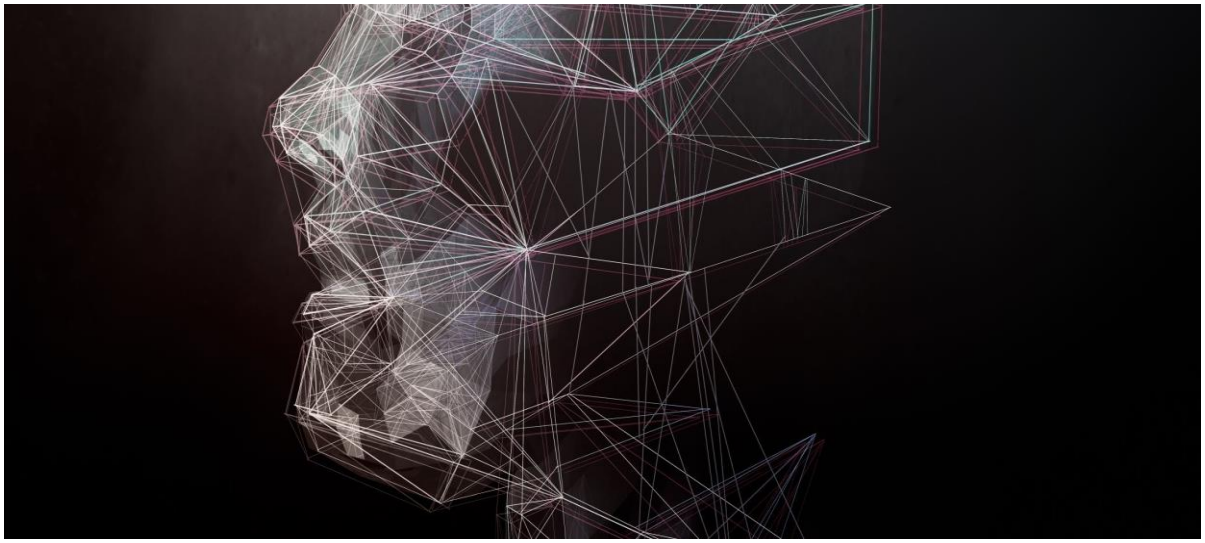

Face Recognition System

A PROJECT REPORT

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Abstract

Face detection and face recognition are very important technologies these days, furthermore we noticed that they got have a variety of uses such as cell phones, army uses, and some high-risk information offices. We decided to make a device that detects and recognize the face as a student attendance system and can be a substitute for the regular paper attendance system and finger print attendance system. The main function in our project is going to be done using LabVIEW because, LabVIEW is a very helpful programming tool in regards of facial uses and very helpful in other uses. Our project is based on a main program in LabVIEW that detects and recognize faces with giving scores and parameters, furthermore the subsystems are an Excel sheet that is integrated with the program, and a messaging device that is for either a message for absent students or to the student's parents. Components of our project are LabVIEW program as the main system and subsystems, Office Excel sheet to include students names, and a computer (or laptop) to integrate the programs together.

INTRODUCTION

1.1 Project Definition

Design of an automatic class attendance system using face detection algorithm of LabVIEW software. The system requires a video capture device and the running LabVIEW algorithm to be implemented successfully. It detects the faces and mark attendance accordingly. This system will prevent unnecessary wastage of time of classes that is usually wasted in form of class roll calls.

1.2 Project Objectives

1. Reducing time wastage during conventional class attendance.

2. Utilizing latest trends in machine vision to implement a feasible solution for class attendance system.

3. Automating the whole process so that we have digital environment.

4. Preventing fake roll calls as one to one attendance marking is possible only.

5. Encouraging the use of technology in daily lives.

1.3 Project Specifications

a. Uses Pattern Matching algorithm for face detection.

b. Score of minimum 600 required to perfectly match a face.

c. Metric: Camera Resolution.

d. For prototype fixed to 10 users only but scalable design.

e. Requires good lighting condition for better camera capture capability.

f. Attendance sheet is .xlsx format and can be digitally distributed and maintained.

1.4 Product Architecture and Components

The subsystem description is as follows:

Camera: The camera is the only hardware component required to capture live video feed of class.

Vision Acquisition: This module allows image to be captured by camera into LabVIEW for programming. It includes IMAQ submodules such as IMAQ Create, IMAQdx Open, IMAQdx Grab. They all combine to provide Continuous Acquisition of video feed from camera module.

Image to Grayscale: This process is performed using IMAQ ExtractSingleColorPlane VI to convert a 32/16bit image to 8bit image. This is a requirement for our pattern matching algorithm to work completely.

Pattern Extraction: This is included in Vision Assistant VI which deals with our face recognition algorithm. Pattern Extraction is feature in which the image inputted features are compared using Pattern Matching Algorithm.

Feature Extraction: This feature is used to extract important features out of image. It compares them with templates, saves in database and provides a score of comparison.

Find Match in database: Our database has preserved templates or images of students which we aim to recognize and mark attendance. This database can be updated or appended according to requirement. This database is used for comparison with extracted feature of image to confirm a successful hit.

Update Attendance Sheet.xlsx: If match is found our algorithm updates the attendance of user corresponding to his/her name in excel file of format .xlsx. If not, the system marks absent in front of his/her name in the same excel file.

2. Literature Review

2.1 Project background

In the face detection and recognition system, the process flow is initiated by being able to detect the facial features from a camera or a picture store in a memory. The algorithm processes the image captured and identifies the number of faces in the image by analyzing from the learned pattern and compare them to filter out the rest. This image processing uses multiple algorithm that takes facial features and compare them with known database. The motivation behind this project is to simplify how attendance is taken during lectures and how much time it takes. The use of ID cards or manually calling out attendance and writing it down on sheets is not productive and efficient. This system will detect the number of faces on the class and will also identify them from the store database. With the face

detection and recognition system in place, it will be easy to tell if a student is present in the classroom or not.

2.2 Previous Work

PROJECT # 1

This is a project done by students as a final year project at Kingston University London in 2018. The system will be presented an image either via camera or from memory and it must detect the number of faces on it automatically. After identifying faces, the system should crop the faces from the image and store them in memory for image recognition which will be done in the second step. The system should be able to automatically count the number of faces detected on the image. The second step will be the recognition part where the system will be able to match faces from the stored dataset and compare it to the input data from the first step. A software will be used for this system which automatically sorts out the faces. The software will be inter-active so to facilitate interaction between multiple tasks as required. Because the system has two steps, the second phase of the system will involve the training of images on a dataset that are to be used for recognition.

Technology Used:

The key algorithms are Viola-Jones for face detection and Hidden Markov Model with SVD.

* The implementation of The Viola-Jones algorithm is available on software's like MATLAB, OpenCV and Web Browsers (using adobe flash).

* The existing implementation of the Hidden Markov Model with SVD for face recognition are available on MATLAB, C++ and OpenCV libraries.

3. System Design

3.1 Design Constraints

The constraints which were considered while designing on project are following.

3.1.1 Design Constraint:

Engineering Standards The samples for database should be increase, as to increase the efficiency of detection. Also, the more the expensive the camera, the easier its algorithm is likely detecting the person.

3.1.2 Design Constraint:

Environmental The camera should capture all the students present in the class. Each student present should be seated such that it is visible to camera, so that his/her attendance gets marked easily.

3.1.3 Design Constraint:

Ethical The second limitation which is faced include the person appearance by face, which a person changes his/her look and looks different from the picture in the database of the attendance system, then it may be difficult for his/her attendance to be marked.

3.2 Design Methodology

As we mentioned before in (Figure 1.1). The project process is:

- A camera will take continuous stream.
- In LABVIEW, IMAQ library for vision will be used.
- Convert the RGB image to grayscale image.
- Then perform Machine Vision Algorithm and match with patterns stored in our database.
- If pattern matches based on the score of how successful, decide to mark attendance or not.
- Update the marked attendance in a measurement file.

3.3 Implementation:

implementing a face recognition system involves several steps, from data collection to model training and inference. Here's a general process:

1. Data Collection:

- Collect a dataset of images containing faces you want to recognize.
- Ensure the dataset covers various lighting conditions, angles, facial expressions, and backgrounds.
- Each image should ideally contain a single face.

2. Preprocessing:

- Resize images to a consistent size for processing.
- Normalize pixel values (e.g., scale pixel values to the range [0, 1]).
- Convert images to grayscale or keep them in color, depending on the requirements.

3. Face Detection:

- Use a face detection algorithm or library to locate faces within the images.
- Popular libraries include OpenCV, dlib, and MTCNN (Multi-Task Cascaded Convolutional Networks).

4. Face Alignment (Optional):

- Align detected faces to a canonical pose to reduce variations due to head orientation and scale.
- Techniques like affine transformations or landmark-based alignment can be used.

5. Feature Extraction:

- Extract features from the detected faces that capture unique characteristics.

Common methods include:

Eigenfaces

Local Binary Patterns (LBP)

Histogram of Oriented Gradients (HOG)

Convolutional Neural Networks (CNNs)

6. Model Training:

- Train a machine learning or deep learning model using the extracted features.
- Use a suitable algorithm such as Support Vector Machines (SVM), k-Nearest Neighbors (k-NN), or deep neural networks.
- Split the dataset into training and validation sets for model evaluation.

7. Model Evaluation:

- Evaluate the trained model using metrics like accuracy, precision, recall, and F1 score.
- Fine-tune hyperparameters or consider using techniques like cross-validation for better performance.

8. Face Recognition:

- Given a new image, apply the trained model to recognize faces.
- Extract features from the new image's faces using the same methods used during training.
- Compare the extracted features with those stored in the database.
- Use distance metrics (e.g., Euclidean distance, cosine similarity) to measure similarity between feature vectors.
- Apply a threshold to decide whether a match is found.
- Optionally, implement techniques like clustering or ensemble methods for improved recognition.

9. Deployment:

- **Deploy the train**ed model in a real-world application.
- Integrate the face recognition system with other modules or systems as required.
- Ensure scalability, reliability, and security of the deployed system.

10. Continuous Improvement:

- Collect feedback and performance metrics from the deployed system.
- Refine the model and algorithms based on feedback and changing requirements.
- Stay updated with advancements in face recognition research and technology.

Throughout the implementation process, it's essential to consider privacy and ethical implications, especially when handling sensitive data such as facial images. Additionally, ensure compliance with regulations and guidelines related to data privacy and security.

4.Strengths and Weakness

Strengths:

- High Accuracy: With advances in deep learning techniques, modern face recognition systems can achieve high accuracy in detecting and recognizing faces.
- Non-intrusive: Face recognition systems are non-invasive and do not require physical contact, making them convenient for users.
- Wide Range of Applications: Face recognition technology finds applications in various fields such as security (e.g., access control), law enforcement (e.g., surveillance), identity verification (e.g., biometric authentication), and personalized services (e.g., personalized advertising).
- Fast Processing: Many face recognition algorithms can process images in real-time, enabling quick identification of individuals even in dynamic environments.
- Robustness: Face recognition systems can handle variations in lighting conditions, facial expressions, and poses to some extent,

thanks to advancements in feature extraction and matching algorithms.

- Scalability: These systems can be scaled to handle large databases of faces efficiently, making them suitable for use in environments with a high volume of users.

Weaknesses:

- Privacy Concerns: Face recognition systems raise privacy concerns related to unauthorized surveillance, tracking, and profiling of individuals without their consent.
- Bias and Discrimination: Biases in training data or algorithms can lead to inaccurate or discriminatory results, affecting certain demographic groups more than others.
- Vulnerability to Spoofing: Face recognition systems can be vulnerable to spoofing attacks using techniques such as wearing masks, using photos, or creating synthetic faces, compromising their security.
- Performance Degradation: Performance may degrade under challenging conditions such as poor lighting, occlusions, or low-resolution images, reducing the accuracy of recognition.
- Ethical Considerations: Ethical dilemmas arise concerning the use of face recognition technology, including issues of consent, transparency, accountability, and potential misuse.
- Legal and Regulatory Challenges: There is a lack of comprehensive regulations governing the use of face recognition technology, leading to legal uncertainties and debates over its ethical and societal implications.
- Resource Intensive: Training and deploying face recognition systems may require significant computational resources, expertise, and infrastructure, limiting their accessibility and affordability in some contexts.

Overall, while face recognition systems offer numerous benefits, addressing their weaknesses, particularly concerning privacy, bias, and security, is crucial for their responsible and ethical deployment in society.

5. Conclusions and Future Recommendations

5.1 Conclusions

Number of modules are available on LabVIEW to achieve incredible number of tasks. The best thing about LabVIEW is that you can view the flow of data from one block to other and have more freedom to make changes according to your requirements. The Automatic Class Attendance System implemented in this project would be much more difficult if it was not implemented on LabVIEW. The objective of class attendance system is to automate the time consuming and error prone attendance system.

There are always limitations of every system. One can only have fixed number of students and provide less freedom to have interclass attendance system. This means the attendance system for one class can’t be used for attendance system of other class. One must change programming to do this.

The Project experience was tremendous as we learned the core of vision algorithms and different programming techniques of LabVIEW. We learned how can a problem be simplified into smaller tasks and

can be achieved successfully. It is the reason why we are able to complete our project in 1 st of the two semesters

5.2 Future Work and Expected Final Prototype/Results

Due to COVID-19 pandemic we were left with10% of our project is being left and the list of unfinished parts:

1. Scaling the number of attendees (which can be done easily by any user).

2. Optimizing the synchronization between LABVIEW and Excel attendance sheet.

Our project can be implemented in a computer and then the user take pictures (or upload them) to the vision assistant and add their names of the desired students in excel sheet.

5.3 Future Recommendations

The system can be made more flexible and scalable using these recommendations. Please note that the system implemented here is just a prototype of idea presented via this project. The recommendations are as follows:

- The system can be extended to more number of students with freedom to change list of students according to class changes.
- The system can be made more flexible to allow updating of templates in case student incurs significant amount of change in his facial features.
- The system can also be extended to allow better face recognition algorithm in which even rotational features of face can be detected efficiently

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