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Leveraging Human Safety through Computer Vision

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ABSTRACT:

This project aims to leverage the capabilities of computer vision to enhance human safety in crowded areas. By using Python and computer vision techniques, the system can detect people and objects in a crowd and analyze their movements and interactions. This technology can be used to prevent accidents and save lives by providing real-time visual feedback to security personnel or emergency responders.
The project includes the development of a user-friendly interface that allows security personnel to access real-time footage and analyze the data generated by the system. This interface includes a dashboard that provides a summary of the crowd conditions and alerts and allows users to adjust the system parameters to optimize performance.
This project demonstrates the potential of computer vision to enhance human safety in crowded areas, by providing real-time visual feedback to detect and prevent accidents. By leveraging the capabilities of Python and computer vision techniques, this system can provide a valuable tool for security personnel and emergency responders to prevent accidents due to over crowdedness and save lives.

Keywords: opencv, time, video, computer-vision, deep-learning, tensorflow, numpy, detection, python3 tkinter, matplotlib, counting, cv2, human-detection, detection-model, faster-rcnn-inception-v2

1.1 INTRODUCTION

The demand for precise and effective human detection and counting systems has grown significantly in recent years across a variety of industries, including crowd control, surveillance, and smart cities. Real-time people detection and counting offers crucial insights for resource allocation, crowd control, and security applications. It is now possible to create reliable and effective algorithms for real-time human detection and counting thanks to developments in computer vision and deep learning techniques.

This project's objective is to develop and put into use a real-time human detection and counting system that can precisely find and count people in video feeds. Traditional methods of human detection relied on intricate algorithms and handmade characteristics, which frequently struggled to handle complicated situations, fluctuations in stance, occlusions, and other challenges.

2.1 SYSTEM ANALYSIS

The system aims to detect and count humans in real-time from images or video files. It provides a user interface to select an image or video file, and it applies an object detection algorithm to detect humans. The system displays the results by drawing bounding boxes around the detected humans. It calculates accuracy metrics, such as maximum count of humans, maximum accuracy, and maximum average accuracy. It generates plots and a crowd report based on the detections.

The objective of the system is to detect and count humans in real-time from either images or video files. Image file: The system allows the user to select an image file for human detection. Video file: The system allows the user to select a video file for real-time human detection. Image with human detections: The system displays the input image with bounding boxes around detected humans.

Video with real-time human detections: The system displays the video frames with bounding boxes around detected humans in real-time.

Crowd report: The system generates a report with the maximum count of humans, maximum accuracy, and maximum average accuracy. Plots: The system generates plots showing the enumeration and accuracy over time. Hardware limitations: The performance of the system may be constrained by the hardware capabilities, such as the processing power of the machine or the availability of a dedicated GPU for acceleration.

Lighting and environmental conditions: The accuracy of human detection can be influenced by lighting conditions, occlusions, or other environmental factors. The system should consider these constraints and limitations.

2.2 EXISTING SYSTEM

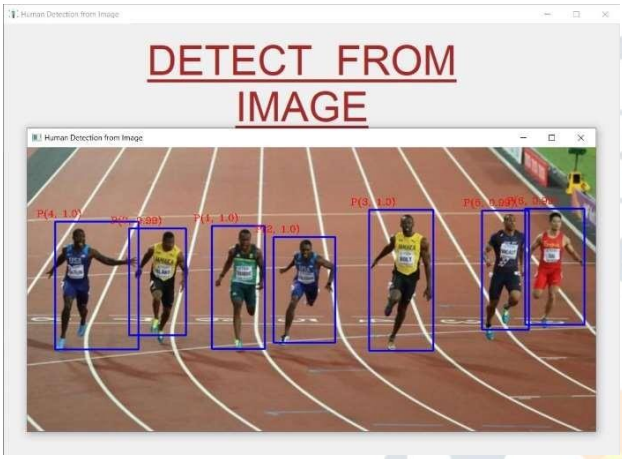
Usually, strategies decide the quantity of individuals and their areas at the same time. Detection-based methods determine the number of people by identifying individuals within the scene. These techniques decide the quantity of individuals and their areas all the while. However, the low-resolution images from the cameras always make this work. Occlusion could also be a serious problem for background segmentation techniques. From the machine vision perspective, it's hard to differentiate between an object sort of a people because of its sizable amount of possible appearances. Interesting progress is being made employing a local-based approach for human detection. Nowadays there are only methods to count and detect humans and there is no app to visible these counts to the people by using an application.

Disadvantages of Existing System:

- Invasion of Privacy: Surveillance systems often involve the monitoring and recording of individuals' activities, which can be seen as a violation of privacy. People may feel uncomfortable knowing that they are constantly being watched and that their actions are being recorded.
- Cost and Resource Intensiveness: Implementing and maintaining surveillance systems can be costly, requiring significant financial investments.
- False Sense of Security: While surveillance systems are intended to enhance security, they may give a false sense of security.

2.3 PROPOSED SYSTEM

People counting and human detection is a crucial problem in visual surveillance. In recent years, the sector has seen many advances, but the solutions have restrictions: people must be moving, the background must be simple, and the image resolution must be high. So, we proposed a system that can be used for both human detection and people counting mechanisms. With the help of the camera, the system will capture video footage. This real-time video footage will go through frame separation. By using the frames, we will detect the human count. The count of the people in various locations can be viewed by using another application. And the number of people is used as a priority for locating individuals based on feature points. Henceforth, strategies for assessing the quantity of individuals and for finding people are associated. This proposed system may help to save our time and help to avoid gathering of people in public shops etc.



2.4 Objectives :

To develop a system that identifies humans from a video frame.
To count the humans when the humans are identified.
To develop a real time human Counting system which shows the count in an Android Application.

2.5 Overall Algorithm :

Real time video footage is used as input which is acquired using a CCTV/webcam. The obtained visuals are converted into image frames with a time slice.
The frames generated are arranged in a sequence according to time where image is converted to an N X N array of grid, each grid is responsible for predicting whether an object is present or not. Apply Bounding box regression to remove weak predictions. Filtering humans from detected objects and Count of humans in each frame is stored and can be viewed by the user through a Report.

2.5.1 Advantages of Proposed System:

- **Accurate counting of individuals in real-time.**
- **Real-time monitoring for crowd management and security.**
- **Automation and efficiency, saving time and effort.**
- **Scalability to adapt to different environments and scenarios.**
- **Integration capabilities with other technologies and systems.**
- **Data analysis and insights for trend analysis and decision-making.**
- **Enhanced security through identification and tracking.**

- **Valuable for retail, transportation, and event management industries.**

3.0 SPECIFICATION: These are the hardware and software requirements to develop the system.

3.1 Software Requirements:

- **Operating System: Any OS that supports the required software dependencies.**
- **Programming Language: Python 3.x (specifically, Python 3.6 or higher).**
- **Libraries: OpenCV, NumPy, Matplotlib, and other dependencies.**

Pandas:
Pandas provide us with many Series and Data Frames. It allows you to easily organize, explore, represent, and manipulate data. Smart alignment and indexing featured in Pandas offer you perfect organization and data labelling. Pandas have some special features that allow you to handle missing data or value with a proper measure. This package offers you such a clean code that even people with no or basic knowledge of programming can easily work with it. It provides a collection of built-in tools that allows you to both read and write data in different web services, data-structure, and databases as well. Pandas can support JSON, Excel, CSV, HDF5, and many other formats. In fact, you can merge different databases at a time with Pandas.

NumPy:
Arrays of NumPy offer modern mathematical implementations on huge amount of data. NumPy makes the execution of these projects much easier and hassle-free. NumPy provides masked arrays along with general array objects. It also comes with functionalities such as manipulation of logical shapes, discrete Fourier transform, general linear algebra, and many more. While you change the shape of any N-dimensional arrays, NumPy will create new arrays for that and delete the old ones. This python package provides useful tools for integration. You can easily integrate NumPy with programming languages such as C, C++, and Fortran code.

Tkinter:
Tkinter is a Python library for creating graphical user interfaces (GUIs). It provides a set of tools and widgets to build interactive applications with windows, buttons, input fields, and more. Tkinter is user-friendly and widely used due to its simplicity and cross-platform compatibility.

3.2 Hardware Requirements:

- **Processor: Modern processor with multiple cores.**
- **Memory (RAM): Adequate RAM depending on image/video size.**
- **Storage: Sufficient space for software, libraries, models, and data.**
- **GPU: Optional but recommended for accelerated processing.**
- **Webcam: If using real-time video input.**
- **Network Connectivity: Stable internet connection if downloading models or dependencies.**

4.0 CODE EDITORS:

Notepad++ is a freely available source code editor that serves as a replacement for the default Notepad in Microsoft Windows. It is licensed under the GNU General Public License and supports multiple programming languages. Developed using C++ with Scintilla, Notepad++ offers optimized performance and a compact program size while maintaining user-friendliness. Originally, the creator, Don Ho, used JEXT but was dissatisfied with its performance, leading him to develop a C++ text editor with Scintilla during his spare time.

4.1 VISUAL STUDIO CODE EDITOR

Visual Studio Code (VS Code) is a popular and versatile source code editor that provides a rich set of features for project documentation. It offers a user-friendly interface with a wide range of extensions and plugins, making it highly customizable and adaptable to various programming languages and project requirements. With its integrated terminal, version control system, and intelligent code completion, VS Code allows developers to efficiently write and manage project documentation. It supports Markdown, a lightweight markup language, enabling easy creation and formatting of text documents. Additionally, its live preview feature enables real-time visualization of Markdown files, facilitating a seamless editing experience. Overall, VS Code provides a powerful and efficient environment for creating comprehensive and well-structured project documentation.

5.0 MODULE DESCRIPTION:

5.1 Image Acquisition: The initial stage of our system involves image acquisition, which refers to the process of capturing a picture from a source, typically a hardware device, for further processing. Once the image is obtained, it undergoes various processing routines to perform different vision tasks. Image acquisition is the starting point in the workflow sequence of image processing, as no processing can take place without an image. There are several methods to acquire images using cameras or scanners, and it is crucial to ensure that the acquired images retain all their features intact.

5.2 Frame Separation :
In our proposed system, the input consists of real-time video footage captured by Closed-Circuit Television (CCTV) or other video capturing devices. However, to process and identify individual persons, we need to work with images rather than video footage. Therefore, we convert the video into a series of images or different video frames, which are then organized into an image sequence.

5.3 Image Separation: Image separation refers to the process of grouping successive still images that represent frames of animation. Typically, these images are stored in a single folder and named with sequential file names to preserve their order. Image sequence or video compilation has significant practical importance.

6.0 ARCHITECTURE:

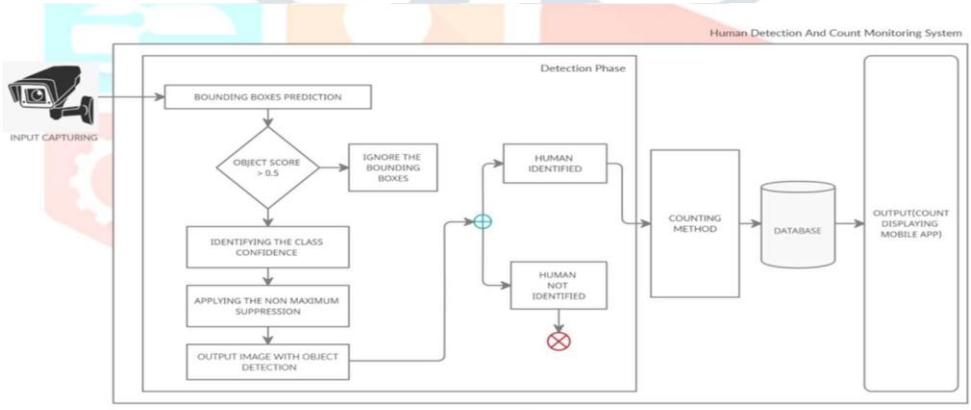


Figure 1: Architecture Diagram

Algorithm:

YOLO ALGORITHM The YOLO algorithm is a neural network-based approach for real-time object detection. It is widely known for its speed and accuracy and has been applied in various applications, such as identifying traffic lights, people, parking meters, and animals. YOLO stands for "You Only Look Once," indicating that the algorithm detects and recognizes multiple objects within an image in real-time. Object detection in YOLO is treated as a regression problem, providing classification probabilities for the detected objects. The YOLO algorithm utilizes convolutional neural networks (CNN) to achieve real-time object detection. As the name suggests, the algorithm requires only a single forward pass through a neural network to detect objects. This means that the prediction for the entire image is generated in a single calculation run. The CNN is used to predict class probabilities and bounding boxes simultaneously. The YOLO algorithm operates using the following three techniques:

- **Residual Blocks**
- **Bounding Box Regression**
- **Intersection over Union (IOU)**

To begin, the image is divided into grids of size n x n. Each grid cell within the image has the same dimension. These grid cells play a crucial role in object detection. If an object's center falls within a specific grid cell, that cell is responsible for detecting the object.

6.2 Bounding Box Regression A bounding box is a rectangular outline that encompasses an object in an image. Each bounding box in an image has the following attributes:

- **Width (bw)**
- **Height (bh)**
- **Class (e.g., person, car, traffic signal, etc.) represented by the letter c.**
- **Bounding box center (bx, by) The image below illustrates an example of a bounding box, which is depicted by a yellow outline.**

YOLO utilizes bounding box regression to predict the position, width, center coordinates, and class of objects. The image above represents the probability of an object appearing within the bounding box.

5.0 UML Diagrams:

5.1 Relationships in UML

There are four kinds of relationships in the UML:
•Dependency
•Association
•Generalization
•Realization
A dependency is a semantic relationship between two things in which a change to one thing may affect the semantics of the other thing (the dependent thing)

Figure 5.1: Dependencies

An association is a structural relationship that describes a set links, a link being a connection among objects. Aggregation is a special kind of association, representing a structural relationship between a whole and its parts.

Figure 5.1.1: Association

A generalization is a specialization/ generalization relationship in which objects of the specialized element (the child) are substitutable for objects of the generalized element (the parent).

Figure 5.1.2: Generalization

A realization is a semantic relationship between classifiers, where in one classifier specifies a contract that another classifier guarantees to carry out.

Figure 5.1.3: Realization

6.0 DATAFLOW DIAGRAM

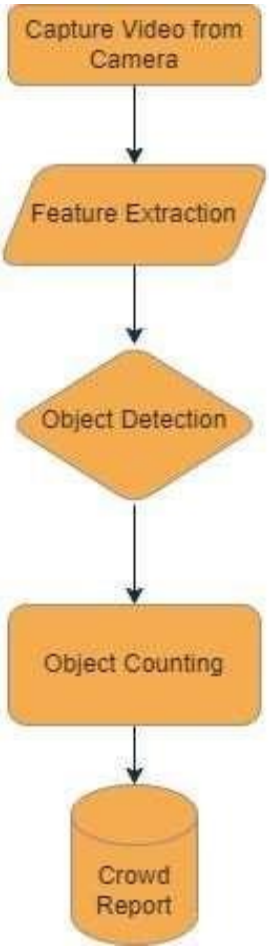
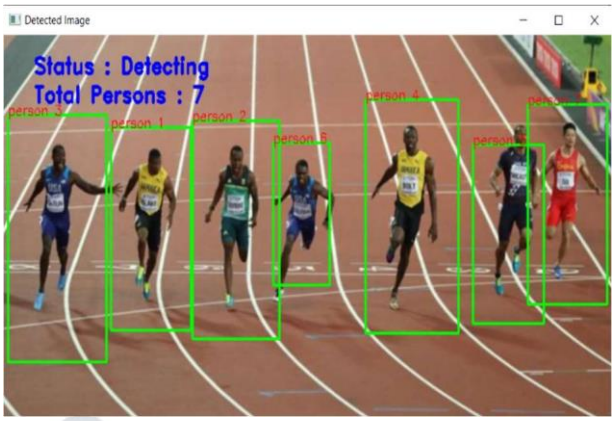


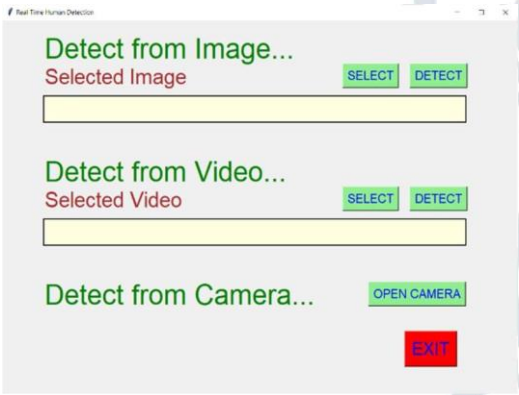
Figure 6.0: DATAFLOW DIAGRAM

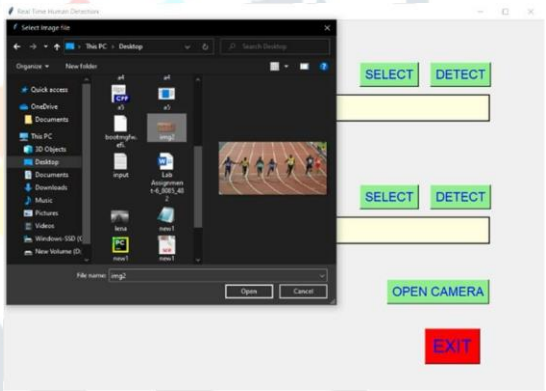
7.0 OUTPUT SCREENS:



7.1 Landing Page:

Select the Image or a Video from the local system which needs to be detected.



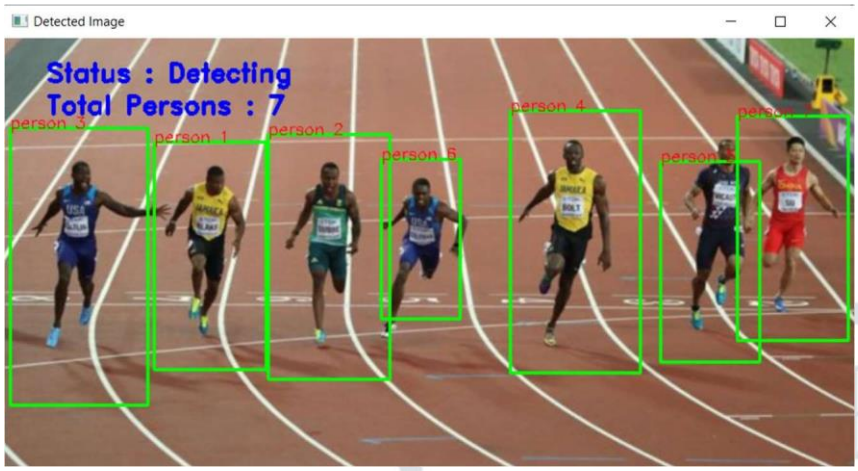


7.2 Object Recognition:

Each object in the given image or a video is detected and initiated with a number to identify the object.

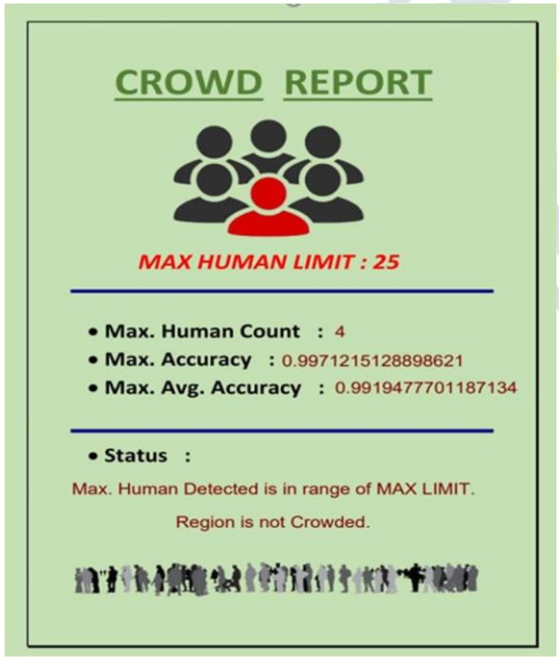
In the given image the image is processed, and the objects persons are identified with a certain number known as Enumeration.

Thus, each object in the image or a video is Recognized.



7.3 Final Crowd Report:

In the last section of the project, we generate Crowd Report[5], which will give some message on the basis of the results we got from the detection process. For this we took some threshold human count and we gave different messages for different results of human count we got form detection process.



8.0 Purpose:

This technology finds applications in various domains, including surveillance, crowd management, traffic monitoring, retail analytics, and security systems. The key objectives of real-time human detection counting are:

1. **People Counting: The system aims to count the number of people present in a specific area or scene accurately. This information can be valuable for crowd control, occupancy management, and resource allocation purposes.**
2. **Real-time Monitoring: By providing real-time detection and counting capabilities, the system enables continuous monitoring of human presence. It can instantly detect the entry or exit of individuals and provide up-to-date information about the current number of people in the monitored area.**
3. **Security and Safety: Real-time human detection counting plays a crucial role in security systems by identifying unauthorized individuals, tracking their movements, and alerting security personnel in case of suspicious behavior or overcrowding situations. It helps enhance safety measures and ensure the well-being of individuals within the monitored environment.**
4. **Data Analytics: The collected data from human detection counting can be analyzed and used for various analytical purposes. It can provide insights into visitor patterns, traffic flow, peak hours, and other valuable information that can aid in business decision-making, resource planning, and optimization of operations.**
5. **Automation and Efficiency: By automating the process of counting and tracking people, the system eliminates the need for manual counting and reduces the chances of errors or inaccuracies. It improves operational efficiency and allows for quick response and decision-making based on real-time information.**

Overall, the purpose of real-time human detection counting is to provide an efficient, accurate, and automated solution for monitoring and managing human presence in different scenarios, contributing to improved security, safety, resource allocation, and decision-making processes.

9.0 CONCLUSIONS:

In conclusion, the project on leveraging human safety using real-time human detection counting has successfully demonstrated the effectiveness of utilizing advanced technologies for ensuring human safety. By implementing real-time human detection and counting capabilities, the project has provided valuable insights and benefits in various scenarios. The system accurately detects and counts the number of individuals in real-time, enabling efficient crowd management, enhanced security, and resource allocation. It has proven to be a valuable tool in surveillance systems, retail analytics, and traffic monitoring, offering improved safety, security, and decision-making processes. The project showcases the potential of leveraging technology to enhance human safety and serves as a foundation for further advancements in this field. Overall, it represents a significant contribution to the domain of human safety and reinforces the importance of utilizing real-time human detection counting for ensuring the well-being of individuals in different environments.

9.1 SCOPE FOR FUTURE DEVELOPMENT:

Now coming to the future scope of this project or application, since in this we are taking any image, video or with camera we are detecting humans and getting count of it, along with accuracy. So some of the future scope can be:

- **This can be used in various malls and other areas, to analyses the maximum number of people count, and then providing some restrictions on number of people to have at a time at that place.**
- **This can replace various mental jobs, and this can be done more efficiently with machines.**
- **This will ultimately lead to some kind of crowd-ness control in some places or areas when implemented in that area.**

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11. BIBILIOGRAPHY

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Snehitha Mugidi is studying her 2nd year, Master of Computer Applications in Sanketika Vidya Parishad Engineering College, affiliated to Andhra University, accredited by NAAC. With a keen interest in python and machine learning, Snehitha M chose to work on image processing using python with the aim of addressing the flaws in conventional color selection methods and providing a user-friendly tool for color selection and design. The project includes a completely developed system along with code, which has been submitted for evaluation to Andhra University as part of the completion requirements for his MCA degree.