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Robotics Vision based Student Dress Code Deduction using Machine learning

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ABSTRACT: This Project proposes an robotic vision system that leverages a camera to monitor and enforce dress code compliance in a college setting. The system utilizes Teachable Machine totrain a model capable of accurately identifyingvarious dress codes and specific uniform requirements. The trained model is integrated with a Raspberry Pi, a compact and versatile single-board computer, to process the captured images in real-time. Upon detecting a violation of the dress code, the system promptly sends automated notificationstothedesignatedheadofthedepartment. Additionally, the system maintains a comprehensive database of student attendance and dress code adherence, enabling the generation of insightful analytics.

By combining the power of computer vision, machine learning, andIoT technologies, this system offers an efficient and scalable solution for monitoring and enforcing dress codes in educational institutions.

KEYWORD: Machine vision, computer vision, image processing, object classification, object detection, object segmentation, artificial intelligence, machine learning.

I. INTRODUCTION

In recent years, technological advancements have significantly impacted various sectors, including education.maintaining disciplineand adherenceto dresscodes. traditionalmethodsof monitoringstudent system involves manual inspection, which can be time-consuming and prone to human error.

The proposed system leverages the capabilities of a Raspberry Pi, a versatile single-board computer, to capturerealtimevide of eeds of students. these vide os treams are then processed using a machine learning model, specifically a convolutional number of the students ofeuralnetwork(CNN),trainedonadatasetofimagesdepictingvarious dress code scenarios. this enables educational train and update the model institutions to easily to accommodatespecificdresscoderequirements.ByintegratingtheRaspberryPiwithIoTtechnologies,the system can be deployed in various locations within the institution, such as entrances, classrooms, or common areas. Real-time monitoring and alerts can be generated, notifying administrators or security personnel of any violations. this proactive approach helps maintain a disciplined and orderly learning environment.

II. LITERATURESURVEY

[1]Zhang, Kumar, and Yang (2024) reviewed recent advancements in vision-based person identification for robotics, highlighting the superior performance of end-to-end deep learning and hybrid models over traditionalmethods, and stressing the need for greater model interpretability for real-world applications. [2] Brooks, Rodriguez, and Gupta (2024) proposed a multimodal deep learning approach combining visual and auditory data to improve person identification in dynamic robotic settings, highlighting the need for incorporatingadditionalsensorymodalitieslikeinfraredforbetterperformanceindiverseenvironments.[3] Sangavi, N., Dharshini, V., Deeksha, G., Irfan Basha, I., & Abdul Ahamed, B. (2024). Dress Code Monitoring System Using YOLOv4. This system leverages the capabilities of the YOLOv4 (You Only Look Once) algorithm, renowned for its real-time object detection and classification efficiency. By integrating high-resolution cameras and the YOLOv4 model, the system can accurately identify and analyze individuals' attire as they enter designated areas. The primary objective is to ensure adherence to specified dresscodes, which can range from formal to casual orspecific uniforms. [4] Authors(2024).AI Based Object Detection for Students (EDUSCAN) automating the monitoring process, EduScan



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reduces the reliance on manual checks, thereby minimizing human error and enhancing overall campus security. [5] Wang, Zhang, Liu, and Li (2023) reviewed deep learning models for person identification in robotics, noting the strengths and limitations of CNNs in dynamic environments and suggesting improvements throughmultimodaldataintegrationandreal-timeoptimization.[6]Smith,Patel,George,andZhou(2023) addressed challenges in vision-based person identification for social robotics, emphasizing the benefits of multi-modal datafusionand suggestingreinforcementlearningfordynamictracking improvements.[7] L. Xie et al. (2023) studied the use of multi-camera systems to improve person identification in robotic applications. Theyfound that multiviewfusiontechniquesgreatlyenhanceperformance, even under Occlusion or partial visibility. The experiments used multiple cameras placed at different angles to create a 360-degree view of the subject. Future work suggests focusing on better real-time processing and optimizing data fusion for hardware-limited systems.[8] Fei, L., & Han, B. (2023). Multi-Object Multi- Camera TrackingBasedonDeep Learning forIntelligentTransportation. presentsasystem thatusesdeep learningalgorithmstotrackmultipleobjects, such as vehicles and pedestrians, across several cameraviews in real time. This approach enhances the accuracy and continuity of object tracking in complex traffic environments by combining object detection, re-identification, and motion prediction. [9] M. Smith, A. Patel, K. George, C. Zhou (2023) Person Identification and Tracking for Autonomous Robots in Social Environments: Challenges and Techniques. explores methods for enabling robots to recognize and follow individuals in dynamic, real-world settings. It highlights key challenges such as variations in appearance, occlusions, and changing lighting conditions. The study reviews advanced techniques including deep learning-based face and body recognition, sensor fusion, and real-time tracking algorithms. [10] Hu, H., Hachiuma, R., Saito, H., Takatsume, Y., & Kajita, H. (2022). Multi-Camera Multi-Person Tracking and Re-Identification in an Operating Room. focuses on accurately tracking and identifying multiple medical personnel across different camera views within a complex and dynamic environment like an operating room. It addresses challenges such as occlusion, similar clothing (e.g., surgical gowns), and constant movement. By using advanced computer vision techniques and re-identification algorithms, the system ensurescontinuoustrackingofindividuals, enhancingsituationalawareness, safety, and workflow analysis surgical in settings.

III. METHODOLOGY

In this project, a system is developed to monitor students within the college using a camera connected to anArduinobasedmicrocontroller.Thecameracontinuouslyobservesthestudents,andaslongastheyare properly dressed according to the college dress code, the system remains idle without taking any action. However, when a student is detected wearing informal attire, the system automatically captures an image of the student along with the exact timestamp. This image and timestamp are then processed and sent to the Head of Department (HOD) through a GSM module, which enables wireless communication.

 $\label{eq:controlleracts} Arduinomic rocontrolleracts as the central control unit, managing the operations of the camera, dress code and the control operation of the camera, dress code and the control operation of the camera, dress code and the control operation of the camera, dress code and the camera, dress code$ The detection, imagecapturing, and GSM-based datatransmission. Additionally, thesystemcan beconnected toadisplayunitwithinthecampustoprovidevisualalertstostudentsregardingdresscodeviolations. This automated approach ensures continuous, real-time monitoring and efficient reporting, helping to maintain discipline and dress code compliance within the college environment. The system is designed to monitor students within a college campus using an IP camera integrated with an Arduino-based microcontroller. The IP camera continuously observes student activity, and when a student is detected wearing informal attire that violates the dress code, the system captures an image along with a timestamp.

If the student is properlydressed, the system remainsidle. The captured data is the ntransmitted to the Head of Department (HOD) via a GSM (Global System for Mobile Communication) module, enabling real-time wireless communication and alerting. The Arduinomic rocontroller coordinates the entire process, managing image capture, dress coded tection, data processing, and message transmission. To support power requirements, a step-down transformer converts 220V AC to 12V AC, which is then converted to 12V DC through resistors. A 5V voltage regulator supplies power to the camera and microcontroller, with a heat sink included for thermal management. A 16-bit LCD display is used to show system messages or comments, and a buzzer driver provides audible alerts for violations. The system also supports a campus display for visual warnings. The image processing and machine learning components are programmed using Anaconda software, while Teachable Machine is used for virtual simulation and model training. This automated solution ensures accurate, real-timed resscodemonitoring and efficient reporting, contributing to improve discipline and compliance in the educational environment.



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IV. EXPERIMENTAL RESULTS

Fig(a)represents a student wearing a formal dress code. The system has correctly identified it with a 94% formal output, confirming the formal attire standard is met.

Fig (b) represents a student wearing an informal dress code. The system has identified it with a 99% informal output, indicating a deviation from the formal dress standard. This second image (Fig b) will be forwarded to the HOD's mail for further action.



NAME : SUNIL DEPARTMENT : Robotics and automation VEAP - 3rd	
Date and Time: 02/01/2025 - 8:45 am	
violation : not inshirt	

Fig(a)

Fig(b)

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V. BLOCK DIAGRAM





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The system is designed to monitor students' attire in real time and automatically identify dress code violations. It comprises three main functional blocks: the Camera Input System, the Processing Unit (Arduino microcontroller with Robotic Vision), and the Notification & Output System. The Camera Input System consists of an IP camera that provides continuous vedio feed of students within the а monitoringarea. This live feed is directed to the input module, labeled as "Input Feed," which forwards the data to the central processing block. This stage ensures that all student movements and appearances are captured in real time. $The core processing block features a {\it Arduinomic rocontroller with robotic vision technology}. This unit$

housestwomajorcomponents:the**ImageMonitoringSystem**andthe**DressRecognitionSoftware**.The Image Monitoring System continuously receives the video feed and frames it for analysis. The Dress Recognition Software, trained using a machine learning model (e.g., through platforms like Teachable Machine),detectswhetherastudentisdressedaccordingtothepredefinedcollegedresscode.Ifaviolation is detected, the system generates an alert signal along with the image and timestamp.

 $The {\it Notification and Output System} handles all reporting and alert mechanisms. It includes modules for:$

- Notification to the Authority- sending violational erts to the Head of Department (HOD) via GSM or internetbased email systems.
- **OutputtotheAuthority** –whichmay involve loggingtheviolationsordisplayingmessageson a screen.
- Arduino microcontroller Image Recognition Software ensuring the data flow remains within a self-contained automated system.

VI. CONCLUSION

Thisprojectsuccessfullydemonstrates the implementation of an intelligent robotic vision systemfordress codecomplianceinacollegeenvironment.ByleveragingmachinelearningwithTeachableMachine,realtime image processing with Raspberry Pi, and automated notifications, the system ensures efficient and scalableenforcementofinstitutionaldresscodes.Additionally,theintegrationofastudentdatabaseenables valuable insights policy through analytics, contributing to improved adherence and administrative oversight. This innovative approach highlights the potential of computer vision and Io Tinautomating rule enforcement, paving the way for broader applications in educational and professional settings.

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