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IOT-BASED ANTI THEFT FLOORING SYSTEM USING RASPBERRY PI

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Abstract - The proposed project focuses on developing a cutting-edge anti-robbery flooring device that combines Raspberry Pi, Internet of Things (IoT) technologies, and infrared cameras to enhance security in sensitive regions. This technology is especially effective during activities that take place after midnight since it seeks to provide real-time danger detection with enhanced thermal imaging capabilities. Through the use of machine learning algorithms trained on an extensive thermal dataset, the gadget is able to recognize objects that are not authorized or questionable sports.In order to ensure that users are alerted as soon as an ability hazard is detected, the computer is programmed to automatically send out an email notifying them of the use of the "smtplib" module. It also has an aural deterrent, such as a buzzer or prank voice, that acts as an active defense against someone with the ability to break in.This dual approach helps trigger reactions to unwanted access attempts in addition to increasing awareness.The floor device's contemporary form overcomes limitations of traditional security systems, which frequently rely on visible cameras and motion sensors. Sensors embedded in the flooring reduce the system's vulnerability to evasion techniques employed by trespassers. Its efficiency is further increased by the incorporation of thermal imaging, which allows for detection in low-visibility settings.

Keywords: Anti-theft flooring system, IoT security, infrared cameras, machine learning, real-time detection,automation alert.

1. INTRODUCTION

1.1 NEED FOR ADVANCED SECURITY SYSTEM:

Protecting private and business assets against theft and illegal access has become crucial in today's security-conscious society. In low light or at night, traditional security systems like cameras and motion detectors frequently fail. This restriction calls for the creation of sophisticated and dependable systems that can offer real-time danger identification and prompt action

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1.2 ANTI-THEFT FLOOR SYSTEM OVERVIEW

This project presents a state-of-the-art IoT-Based Anti-Theft Floor System that improves security in high-risk or sensitive locations by utilizing IoT technology, Raspberry Pi, infrared cameras and machine learning. Because the system uses thermal imaging to detect intruders, it works especially well in low-visibility settings like dimly lit places or at night.Even in total darkness, the system can accurately identify illicit movements or objects by integrating infrared cameras with machine learning algorithms that have been trained on thermal datasets. This skill outperforms conventional security techniques, which frequently have trouble identifying possible threats in comparable circumstances.identifying items or unapproved movements in low visibility situations.Machine Learning Algorithms: Reduce false alarms by using thermal image analysis to differentiate between potential threats and regular activity

1.3 ESSENTIAL PARTS AND FUNCTIONALITY

The following are the main parts of the anti-theft floor system:IoT Framework: The main hub for system functions, built on a Raspberry Pi.Infraredcameras: These devices continuously scan specific regions by taking thermal pictures, which arecrucial for identifying objects or unlawful movement in low light.Machine Learning Algorithms: Reduce false alarms by using thermal image analysis to differentiate between potential threats and regular activity.

1.4 MACHINE LEARNING FOR IMPROVED THREAT DETECTION

For the analysis of thermal data, the machine learning capabilities of the system are essential. The machine learning model can correctly classify and identify possible security threats by being trained on thermal datasets. This clever analysis guarantees that the system can accurately identify intrusions without being tricked by innocent objects, light variations, or shadows.

1.5 THE PROJECT'S SCOPE

The following are the main goals of this project, which attempts to create a strong IoT-Based Anti-Theft Floor System Intrusion Detection in Real Time Even in low-visibility situations, make use of infrared cameras and machine learning algorithms to guarantee accurate and dependable identification of unlawful movements or objects.Automated NotificationsCreate an email notification system that uses Python's smtplib module to quickly alert users about intrusions that are detected. This guarantees prompt action without necessitating ongoing manual oversight.
Deterrence by Sound To immediately discourage intruders and lessen the possibility of additional illegal conduct, turn on a loud buzzer or pre-recorded audio message.

2.1 Background of the Work

The growing need for efficient security solutions in commercial, industrial, and residential settings emphasizes how inadequate traditional systems like motion sensors and surveillance cameras are. In low light or at night, traditional security measures frequently malfunction, leaving properties open to theft and unwanted access. There is a great chance to develop more intelligent and flexible security systems thanks to developments in machine learning and Internet of Things (IoT) technologies.Real-time data processing combined with thermal imaging provides a novel way to fill up these gaps. More responsiveness and dependability can be attained by advanced systems through the use of infrared cameras and Internet of Things frameworks, particularly in settings where conventional systems are inadequate. The creation of an IoT-based anti-theft flooring system is motivated by the increasing demand for strong, intelligent security solutions

1.2 Motivation and Scope of the Proposed Work

Thermal Imaging Object Detection Using YOLOv5, this project on GitHub demonstrates the application of the YOLOv5 algorithm for detecting objects in thermal images. The study highlights how YOLOv5, an advanced object detection algorithm, outperforms its predecessors by effectively classifying objects within thermal images. This research lays the groundwork for implementing similar techniques in anti-theft systems that rely on infrared cameras for monitoring and detection[1].
Thermal Vision: Night Object Detection with PyTorch and YOLOv5,this tutorial provides insights into using PyTorch and YOLOv5 for detecting objects in thermal images, emphasizing real-time applications. The authors demonstrate how to utilize the Teledyne FLIR ADAS Dataset to train a YOLOv5 model, achieving significant accuracy in detecting various object classes under low visibility conditions. This work is particularly relevant for developing an IoT-based anti-theft flooring system that requires effective detection capabilities in the dark[2].
Improved YOLOv5 for Object Detection in Visible and Thermal Infrared Images, this paper presents an enhanced version of the YOLOv5 algorithm that incorporates contrastive learning to improve object detection accuracy in both visible and thermal infrared images. The proposed method addresses challenges such as occlusion and illumination variations, making it suitable for applications like nighttime surveillance, which is critical for the proposed anti-theft flooring system[3].
Training Object Detectors with FLIR Thermal Images, the research outlines a methodology for training object detectors using FLIR thermal images, focusing on optimizing the YOLOv5 model for enhanced performance. The findings indicate that using transfer learning techniques can significantly improve detection accuracy, which is essential for real-time monitoring systems like the anti-theft flooring system [4].
Using Machine Learning Algorithms to Enhance IoT System Security, this study explores various machine learning algorithms to bolster security in IoT systems, achieving high accuracy rates in threat detection. The findings emphasize the importance of integrating machine learning with IoT applications to enhance security measures, aligning well with the objectives of developing a robust anti-theft flooring system[5].
Object Detection from UAV Thermal Infrared Images Using YOLO Models, this research investigates the application of YOLO models for detecting objects from thermal infrared images captured by UAVs (unmanned aerial vehicles). The study provides qualitative and quantitative evaluations of object detection performance, demonstrating the effectiveness of deep learning approaches in challenging imaging conditions, which can be applied to ground-based anti-theft systems[6].
A Comprehensive Review of Deep Learning Techniques for Object Detection, this review examines various deep learning techniques used for object detection across different domains, including thermal imaging. It discusses the evolution of algorithms like YOLO and their applications in security systems, providing a foundation for understanding how these technologies can be leveraged in IoT-based security solutions.
Anomaly Detection Framework for IoT Networks, the authors propose an anomaly detection framework specifically designed for IoT networks, utilizing machine learning techniques to identify unusual patterns indicative of security breaches. This framework's principles can be adapted to enhance the threat detection capabilities of the proposed anti-theft flooring system by identifying unauthorized movements or objects.
Real-Time Intrusion Detection Using Deep Learning Technique, this paper discusses real-time intrusion detection systems that employ deep learning techniques to monitor environments continuously.

2. METHODOLOGY

System Design:

- Define the hardware components needed, including Raspberry Pi, pressure sensors, motion sensors, and a thermal camera.
- Design a schematic for the system layout, ensuring efficient sensor placement within the flooring.

Hardware Setup:

- Assemble the Raspberry Pi with the necessary sensors.
- Connect the sensors to the Raspberry Pi GPIO pins for data collection.

Software Development:

- Write Python scripts to interface with the sensors and collect data.
- Develop a machine learning model using PyTorch or similar frameworks to analyze sensor data and identify patterns indicative of unauthorized access.

Data Processing and Transmission:

- Use OpenCV for image processing, integrating thermal camera data with sensor inputs to enhance detection capabilities.

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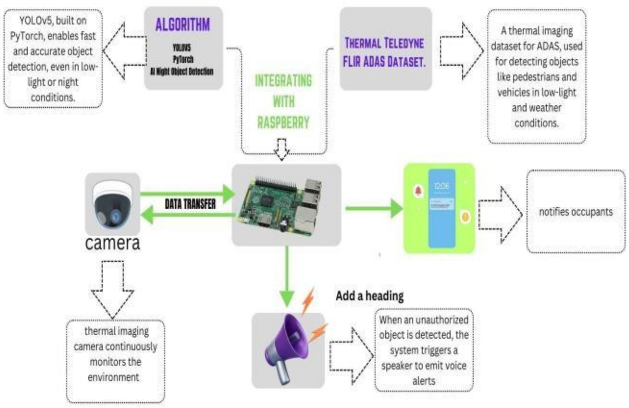
- Implement data transmission protocols to send alerts to a server or directly to user devices.

User Interface Development:

- Create a mobile application or web interface for users to monitor sensor status, view alerts, and control system settings.
- Ensure the interface is user-friendly and provides real-time updates.

Testing and Evaluation:

- Conduct thorough testing of the system under various conditions to evaluate performance, accuracy, and response time.
- Gather feedback from users to refine the system and improve its effectiveness.



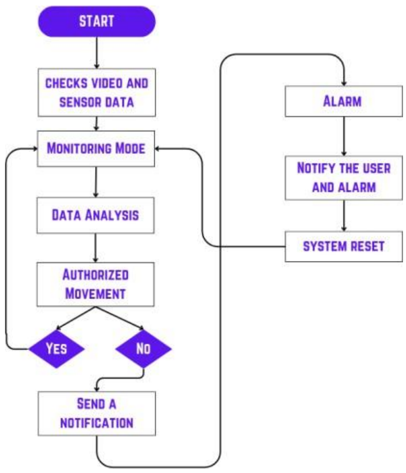
2.2 Accuracy and Precision

The accuracy and precision of YOLOv5 depend on various factors, such as the size of the model, the dataset used for training, and the specific task at hand. However, some general observations can be made:

1. **Model Size:** YOLOv5 comes in five different sizes: nano (n), small (s), medium (m), large (l), and extra-large (x). Larger models generally achieve higher accuracy and precision but have slower inference times.
2. **Coco Dataset:** On the COCO dataset, which is a widely used benchmark for object detection, the YOLOv5 models achieve the following performance:
    - YOLOv5s: 37.4% mAP (mean Average Precision)
    - YOLOv5m: 45.4% mAP
    - YOLOv5l: 49.0% mAP
    - YOLOv5x: 50.7% mAP
3. **Thermal Imaging:** When applied to thermal imaging datasets, such as the Teledyne FLIR ADAS dataset, YOLOv5 models can achieve high accuracy and precision in detecting objects under low-visibility conditions. However, the exact performance depends on the specific dataset and fine-tuning of the model.
4. **Technology Stack**

The system will utilize:

- Raspberry Pi 4: Serving as the central processing unit for running the YOLOv5 model.
- Thermal Imaging Cameras: To capture thermal images for object detection.
- YOLOv5 Framework: For implementing the object detection algorithm.



Evaluation Metrics

- On the MS COCO dataset, YOLOv5x achieved an AP of 50.7% with an image size of 640 pixels and a speed of 200 FPS on an NVIDIA V100 GPU.
- By increasing the input size to 1536 pixels and using test-time augmentation (TTA), YOLOv5 reached an AP of 55.8% on the MS COCO dataset.

While these metrics provide a general idea of YOLOv5's performance, the actual results may vary when using the FLIR thermal dataset due to differences in image characteristics and object classes.

3. CONCLUSIONS

In conclusion, plant disease detection using transfer learning offers a highly effective and efficient approach for identifying diseases in crops with high accuracy. By leveraging pre-trained models on large datasets, transfer learning allows for quick adaptation to new tasks, even with limited labeled data. This not only accelerates the training process but also enhances the accuracy, often exceeding 90%, making it an invaluable tool for addressing agricultural challenges. The ability to reuse learned features enables more precise detection of plant diseases, leading to better crop management, reduced losses, and more sustainable farming practices. Ultimately, transfer learning provides a promising solution for improving agricultural productivity and supporting global food security through advanced technology.

Suggestions for Future Work

- Future enhancements will focus on improving the robustness of sensor readings against environmental factors through better calibration techniques.
- Exploring integration with additional IoT devices, such as cameras and alarm systems, could provide a more comprehensive security solution.
- Further research will include developing predictive analytics using machine learning to identify potential threats based on user behavior and historical

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