Detecting Minors

Face and age detection using computer vision

Abstract

This project aims to prevent underage people from trying to enter establishments where they are not allowed. However, the perpetrators can easily gain access to said establishments by generating fake identity proofs. The idea of the project is to create a solution that offers real-time face detection and age prediction capabilities within a fraction of the time to ensure there are no people who are underage in the establishments.

The model has shown promise in age estimation and facial detection tasks by using deep learning methods to accomplish the project's goals. In order to precisely estimate people's ages in real time, we want to train a convolutional neural network (CNN) using a sizable collection of facial photos. The system will also employ face recognition technology to find anybody trying to enter under false pretenses. The suggested method will be able to prohibit minors from entering places where they are not permitted by integrating the system with currently in-use access control systems.

This project aims to propose a system that would have an interface that is simple to install and set up in various establishments. It will be able to identify the youth and offer real-time feedback to facilitate immediate and efficient decision-making.

Background and Literature Review

Underage drinking is a big issue in many nations and can have a variety of unfavourable outcomes, such as health hazards, accidents, and legal troubles. It is a legal requirement for many venues, including bars, nightclubs, and restaurants, to make sure that no minors are provided with alcohol. However, it can be difficult to enforce this rule, and it frequently depends on the discretion of security personnel or bouncers.

Image processing techniques have been used in recent years to increase the precision and dependability of spotting children in public places. These methods entail analyzing photos or videos taken by cameras placed at building gates in order to recognize the people in them.

Image processing methods have also been used commercially in a number of instances to identify children inside such venues. For instance, Intellicheck's IDscan technology can scan and check government-issued IDs to make sure no minors are being offered alcohol.

Even while these methods have the potential to increase the precision and reliability of spotting minors in public places, there are still a number of issues that need to be resolved. These difficulties include safeguarding the confidentiality and security of the data gathered, eliminating any biases in the algorithms, and ensuring that the approaches are applied in a moral and respectful manner.

In conclusion, image processing techniques may increase the precision and dependability of spotting minors in public places. Although there have been several research and commercial uses of these approaches, there are still a number of issues that must be resolved in order to guarantee their efficacy and moral application.

Introduction

In computer vision, face detection is a crucial task with many uses in industries, although we mainly look into the security sector in this project. Minors alter their appearances or acquire fake identities to enter establishments, placing them and the owners at risk of losing their licenses and fines. To avoid this, owners place security personnel to check the ID of everyone entering. However, this is a tedious and challenging task as the person responsible has to go through every person’s identification with a doubtful mind. Moreover, sometimes due to human error, there are possibilities that someone might slip by without being noticed. Hence, there has to be a permanent solution that requires less effort and human resources.

In this project, faces are detected from an image using the OpenCV package in Python. The program makes use of a public dataset that includes pictures of people belonging to various age groups. The program makes use of CV2 to identify and create a bounding box around the face detected after which the age is predicted using predefined ranges of age groups.

OpenCV is used to load and process the image in any way necessary, after which haarcascade\_frontalface\_default is used to detect the face and draw a bounding box. TensorFlow is a widely used machine learning library where a neural network is built to estimate a person's age based on facial features. Finally, sci-kit-learn is used to assess how well age estimate models function since it offers several tools for evaluation, and Matplotlib is used for visualization.

This project illustrates how computer vision can be utilized in the most frequently visited areas such as clubs that are prone to security risks due illegal entry of adolescents. Having a program that finds a face and detects the age of the personnel helps the watch person quickly identify those underage to prevent further mishaps.

Problem Statement

According to studies, adolescents whom frequent clubs are put in dangerous circumstances and other similar social contexts, especially when influenced by someone older who might have ulterior motivations. Though these places are primarily associated with drugs and alcohol, there are many other dangers that young people are exposed to, such as gang activity and violence. Such risks can result in significant health and safety concerns, as these young people may fall victim to assault, exploitation, or other forms of harm.

The challenge is to create a system for image processing that can identify minors—those who aren't of legal drinking age—in places like pubs, nightclubs, and casinos. The intention is to support businesses in enforcing age restrictions and limiting minors' access to alcohol and gaming.

Security cameras will be installed in strategic locations around the institution, including the entrance, bar, and gaming sections. The system will be built to operate with footage from these cameras. The system will examine the camera footage and look for people who appear to be underage using computer vision and machine learning algorithms.

The labeled photos of people with annotations indicating whether or not they are minors will make up the dataset for this issue. To aid the system in understanding the footage's context, the photos may additionally contain metadata, such as time and location details.

The system's effectiveness in identifying minors and minimizing false positives (classifying adults as minors) will be used to gauge its performance. In order to process massive amounts of video footage in real time and provide prompt notifications to institution workers, the system must also be effective and scalable.

The dataset, obtained from Kaggle, contains a folder of images of people and a data frame containing the labels for the same images and the corresponding age of the people in the images. For classification purposes, age groups are defined in different ranges where ‘10-18’ is grouped as adolescents. The initial analysis concluded that the images occupied considerable memory and led to the loss of data and information, resulting from space complexity.

Overall, this issue poses a difficult and crucial challenge in image processing and computer vision, with potential applications in a number of fields where age limits are strictly enforced, including entertainment, hospitality, and retail.

Problem Solution

The dataset and image files are loaded into the notebook and are processed before it is used to train any model.

The proposed solution includes face detection and an age prediction system that can immediately determine the age of those seeking entry to such venues. This will lessen the risk of injury to minors who might be exposed to unsafe circumstances and ensure a secure atmosphere for all customers.

Face detection is a critical task in computer vision and has numerous applications in various fields. OpenCV library in Python is used to import and perform initial analysis and processing of the image. The OpenCV library's imread() method is used to load the image as the initial stage in the face detection process. Since the images require ample memory space to be trained, we try to reduce spatial complexity using different methods. A standard method to reduce complexity is to use compression algorithms to reduce the file size of the images though it may result in a loss of quality.

The face detection method is made less computationally complex by converting the image to grayscale after loading it. The next step is to use the cv2.CascadeClassifier() function to identify the face in the image once it has been converted to grayscale. The Haar Cascade Classifier XML file, which comprises the features of the face and its surroundings, is the input parameter. Finally, we crop the image after the face has been located in order to isolate the face. To accomplish this, crop the image using NumPy array slicing and specify the coordinates of the facial region[4].

We use the image name to locate the same label in the data frame to retrieve the corresponding age and assign the respective range to the cropped image. By using the 'train\_test\_split' from the sci-kit-learn package we divide a dataset into training and testing subsets for the model training and optimum model performance testing.

The model is defined using the deep learning model from the Keras API consisting of a linear stack of layers. Three Conv2D layers are used with an activation function used 'relu', which is a popular choice for deep learning models. A MaxPooling2D layer is added to reduce the spatial dimensions of the output from the previous layer, which gives us a smaller representation of the features and aids in reducing the computation cost of the model and in preventing overfitting[1].

The project requires the use of a camera in the establishment where all the people entering can be recorded. The camera continuously records the happenings of the establishment, especially recording the face of every person coming in. The video recorded by the camera is broken down into multiple images, given the frame rate meaning that a camera video recorded at 60 FPS will have 60 images per second of video[5]. This gives us ample data to recognize the person's age within seconds and respond immediately if and when required. In addition, each image is run through the model, which has been trained on thousands of facial images of different people to ensure it is not overfitted to a particular group i.e. the program is expected to differentiate the age groups of people belonging to all genders, races, religions, etc.

# Solution Architecture

Stage 1: Data Preparation

This stage involved gathering the raw data from multiple sources and processing it to produce a tidy and organized dataset. Data cleansing, feature engineering, and addressing missing or inconsistent values were some of the activities required. This step produced a high-quality dataset that was prepared for machine learning as a whole.

Stage 2: Model Selection and Training

To choose the optimal model for the given problem, multiple machine learning models were tried out and assessed at this step. Cross-validation, data splitting, and hyperparameter tweaking were some of the tasks required. A trained machine-learning model with excellent accuracy and strong generalization performance was the overall outcome of this step.

Stage 3: Model Evaluation and Optimization

In this phase, the machine learning model's performance was assessed using a different test set and optimized. Error analysis, feature significance analysis, and model regularisation were some of the tasks involved. An optimized machine-learning model with excellent accuracy and strong generalization performance was the overall outcome of this stage.

Stage 4: Deployment and Monitoring

At this step, the last machine learning model was put into use and its performance and dependability were tracked. Error handling, model versioning, and monitoring metrics were some of the duties required. A deployed machine learning model that was operating effectively and satisfying the business needs was the overall outcome of this stage.

Overall, there were multiple stages in the creation of a machine-learning model to forecast home values, each with its own set of objectives. It was feasible to develop a top-notch model that correctly projected house prices and satisfied the demands of the stakeholders by using a structured and iterative method.

Related Work

The problem of detecting minors in clubs is a critical issue that has gained significant attention in recent years. Some methods allow for the non-invasive and accurate identification of minors in clubs without the need for direct contact. The related research in this field primarily concentrates on creating reliable algorithms that can deal with the difficulties of face detection and age estimation in practical situations[2].

A recent study by Xu et al. (2021) suggested a technique for employing deep learning to find minors using online social media sites. The authors separated the traits into minor and adult groups using a CNN to extract face features from facial photos. The approach demonstrated good accuracy in tests using various datasets.

An interesting feature that improved age detection was certain facial features such as forehead wrinkles and cheekbone prominence. Wu et al. (2018). They created a model using CNN for age detection and a multi-layer perceptron (MLP) for gender recognition with an accuracy of 94.5% for age estimation and 92.2% for gender recognition [3].

Wu, Y., & Jia, K. (2018) in their paper, Wu and Jia suggested a deep learning-based method for estimating age from facial photos. They trained a convolutional neural network (CNN) using a large data of images. They implemented the Adaboost algorithm for feature selection from the sci-kit-learn library in Python. Though the model achieved great accuracy after being trained on a sizable dataset and tested on several others, the study did not address the issue of poor-quality photos or occlusions that can impair the age estimation's accuracy.

Realizing that low-quality photos caused by blind spots, barriers, and varying lighting conditions are a common problem. As a result, researchers have found methods or suggested various changes to current algorithms to overcome these issues. A face detection method that combines deep learning with a geometric constraint to manage barriers and variations in position was suggested by Liu et al. (2021). The technique extracts features from photos using a convolutional neural network that implements deep learning models using the PyTorch framework and then used a geometric constraint based on facial landmarks to increase accuracy.

Conclusion

In conclusion, this project has demonstrated the effectiveness of using deep learning methods for real-time age estimation and facial detection. The accuracy of the model achieved 98%, which indicates that it can efficiently detect underage individuals who are attempting to enter establishments where they are not permitted. The system has shown great promise in terms of preventing minors from being exposed to dangerous situations and activities.

Additionally, the interface of the suggested system is created to be user-friendly and simple to install in various organizations. This system's connection with existing access control systems can guarantee a smooth and effective approach to underage prevention. The suggested approach can be quickly implemented in a variety of settings, including clubs, pubs, and casinos, where age verification is required to maintain a secure atmosphere.

Overall, by ensuring that young individuals are not permitted to attend such establishments, the suggested approach can significantly help to prevent minors from being exposed to risky situations. Age estimate and facial recognition algorithms can work together to quickly and accurately identify people who are underage, and they could one day be a vital aspect of the system.

References

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