion detected	Ensure motion detection boundaries
MS-007	tree movement	No motion detected	System ignores false motion caused by wind

Table 5.2: **Unit Testing Input for Human Detection**

The table 5.2 outlines the test cases for a motion detection sensor system, detailing various conditions, expected outcomes, and objectives to ensure accurate performance in a forest environment. Test suite ensures the system accurately detects human motion within a specified range while ignoring non-human and environmental motions, which is crucial for minimizing false alerts and enhancing reliability in forest monitoring.A human outside the sensor's detection range should not trigger any alerts. Expected outcome is ”No motion detected,” which ensures the system's detection is accurately limited to its designated range.

Test result

Figure 5.2: **Unit Testing output**

5.3.2 Unit testing

Unit testing for weapon Detection: Each individual component or subsystem of the project is tested separately.Test whether the model isdetecting weapons.Test whether the alert system (e.g., sending notifications or messages to the forest department) works on its own.

Test ID	Input Condition	Expected Output	Description
MS-001	No object	No weapon detected	Tests baseline behaviour
MS-002	Human holding a firearm	Weapon detected	Tests ability to detect a firearm
MS-003	Human holding a sharp tool	Weapon detected	Tests ability to detect sharp objects
MS-004	Human holding a stick	No weapon detected	check non-weapon object trigger alerts
MS-005	Weapon detected	Weapon detected	Tests ability to detect hidden weapons
MS-006	Human carrying multiple objects	Weapon detected	detected in closed environments
MS-007	Human holding plastic toy gun	No weapon detected	Ensure toy objects don't trigger alerts

Table 5.3: **Unit Testing Input for Metal Detection**

Input

The table 5.3 represents test cases for a weapon detection system that detects the presence of weapons in a forest zone. Each test case has a unique ID, input condition, expected output, and description. These tests are designed to verify that the detection system. It Differentiates between weapons and non-weapons.Avoid false positives from harmless objects. Detect weapons even when other objects are present.

Test result

Figure 5.3: **Unit Testing output**

5.3.3 Integration testing

Motion Sensor + Weapon Detection + Alert System: After ensuring each component works in isolation, you would check how they work together.Integration of the motion sensor and weapon detection system to ensure both work simultaneously without conflict. Test that detection triggers the alert system correctly, such that when motion is detected or a weapon is identified, the notification is successfully sent.

Input

Test ID	Input Condition	Expected Output	Description
MS-001	Human motion detected with weapon	High-priority alerts	Ensure both detections work
MS-002	Human motion detected without weapon	Standard alert triggered	Ensures motion triggers alert
MS-003	Animal motion detected with no weapon	No alert triggered	Ensure false alert do not trigger
MS-004	Human motion detected + concealed weapon	High-priority alert triggered	Tests how the system responds
MS-005	Human motion + weapon in obstructed view	High-priority alert triggered	Ensures partial output

Table 5.4: **Integration Testing Input for Forest Security**

The table 5.4 represents a set of test cases for a security system that detects motion and weapons, triggering alerts based on specific conditions. Each test case has a unique identifier, input conditions, the expected system response, and a description explaining the purpose of the test.This test ensures that the system can detect both motion and a weapon even if the view is partially obstructed. It verifies that the system remains effective in less-than-ideal visibility conditions, ensuring security in complex environments.

Test result

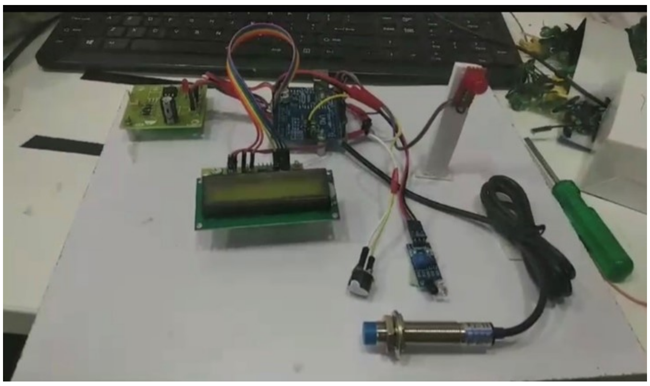

Figure 5.4: **Integration testing output**

Chapter 6

RESULTS AND DISCUSSIONS

6.1 Efficiency of the Proposed System

The proposed system is based on the SVM Algorithm that classifies between two classes. Accuracy of proposed system is done by using random forest gives the ouput approximately 90 to 92 percent. The efficiency of the proposed method depends on several factors, including the accuracy and responsiveness of the sensors, the effectiveness of the control algorithms implemented in the microcontroller unit (MCU), and the overall reliability of the motorized components such as the IR sensor and Metal sensor. Additionally, the efficiency can be influenced by the system's ability to interpret and execute commands from the farmer through the dispatch unit.

To evaluate efficiency, it's essential to consider the system's performance in real-world scenarios. Factors such as response time, precision in movements, and adaptability to varying environmental conditions will contribute to the overall efficiency. Rigorous testing and validation under different operating conditions, including potential challenges in agricultural settings, will provide insights into the system's reliability and effectiveness.

Ultimately, the efficiency of the proposed method can be quantified through performance metrics, testing outcomes, and feedback from practical implementations in forest environments. Continuous optimization and refinement based on real-world experiences will be crucial for enhancing the overall efficiency of the robotic arm system.

6.2 Comparison of Existing and Proposed System

Existing system:(TRADITIONAL METHODS)

For centuries, traditional irrigation methods have been the foundation of agriculture, relying on manual practices and generational knowledge. However, these methods face significant limitations, particularly in water efficiency, leading to issues of over- or under-irrigation and impacting crop health. Manual labor introduces inconsistency in water resource application. Furthermore, these traditional methods struggle to meet modern concerns about environmental sustainability, with risks of human life and resources. The adoption of innovative technologies, such as IoT-powered smart sensor systems and data analytics, becomes imperative to overcome these challenges. This shift towards precision farming not only optimizes forest resource usage but also enhances resources that helps in saving forests and maintaining sustainability

Proposed system:(MACHINE LEARNING AND ANOLOMY ALGORITHMS)

We use pattern recognition algorithms like Dynamic Time Warping (DTW) to analyze the patterns of motion detected by the IR sensor. DTW is used to measure similarity between two temporal sequences that may vary in speed. It can align and compare motion patterns over time. Human motion has distinct patterns compared to animals or wind. Machine learning algorithms like Support Vector Machine (SVM) is used as a classification algorithm that finds the optimal hyperplane separating different classes of data. By training it classifies motion patterns into categories (e.g., human vs. non-human) based on features extracted from sensor data. Anolomy detection algorithms such as Local Outlier Factor (LOF) and Isolation Forest helps in detecting anomalous motion patterns that deviate from the norm, which might be indicative of human activity. Arduino IDE is an open-source software that is mainly used for writing and compiling the code into the Arduino Module.

```
START ForestSecuritySystem

FUNCTION InitializeSensor()
    SET sensorID = GenerateUniqueID()
    SET location = GetLocationFromGPS()
    SET status = "Active"
    RETURN sensorID, location, status
END FUNCTION

FUNCTION MonitorEnvironment(sensorID)
    WHILE status == "Active"
        data = CollectSensorData() // Collect data for analysis
        processedData = PreprocessData(data) // Preprocess the data
        prediction = SVMClassify(processedData) // Classify using SVM

        IF prediction == "Suspicious" THEN
            alertType = "Suspicious Activity Detected"
            GenerateAlert(alertType, sensorID)
            LogData(sensorID, alertType)
        END IF
    END WHILE
END FUNCTION

FUNCTION CollectSensorData()
    // Code to gather data from motion and weapon sensors
    RETURN sensorData
END FUNCTION

FUNCTION PreprocessData(sensorData)
```

```
    // Normalize and format the data for SVM
    RETURN preprocessedData
END FUNCTION

FUNCTION SVMClassify(data)
    model = LoadTrainedSVMModel() // Load pre-trained SVM model
    prediction = model.Predict(data) // Predict using the SVM model
    RETURN prediction
END FUNCTION

FUNCTION GenerateAlert(alertType, sensorID)
    alertID = CreateAlertID()
    timestamp = GetCurrentTimestamp()
    alert = CreateAlert(alertID, alertType, timestamp, sensorID)
    SendAlertToForestDepartment(alert)
END FUNCTION

FUNCTION LogData(sensorID, alertType)
    timestamp = GetCurrentTimestamp()
    LogEntry = CreateLogEntry(sensorID, alertType, timestamp)
    StoreInDataLog(LogEntry)
END FUNCTION

FUNCTION SendAlertToForestDepartment(alert)
    // Code to send alert via SMS/email to forest department
END FUNCTION

// Main execution
sensorID, location, status = InitializeSensor()
MonitorEnvironment(sensorID)

END ForestSecuritySystem
```

Output

```
File  Edit  Shell  Debug  Options  Window  Help
Python 3.11.2 (tags/v3.11.2:878ead1, Feb  7 2023, 16:38:35) [MSC v.1934 64 bit (
AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:\Users\MOULI\OneDrive\Desktop\vel tech\minor\minor-irrigatio\progra
ms\program.py
Accuracy with KNN:  0.6923076923076923
Accuracy with SVC:  0.9230769230769231
Accuracy with LR:  0.9230769230769231
29,76,60,1
[[29. 76. 60.  1.]]

Warning (from warnings module):
  File "C:\Users\MOULI\AppData\Local\Programs\Python\Python311\Lib\site-packages
\sklearn\base.py", line 465
    warnings.warn(
UserWarning: X does not have valid feature names, but LogisticRegression was fit
ted with feature names
[1]
Pump Om
```

Figure 6.1: **Outputs for Testing Accuracy of Algorithms**

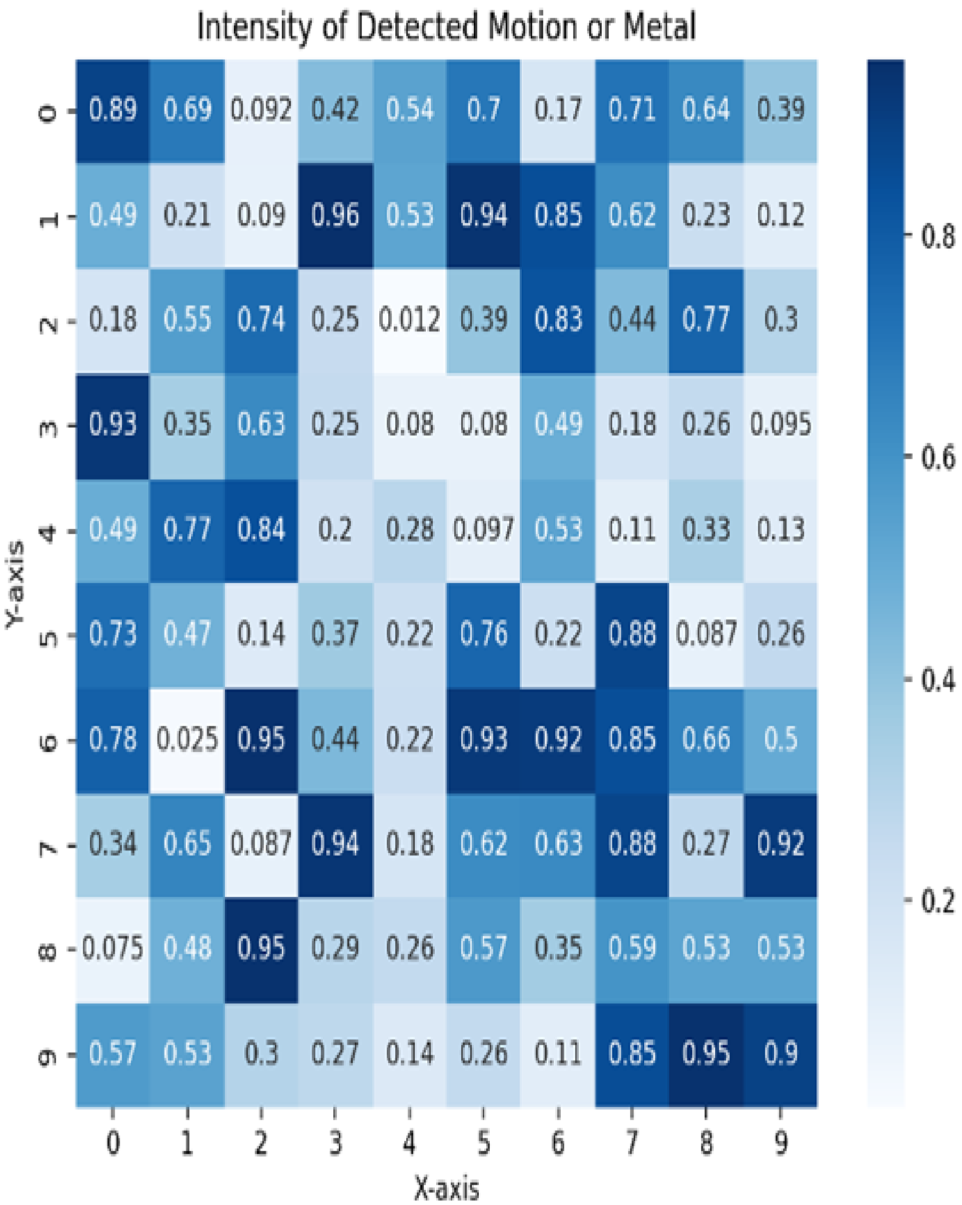

Figure 6.2: **Output for Intensity of Metal Detection**

Chapter 7

CONCLUSION AND FUTURE ENHANCEMENTS

7.1 Conclusion

In conclusion, the advancement of forest security systems represents a crucial step towards safeguarding global forest ecosystems. Integrating technologies such as wireless sensor networks, enhances detection capabilities but also enables proactive measures against threats like illegal logging and forest fires. Community involvement further strengthens these efforts, fostering sustainable practices and ensuring the preservation of biodiversity and natural resources. As we continue to innovate and implement these solutions, the future holds promise for more resilient forests, contributing to environmental stability and the well-being of present and future generations.

To enhance forest security and protect trees, the proposed system integrates various sensors and devices to detect and prevent illegal activities. The core component is the Metal Detector Sensor, which will be strategically placed to identify metallic objects often used in illegal logging activities. IR Sensors will be deployed to detect unauthorized human presence and movements within the forest areas. When these sensors are triggered, Buzzers will sound an alarm to alert nearby forest rangers or monitoring personnel. An LCD display will be used to provide real-time data on sensor activations and system status, ensuring that forest security teams can monitor conditions easily.

7.2 Future Enhancements

In the pursuit of feature enhancement for our project aimed at creating a sensor system that detects human motion and weapons to protect forests, has significant potential for growth and evolution. As environmental concerns and the need for forest preservation continue to rise, advancements in technology will play a key role in shaping the future of forest security. Enhancing your project can involve improving the system's capabilities, integrating new technologies, and expanding its use cases. Below are several possible future enhancements, organized into key areas, that can propel your project to the next level.

The forest security project you've developed is an innovative and much-needed solution that addresses growing concerns regarding illegal activities, deforestation, poaching, and overall environmental degradation. With the ability to detect human motion and weapon presence, the system can already alert forest departments of any unusual or suspicious activities in forested areas. However, like any technology, the system can be significantly enhanced to increase its accuracy, efficiency, and overall impact. The following are potential future enhancements that could be integrated into the project, helping the system evolve into a more powerful tool for forest security and conservation efforts.

One of the most impactful enhancements for the current system would be the integration of artificial intelligence (AI) and machine learning (ML) algorithms. AI could make the detection system smarter by learning from previous data and improving the differentiation between threats and non-threats. Currently, the system might rely on basic motion sensors that detect any human movement. AI models trained on diverse datasets could differentiate between normal human activity, such as forest rangers patrolling, and suspicious movements indicative of poachers or loggers. Over time, the system could predict and identify high-risk activities more accurately.Enhancing the system with AI models that recognize specific animal behaviors and movement patterns could help eliminate false alerts triggered by wildlife. For example, AI could be trained to recognize the movement of specific species such as deer, boars, or monkeys and disregard them as threats.

Chapter 8

PLAGIARISM REPORT

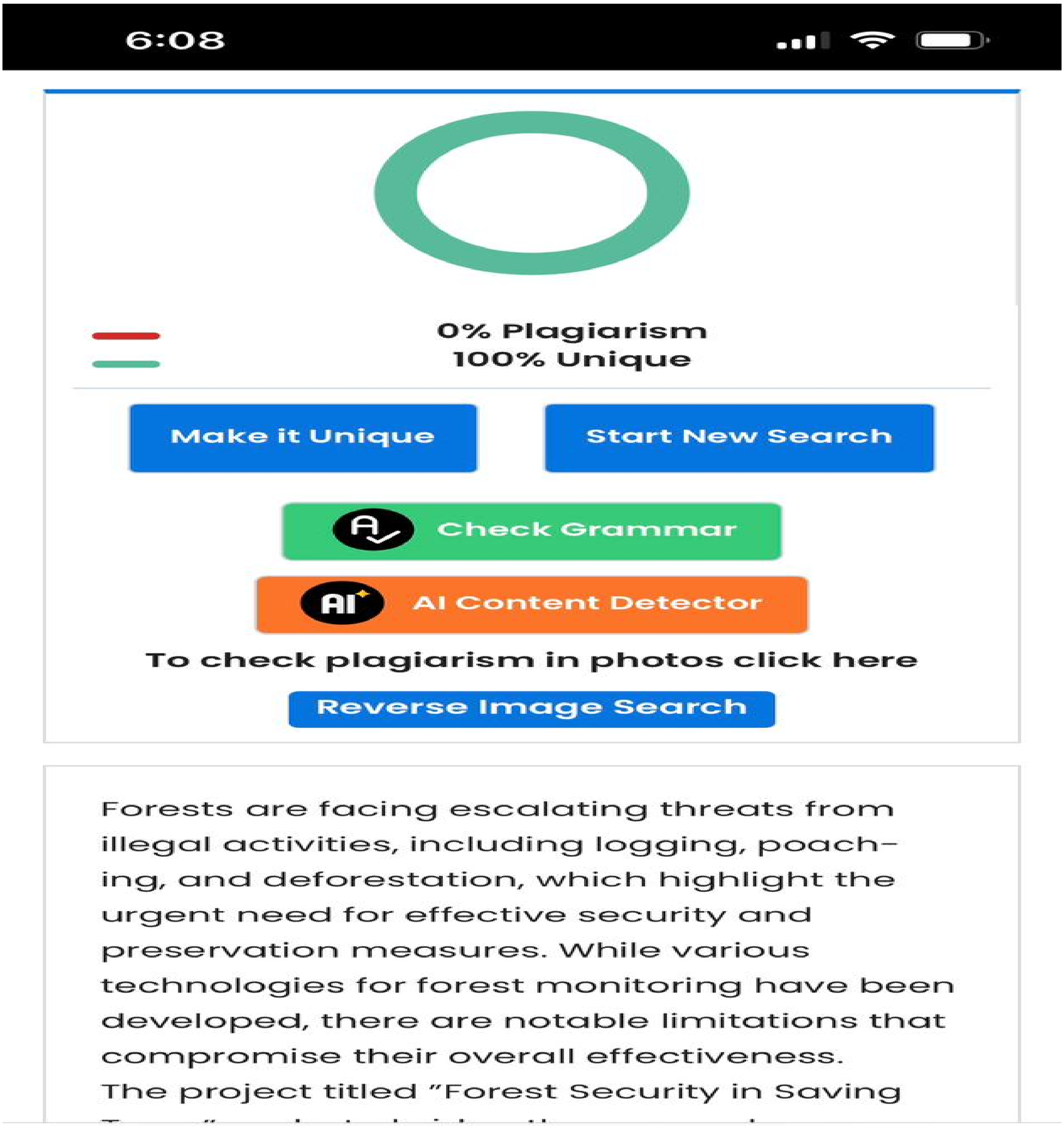

Figure 8.1: **Plagiarism Report**

Appendices

Appendix A

Complete Data

Forest security with sensors for human motion and weapon detection, the main components would involve sensor interfacing, machine learning models for detecting weapons, and communication protocols for alerting. The proposed forest security system to save trees involves an integrated solution utilizing Arduino, LCD, metal detector, IR sensor, buzzer, power supply, LEDs, and a 12V adapter.The Arduino microcontroller serves as the central unit, coordinating all components. The metal detector is strategically placed to identify unauthorized equipment used for logging, while IR sensors detect human presence and movement in restricted areas. Upon detecting a threat, the system triggers an audible buzzer and activates LEDs as visual alerts, signaling an immediate threat. The LCD screen displays real-time information and alerts, providing forest rangers with instant updates.

The entire system is powered by a robust power supply and stabilized using a 12V adapter, ensuring continuous operation in remote forest areas. This method combines real-time monitoring, immediate threat detection, and alert mechanisms to enhance forest security and protect trees from illegal activities effectively. Placed amidst trees, their purpose was to detect sounds such as chainsaws, vehicles, and other indications of human activity connected to illicit logging. After analysing a real-time audio stream, an algorithm looks for anomalies and notifies the user when it finds anything. Several countries, including Brazil, Indonesia, and Peru, are using this work, which has shown promising results in terms of stopping illicit logging. Using Internet of Things sensors to monitor the surroundings and identify human activity in woods is being done by the Smart woods work. Traditionally, these sensors have only been available as acoustic, motion, and camera sensors.

Machine learning techniques are used to examine the sensor data and look for any changes or anomalies that might point to illicit logging. to establish the forest rangers' capabilities and enable real-time monitoring so they can respond quickly to any illegal activity. WWF rolled out a program called Forest Guardian that uses drones and ground-based sensors to monitor forests. The sensors can detect human presence and activity, while drones make high-resolution images. AI and ML systems verify the information collected by sensors and drones to detect illegal forestry activity.

Appendix B

Sample Source Code

```
import machine
import time

pir_sensor = machine.Pin(12, machine.Pin.IN)  # Connect PIR sensor to GPIO12
alert_sent = False

def send_alert():
    # Placeholder function for sending an alert
    print("Motion Detected! Sending alert to forest department...")
    # Integrate SMS or email API here

while True:
    if pir_sensor.value() == 1:  # Detects motion
        if not alert_sent:
            send_alert()
            alert_sent = True
        time.sleep(5)  # Delay to avoid spamming alerts
    else:
        alert_sent = False
    time.sleep(1)

#Weapon Detection using a Pre-trained Model

import cv2
import numpy as np

# Load YOLO model
net = cv2.dnn.readNet("yolov3.weights", "yolov3.cfg")
layer_names = net.getLayerNames()
output_layers = [layer_names[i[0] - 1] for i in net.getUnconnectedOutLayers()]

# Classes for detection
classes = ["person", "knife", "gun"]

def detect_weapon(image_path):
    image = cv2.imread(image_path)
    height, width, channels = image.shape
    blob = cv2.dnn.blobFromImage(image, 0.00392, (416, 416), (0, 0, 0), True, crop=False)
    net.setInput(blob)
    detections = net.forward(output_layers)

```

```python
    for detection in detections:
        for i, confidence in enumerate(detection[5:]):
            if confidence > 0.5 and classes[i] in ["knife", "gun"]:
                print(f"Weapon detected: {classes[i]}")
                # Integrate alert function here
                return True
    return False

# Test the function
if detect_weapon('/home/pi/captured_image.jpg'):
    print("Alert: Weapon detected!")
else:
    print("No weapon detected.")

#Communication and Alerting

import smtplib

def send_email_alert():
    server = smtplib.SMTP('smtp.gmail.com', 587)
    server.starttls()
    server.login('youremail@gmail.com', 'yourpassword')
    message = "Subject: Forest Security Alert\n\nMotion and weapon detected in the forest area."
    server.sendmail('youremail@gmail.com', 'forestdept@example.com', message)
    server.quit()
    print("Email alert sent to forest department.")
```

References

[1] Nelson, R. (2020) Untamedscience.com. April 2019. [Online]. Available: https://untamedscience.com/blog/the-environmental-impact-of-forest-fires/. Accessed 30 December 2020.

[2] F. F. D. a. P. U. N. w. IoT, “Pantech Solutions,” 4 September 2018. [Online]. Available: https://www.pantechsolutions.net/forest-fire-detection-and-prediction-using-nodemcu-with-iot Accessed 13 March 2020.

[3] Hansen, M., et al. (2016). [Online]Available:https://www.science.org/doi/10.1126/science.1244693. Accessed 15 November 2013.

[4] L.Garcia et al. (2016). ”Advancements in Sensor Technologies for environmental sustainability.” Sensors, 16(8), 1256.

[5] S.White et al. (2021). ”Integrating Weather Data for Enhanced Decision- Making in forest resources.” Journal of Environmental Science, 55(2), 321-335.

[6] H. Patel et al. (2019). ”IoT-based Precision: A Comprehensive Review.” In Proceedings of the International Conference on Internet of Things (pp. 78-92).

[7] L.Chen et al. (2017). ”Wireless Communication Technologies for Real-time Monitoring in forest security.” Journal of Wireless Communications and Networking, 23(4), 456-469.

[8] Rodriguez. M et al. (2019). ”Energy-efficient Algorithms for Smart Systems.” Energy Efficiency, 12(5), 887-900.

[9] H.Wang et al. (2022). ”IoT and Precision for forest: Challenges and Opportunities.” In Proceedings of the International Conference on Precision Agriculture (pp. 134-149).

[10] Kim. S et al. (2018). ”Advancements in mechanism of Sensing Technologies for Smart sensors.” 192, 100-115. .

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- Dont include general content , write more technical content
- Each chapter should minimum contain 3 pages
- Draw the notation of diagrams properly
- Every paragraph should be started with one tab space
- Literature review should be properly cited and described with content related to project
- All the diagrams should be properly described and dont include general information of any diagram
- All diagrams,figures should be numbered according to the chapter number
- Test cases should be written with test input and test output
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General Instructions

1. *Thorough Planning and Design*
    - **Schematic and Wiring Diagram**: Have clear schematics for all connections between sensors, processors, and other components. This prevents wiring errors during assembly.
    - **Component Compatibility**: Verify that all components (e.g., sensors, microcontrollers, camera modules) are compatible in terms of voltage, current, and communication protocols.

2. *Safety Precautions*
    - **Handling Power Sources:** When dealing with batteries or external power supplies, handle with care to avoid short circuits or overheating.
    - **ESD Precautions:** Use anti-static wrist straps and grounding mats if you're working with sensitive electronic components to prevent electrostatic discharge (ESD) damage.
    - **Protective Gear**: Wear gloves, safety goggles, or any other necessary protective gear when handling tools, soldering, or assembling.

3. *Initial Testing and Calibration*
    - **Individual Component Testing**: Test each component (e.g., PIR sensor, camera module, GSM module) individually to ensure they are functioning correctly before integrating.
    - **Sensor Calibration**: Sensors like PIR sensors may need calibration for accuracy. Run tests to set sensitivity and adjust the settings for the environment where the project will operate.
    - **Environmental Testing**: Test components under similar environmental conditions to the deployment location (e.g., humidity, temperature) to identify any vulnerabilities.

4. *Power Supply Checks*
    - **Voltage Matching**: Ensure each component receives the correct voltage to avoid damage.
    - **Fuse or Protection Circuit**: Use a fuse or protective circuit to prevent overloads or short circuits, especially in outdoor or unpredictable environments.

5. *Final Integration and Dry Runs*
    - **Integrate Components Carefully:** Assemble and connect all components slowly, double-checking connections against your wiring diagram.
    - **Field Test:** Run a field test in the actual deployment location to confirm the system's reliability and coverage area.