Mini Project Report on

LIVELINESS DETECTION SYSTEM

Submitted in partial fulfilment of the requirement for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE & ENGINEERING

Submitted by:

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July-2024

CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the project report entitled **"Liveliness Detection"** in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering of the Graphic Era Hill University Dehradun, Department of Computer Science and Engineering, Graphic Era Hill University Dehradun.

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Table of Contents

Chapter 1

Introduction

In the following sections, a brief introduction and the problem statement for the work has been included.

1.1 Introduction

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In the realm of computer vision and face recognition systems, the advent of technology has ushered in a new era of convenience and efficiency. However, this technological leap is not without its challenges, particularly in the context of security and reliability. The rise of spoofing attempts, where an adversary presents a fake image or visual representation to deceive the system, poses a significant threat to the integrity of face recognition systems. To counteract this, our project focuses on the development of an Anti-Spoofing/Liveliness Detector for Face Recognition Systems, with a specific emphasis on distinguishing between real and simulated appearances.

1.2 Problem Statement

The primary objective of our project is to address the vulnerability of face recognition systems to spoofing attempts, whether in the form of printed images, virtual representations, or visuals of a person. The inherent challenge lies in differentiating between authentic facial presences and deceptive inputs, ensuring the system remains resilient to fraudulent activities.

1.3 Project Goals

Our project aims to serve a critical purpose in streamlining attendance-taking processes, particularly in high-traffic environments such as offices and schools. Unlike traditional biometric methods, our solution allows for the simultaneous detection of multiple faces, overcoming a limitation often encountered in existing systems.

1.4 Significance

The significance of our project extends beyond its immediate application. While the streamlined attendance process is undoubtedly valuable, our project serves as a learning ground for understanding the intricacies of dataset collection and training. Unlike conventional approaches that often rely on pre-existing datasets available online, our methodology involves creating a bespoke dataset comprising thousands of images—both genuine and fraudulent—in a remarkably short timeframe. This process empowers developers to adapt their models to respond effectively to the unique characteristics of their target environment.

1.5 Key Takeaways

A distinguishing feature of our project is the rapid and efficient creation of a tailored dataset, facilitating quick adaptation to evolving security needs. By delving into the nuances of dataset creation and model training, our project not only addresses a practical concern but also equips developers with the skills to fortify face recognition systems against emerging threats.

In the subsequent sections of this report, we will delve into the methodologies employed, the literature survey, and the outcomes of our Anti-Spoofing/Liveliness Detector for Face Recognition Systems.

Chapter 2

Literature Survey

As face recognition technology becomes integral to various applications, the concern for its vulnerability to spoofing attempts has garnered attention. This literature survey explores existing research and advancements in the domain of Anti-Spoofing/Liveliness Detection for Face Recognition Systems.

2.1 State-of-the-Art Face Recognition

Researchers such as Zhang et al. have contributed significantly to the field of face recognition, utilizing deep neural networks for feature extraction, achieving high accuracy in real-world scenarios. However, these advancements often overlook the pressing issue of susceptibility to spoofing attacks.

2.2 Security Challenges in Face Recognition

Li et al. have identified the challenges faced by face recognition systems, particularly in the context of spoofing attacks. This recognition has prompted a need for robust anti-spoofing techniques to bolster the security and reliability of facial recognition applications.

2.3 Diverse Anti-Spoofing Challenges

Various studies, including those by Jain et al. and Li and Jain, have explored diverse anti-spoofing techniques. Texture analysis and dynamic facial cues are among the methods investigated to distinguish between genuine and spoofed faces, highlighting the importance of multifaceted approaches in countering evolving spoofing strategies.

2.4 Dataset Challenges and Innovative Solutions

Creating representative datasets is fundamental for training anti-spoofing models. Yang et al. have cautioned against relying solely on publicly available datasets, advocating instead for the development of tailored datasets. Our project aligns with this perspective, emphasizing the efficiency of generating a diverse dataset in a short timeframe.

2.5 Real Time Challenges in Face Recognition

Studies by Singh et al. underscore the complexities of implementing anti-spoofing measures in real-time face recognition systems. Balancing accuracy and speed in live scenarios requires innovative solutions, highlighting the need for advancements in this area.

2.6 Conclusion

In conclusion, this literature survey reveals a dynamic landscape of face recognition research. While existing systems excel in accuracy, the susceptibility to spoofing attacks necessitates dedicated efforts in anti-spoofing/liveliness detection techniques. Our project contributes to this field by addressing challenges associated with dataset creation, training, and real-time implementation, ultimately enhancing the security and reliability of face recognition systems.

Chapter 3

Methodology

3.1 Mini project

Free Anti Spoofing/ Liveliness Detector for Face Recognition System Fake VS Real using Computer Vision on IDE VS code and PyCharm

3.2 Packages used

- **cv2 (OpenCV):**
  - Used for capturing video frames, image processing, and computer vision tasks.
- **cvzone:**
  - Utilized for face detection and additional drawing functions.
- **FaceDetector (from cvzone.FaceDetectionModule):**
  - A module for face detection used within the cvzone library.
- **shutil:**
  - Used for file operations, such as copying and removing directories.
- **random:**
  - Utilized for shuffling the list of unique names.
- **os:**
  - Used for operating system-related operations, such as directory creation and removal.
- **time:**
  - Used for measuring frame processing time and calculating frames per second.
- **math:**
  - Used for mathematical calculations, such as rounding confidence scores.
- **Ultralytics YOLO:**
  - The Ultralytics library is used for YOLO (You Only Look Once) model training and real-time inference.

3.3 Here is a step-by-step methodology for the project

3.3.1 Data Collection (Face Spoofing Detection):

- The code captures video frames from a webcam.
- Utilizes the **cvzone.FaceDetectionModule** for face detection.
- Determines if a detected face is real or fake based on the blurriness of the face image.
- Blurriness is calculated using Laplacian variance, and faces with a blur below a specified threshold are considered fake.
- Normalizes face bounding box coordinates and saves the images along with label information in a specified output folder.

3.3.2 Data Splitting:

- The code splits the collected data into training, validation, and test sets.
- The split is done based on a specified ratio, and directories are created to store images and corresponding labels for each set.

3.3.3 Data Configuration (data.yaml):

- Generates a **data.yaml** file containing paths to training, validation, and test sets, along with the number of classes and class names.

3.3.4 Training Offline:

- Uses the YOLO (You Only Look Once) object detection model from the Ultralytics library to train the anti-spoofing model.
- Trains the model using the specified data configuration and a pre-trained YOLO model (**yolov8n.pt**) for a specified number of epochs.

3.3.5 Real time inference:

- Captures video frames in real-time using a webcam.
- Utilizes the trained YOLO model for object detection, specifically to detect faces and classify them as real or fake.

- Draws bounding boxes around detected faces, highlighting them with color based on their classification (green for real, red for fake).
- Displays confidence scores and class labels on the screen.

3.3.6 Performance Matrics:

- Calculates and prints the frames per second (fps) for real-time processing.

3.3.7 Result Display:

- Displays the processed video frames with bounding boxes and classification information.

3.3.8 Termination:

- Continues to run until the user manually terminates the program.

This methodology outlines the process of collecting data, training an anti-spoofing model using YOLO, and performing real-time inference to detect and classify faces as real or fake based on blurriness. The accuracy and effectiveness of the anti-spoofing system can be evaluated based on the collected and labeled dataset, as well as the performance metrics during real-time inference.

Chapter 4

Result and Discussion

The successful demonstration of the mini project based on liveliness detection was achieved.

4.1 Result:

Once the model is trained, it is integrated into a real-time face recognition system. The system processes the live webcam feed, applying the trained model to detect and classify faces as either real or potential spoofing attempts. The results are displayed on the video feed, providing real-time feedback to the user.

4.1.1 Result Visualization

The results of the real-time implementation include bounding boxes around detected faces, along with confidence scores indicating the likelihood of a face being real or fake. The system color-codes the bounding boxes for visual clarity, with green indicating a real face and red indicating a potential spoofing attempt.

4.1.2 Performance Metrics

The performance of our Anti-Spoofing/Liveliness Detector is assessed using standard metrics, including accuracy, precision, recall, and F1 score. These metrics provide a comprehensive evaluation of the model's ability to correctly classify real and fake faces.

4.1.3 Frame Rate

The system achieves a commendable frame rate, ensuring efficient real-time processing. The frame rate is a critical factor in the practical application of the system, especially in scenarios with multiple faces to process simultaneously.

4.2 Discussion:

Our Anti-Spoofing Detection System demonstrates effective performance in distinguishing between real and fake faces in real-time scenarios. The integration of blur detection, normalization, and YOLOv8-based model training contributes to the system's reliability.

Challenges and Limitations

While our system shows promise, it is essential to acknowledge certain challenges and limitations. The system's accuracy may be influenced by factors such as lighting conditions, variations in facial appearances, and the quality of the training dataset.

Chapter 5

Conclusion and Future Work

On working with the Liveliness Detection project I learned about the OpenCV and the Automation, Data Collection and Training. This project really helped me in improving my skills as a 3rd semester student.

To enhance the system further, future improvements may include refining the dataset by incorporating more diverse facial images and exploring additional anti-spoofing techniques. Additionally, fine-tuning the model parameters and exploring real-world deployment scenarios will contribute to the system's robustness.

In conclusion, our Anti-Spoofing Detection System serves as a foundational step towards secure face recognition applications, particularly in environments where spoofing attempts pose a threat. The combination of effective data collection, model training, and real-time implementation showcases the potential for reliable anti-spoofing solutions.

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