VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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PROJECT REPORT ON

"SMART ATTENDENCE SYSTEM USING BIOMETRIC AUTHENTICATION BASED ON REAL-TIME FACE RECOGNITION"

Submitted in partial fulfillment of the requirements for the award of degree of

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CERTIFICATE

It is certified that the Internship work entitled **"Smart Attendance System Using Biometric Authentication Based on Real-Time Face Recognition"** is a bonafide work carried out by **Abhishek Hegde (1MV20IS001), Kartik G Naik (1MV20IS024)**, **Prateek P Acharya (1MV20IS039) and Pramod K (1MV21IS402)** in partial fulfilment for the award of the Degree of Bachelor of Engineering in Information Science and Engineering of the **Visvesvaraya Technological University, Belagavi** during the year **2023-24**. It is certified that all corrections and suggestions indicated for Internal Assessment have been incorporated in the report. The report has been approved as it satisfies the academic requirements in respect of Internship work prescribed for the course of Bachelor of Engineering.

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DECLARATION

We hereby declare that the entire project work embodied in this dissertation has been carried out by us and no part has been submitted for any degree or diploma of any institution previously.

Place: Bengaluru
Date: 29/05/2024

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ABSTRACT

Face is the crucial part of the human body that uniquely identifies a person. Using the face characteristics as biometric, the face recognition system can be implemented. The most demanding task in any organization is attendance marking. In traditional attendance system, the students are called out by the teachers and their presence or absence is marked accordingly. However, these traditional techniques are time consuming and tedious. In this project, the Open CV based face recognition approach has been proposed. This model integrates a camera that captures an input image, an algorithm for detecting face from an input image, encoding and identifying the face, marking the attendance in a spreadsheet. The training database is created by training the system with the faces of the authorized students. The cropped images are then stored as a database with respective labels. The features are extracted using Haar Cascade Feature extraction algorithm and to recognize face we are using CNN deep learning algorithm.

Attendance Monitoring System is essential in all organizations for checking the performance of students and it is not an easy task to check each and every student is present or not. In all organization, attendance is taken manually by calling their register numbers or names and noted in attendance registers issued by the department heads as proof and in some organizations the students wants to sign in these sheets which are stored for future references. This technique is repetitive, complex work and leads to errors as few students regularly sign for their absent students or telling proxy attendance of the absent students. This method additionally makes it more complex to track all the student's attendance and difficult to monitoring the individual student attendance in a big classroom atmosphere.

In this project, we use are using the technique of utilization face detection and recognition framework to continuously recognize students going to class or not and marking their attendance by comparing their faces with database to match and marking attendance. This facial biometric framework takes a picture of a person using a camera and contrasts that image and compares the image with the image with is stored at the time of enrolment and if it matches marks the attendance and monitors the student performance continuously. We may use the concept of artificial intelligence concept to monitor student attendance like capturing the motion pictures of the student when present in class to analyze the student data how much time the student presents in class.

TABLE OF CONTENT

LIST OF FIGURES

CHAPTER-1

INTRODUCTION

1.1 OVERVIEW

The student's attendance system using artificial intelligence concept mainly works using the concept of facial recognition system was discussed by Akshara Jadhav et al.0.Face is considered as a primary key feature to identify and talk with other peoples in the world because face considered as a unique identity for each and every person. The facial features will be unique to the other indusial. The Unique features for every indusial make facial recognition in implementing the real world. Human distinguish a particular person’s face based on several factors like color, nose, eyes, ears, etc but for computers, it's difficult to analyze the data so we may use the concept of Computer vision. The intention of using computer vision technology to recognize the human features in a computer.

In recent years we observed remarkable changes in face recognition techniques because of available biometric methods, this is the most unnoticeable technique. The installation face recognition systems on a large scale are easy but the actual implementation of face reorganization system is ambitious because it has to take into account for all potential cases variation caused by a modification in face expressions by light-weight, face expressions, different styles, image resolution, sensing element device, viewing distance, etc. Several algorithmic rules are implemented on face recognition and every algorithm has strengths and capabilities by its own. We tend to do face recognition nearly on a daily basis. Most of the time we glance at a face and acknowledge by in a flash with the data present already in the database.

This aptitude if potential followed by machines will influence be valuable and should give for a vital role in real-world applications like vary access management, national and international security and defense, etc. At present mainly two approaches rely on Face reorganization methods. The first and very familiar method is native face recognition system that depends on face expressions of a covering for example eyes, nose, color, etc. to identify the face with a someone matching or not. The second approach is world face recognition system which uses the whole face to identify a person. The two described approaches are enforced by a method by various types of algorithms. The recent implementation using artificial intelligence applications in face recognition attracts many scientists to research on this topic. The elaboration of a face features originates from the changes continuously within the facial expression that changes by time. Apart all these changes, we are ready to acknowledge an individual easily. The idea of developing a self-understanding and self-learning intelligent machine

may require to give sufficient data to the machine was proposed by Pradeepa .M et al. Facial Recognition System can be defined in simple words as the technology that identifies a person and verifies it with the database by comparing the facial features described by Chaitanya Reddy.

1.2 INTRODUCTION OF DOMAIN

DOMAIN: Computer Vision & Deep Learning

Computer vision is an interdisciplinary scientific field that deals with how computers can gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to understand and automate tasks that the human visual system can do.

Computer vision tasks include methods for acquiring, processing, analyzing and understanding digital images, and extraction of high-dimensional data from the real world in order to produce numerical or symbolic information, e.g. in the forms of decisions.[3][4][5][6] Understanding in this context means the transformation of visual images (the input of the retina) into descriptions of the world that make sense to thought processes and can elicit appropriate action. This image understanding can be seen as the disentangling of symbolic information from image data using models constructed with the aid of geometry, physics, statistics, and learning theory.

The scientific discipline of computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, multi-dimensional data from a 3D scanner, or medical scanning devices. The technological discipline of computer vision seeks to apply its theories and models to the construction of computer vision systems.

Deep learning (also known as deep structured learning) is part of a broader family of machine learning methods based on artificial neural networks with representation learning. Learning can be supervised, semi-supervised or unsupervised.

Deep-learning architectures such as deep neural networks, deep belief networks, deep reinforcement learning, recurrent neural networks and convolutional neural networks have been applied to fields including computer vision, speech recognition, natural language processing, machine translation, bioinformatics, drug design, medical image analysis, material inspection and board game programs,

where they have produced results comparable to and in some cases surpassing human expert performance.

Artificial neural networks (ANNs) were inspired by information processing and distributed communication nodes in biological systems. ANNs have various differences from biological brains. Specifically, artificial neural networks tend to be static and symbolic, while the biological brain of most living organisms is dynamic (plastic) and analogue.

The adjective "deep" in deep learning refers to the use of multiple layers in the network. Early work showed that a linear perceptron cannot be a universal classifier, but that a network with a nonpolynomial activation function with one hidden layer of unbounded width can. Deep learning is a modern variation which is concerned with an unbounded number of layers of bounded size, which permits practical application and optimized implementation, while retaining theoretical universality under mild conditions. In deep learning the layers are also permitted to be heterogeneous and to deviate widely from biologically informed connectionist models, for the sake of efficiency, trainability and understandability, whence the "structured" part.

Definition

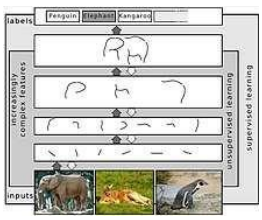


Fig 1.1Representing images on multiple layers of abstraction in deep learning

Deep learning is a class of machine learning algorithms that uses multiple layers to progressively extract higher-level features from the raw input. For example, in image processing, lower layers may identify edges, while higher layers may identify the concepts relevant to a human such as digits or letters or faces.

Overview

Most modern deep learning models are based on artificial neural networks, specifically convolutional neural networks (CNN)s, although they can also include propositional formulas or

latent variables organized layer-wise in deep generative models such as the nodes in deep belief networks and deep Boltzmann machines.

In deep learning, each level learns to transform its input data into a slightly more abstract and composite representation. In an image recognition application, the raw input may be a matrix of pixels; the first representational layer may abstract the pixels and encode edges; the second layer may compose and encode arrangements of edges; the third layer may encode a nose and eyes; and the fourth layer may recognize that the image contains a face. Importantly, a deep learning process can learn which features to optimally place in which level *on its own*. This does not completely eliminate the need for hand-tuning; for example, varying numbers of layers and layer sizes can provide different degrees of abstraction.

The word "deep" in "deep learning" refers to the number of layers through which the data is transformed. More precisely, deep learning systems have a substantial *credit assignment path* (CAP) depth. The CAP is the chain of transformations from input to output. CAPs describe potentially causal connections between input and output. For a feedforward neural network, the depth of the CAPs is that of the network and is the number of hidden layers plus one (as the output layer is also parameterized). For recurrent neural networks, in which a signal may propagate through a layer more than once, the CAP depth is potentially unlimited. No universally agreed-upon threshold of depth divides shallow learning from deep learning, but most researchers agree that deep learning involves CAP depth higher than 2. CAP of depth 2 has been shown to be a universal approximator in the sense that it can emulate any function. Beyond that, more layers do not add to the function approximator ability of the network. Deep models (CAP > 2) are able to extract better features than shallow models and hence, extra layers help in learning the features effectively.

Deep learning architectures can be constructed with a greedy layer-by-layer method. Deep learning helps to disentangle these abstractions and pick out which features improve performance. For supervised learning tasks, deep learning methods eliminate feature engineering, by translating the data into compact intermediate representations akin to principal components, and derive layered structures that remove redundancy in representation.

Deep learning algorithms can be applied to unsupervised learning tasks. This is an important benefit because unlabeled data are more abundant than the labeled data. Examples of deep structures that can be trained in an unsupervised manner are neural history compressors and deep belief networks.

1.3 Existing System

In traditional classroom environment, students' attendance management is one of the key factors to analyze the students' learning process and also to keep track of other factors like discipline, engagement and leads to effective learning and increase the success rate. There are several works in attendance management system to overcome the difficulties faced in a traditional classroom environment by using finger print, RFID, iris, wireless and face recognition-based methods. Also, there are many faces detection-based attendance management systems available in which they place a camera in a classroom, capture the image/video, recognize the students using face detection techniques.

1.3.1 Disadvantages:

- Manual errors.
- Consumes more time in large classrooms.
- Waste of learning time in manual attendance system.

1.4 Proposed System:

We propose a method to overcomes the drawbacks of the existing techniques. Automating a system, without the students being aware of the attendance process and thus taking the attendance in a real classroom environment, makes the proposed application unobtrusive.

In this work, we explain the proposed algorithm for Student Attendance System. It consists of five steps: 1. Enrollment, 2. Capture of classroom images, 3. face detection and description, 4. query database and 5. matching algorithm.

1.4.1 Advantages:

- Less time
- No intervention of learning process
- Low implementation class
- No manual errors.

1.5 ORGANIZATION OF PRODUCT

The project report is organized as follows:

- **Chapter 1-Introduction**
  This chapter talks about the overview of the project, Domain introduction, existing system, proposed system with its theoretical outline.

- **Chapter 2-Literature Survey**
  Gives brief overview of the paper and the research sources that have been studied to establish through an understanding of the under consideration.

- **Chapter 3-Problem statement and objectives**
  Discuss in detail about the problem statement and objectives of the project.

- **Chapter 4- Software and Hardware Requirements**
  Gives detail about software and hardware requirement of the project development.

- **Chapter 5-System Design:**
  Gives the description of the system design with the graphical representation of the project.

- **Chapter 6-Project planning and Cost estimation:**
  Gives the description of the project planning and cost estimation of the project.

- **Chapter 7-Modules and Implementation:**
  Gives the description about modules and implementation of project.

- **Chapter 8-Conclusion:**
  Gives the description about conclusion of project.

SUMMARY

This chapter talks about the overview of the project, Domain introduction, existing system, proposed system and about how we use this information to develop the project that makes automatic attendance using CNN.

CHAPTER-2

LITERATURE SURVEY

A literature survey or a literature review in a project report shows the various analyses and research made in the field of interest and the results already published, taking into account the various parameters of the project and the extent of the project. Literature surveyis mainly carried out in order to analyse the background of the current project which helps to find out flaws in the existing system & guides on which unsolved problems we can work out. So, the following topics not only illustrate the background of the project but also uncover the problems and flaws which motivated to propose solutions and work on this project.

A literature survey is a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews use secondary sources, and do not report new or original experimental work. Most often associated with academic-oriented literature, such as a thesis, dissertation or a peer-reviewed journal article, a literature review usually precedes the methodology and results sectional though this is not always the case. Literature reviews are also common in are search proposal or prospectus (the document that is approved before a student formally begins a dissertation or thesis). Its main goals are to situate the current study within the body of literature and to provide context for the particular reader. Literature reviews are a basis for researching nearly every academic field. demic field. A literature survey includes the following:

- Existing theories about the topic which are accepted universally.
- Books written on the topic, both generic and specific.
- Research done in the field usually in the order of oldest to latest.
- Challenges being faced and on-going work, if available.

Literature survey describes about the existing work on the given project. It deals with the problem associated with the existing system and also gives user a clear knowledge on how to deal with the existing problems and how to provide solution to the existing problems.

Objectives of Literature Survey

- Learning the definitions of the concepts.
- Access to latest approaches, methods and theories.

- Discovering research topics based on the existing research
- Concentrate on your own field of expertise– Even if another field uses the same words, they usually mean completely.
- It improves the quality of the literature survey to exclude sidetracks– Remember to explicate what is excluded.

Before building our application, the following system is taken into consideration:

2.2 RELATED WORK:

2.2.1 Title: An Automatic Method to Identify e-Learner Emotions using Behavioral Cues

Author: Zahra Karamimehr, Mohammed Mehdi Sepehri and Soheil sibdari Abstract:

In this article, we offer and test a nonsurvey-based method to characterize learner emotions. Our method, instead of using surveys, uses logs of learner behaviors in learning management systems (LMS) to reason about the emotional state of the e- learner. We use the control value theory (CVT) as the theoretical base of measuring emotions. Using this theory, learner emotions are directly tied to their achievements. We develop two fuzzy inference systems, one to measure academic self-efficacy (ASE), that we call ASEMEL, and another to measure task value, TAVAMEL. These two factors, according to the CVT, can identify the prospective outcome emotions in a learning environment. We conducted our experiment in an LMS with a sample of 30 students and validated the performance of our nonsurvey-based systems by comparing the results with the measures of an equivalent survey-based method. Finally, by linking our ASEMEL and TAVAMEL results, our system anticipated "hopelessness," "anticipated relief" and "no emotion" with 97% accuracy, "hope/anxiety" with 77% accuracy, and "anticipatory joy" with 87% accuracy compared with the self-reports of the students.

Methodologies Used:

Control Value Theory and Fuzzy Set Theory

Limitation:

- This is only applicable for non-survey based method.
- Limits only for small dataset.

2.2.2 Title: Automated Detection of Engagement using Video - Based Estimation of Facial Expressions and Heart Rate

Author: Hamed Monkaresi, Nigel Bosch, Rafael A. Calvo, Sidney K. D'Mello. Abstract:

We explored how computer vision techniques used to detect engagement while students (N = 22) completed a structured writing activity (draft-feedback-review) similar to activities encountered in educational settings. Students provided engagement annotations both concurrently during the writing activity and retrospectively from videos of their faces after the activity. We used computer vision techniques to extract three sets of features from videos, heart rate, Animation Units (from Microsoft Kinect Face Tracker), and local binary patterns in three orthogonal planes (LBP-TOP). These features were used in supervised learning for detection of concurrent and retrospective self-reported engagement. Area Under the ROC Curve (AUC) was used to evaluate classifier accuracy using leave-several-students-out cross validation. We achieved an AUC = .758 for concurrent annotations and AUC = .733 for retrospective annotations. The Kinect Face Tracker features produced the best results among the individual channels, but the overall best results were found using a fusion of channels.

Methodology:

AAM model

Limitation:

Limitation given that their goal was to experiment with an accurate video- based HR tracking system.

2.2.3 Title: Automatic Facial Expression Recognition using features Of Salient facial patches.

Author: S L Happy, Student member, IEEE, Aurobinda Routray, Member,IEEE.

Abstract: Extraction of discriminative features from salient facial patches plays a vital role in effective facial expression recognition. The accurate detection of facial landmarks improves the localization of the salient patches on face images. This paper proposes a novel framework for expression recognition by using appearance features of selected facial patches. A few prominent facial patches, depending on the position of facial landmarks, are extracted which are active during emotion elicitation. These active patches are further processed to obtain the salient patches which contain discriminative features for classification of each pair of expressions, thereby selecting different facial patches as salient for different pair of expression classes. One-against-one classification method is adopted using these features. In addition, an automated learning-free facial landmark detection technique has been

proposed, which achieves similar performances as that of other state-of-art landmark detection methods, yet requires significantly less execution time. The proposed method is found to perform well consistently in different resolutions, hence, providing a solution for expression recognition in low resolution images. Experiments on CK+ and JAFFE facial expression databases show the effectiveness of the proposed system.

Methodology Used:

SVM and HMM models as classifiers

Limitation:

- This analysis is confined to databases without facial hairs.
- Dynamics of expression in temporal domain is also not considered in this study.

2.2.4 Title: Facial Expression Recognition using facial movement features Author: Ligang Zlang, Student member, IEEE and Dian Tjondronegore.

Abstract: Facial expression is an important channel for human communication and can be applied in many real applications. One critical step for facial expression recognition (FER) is to accurately extract emotional features. Current approaches on FER in static images have not fully considered and utilized the features of facial element and muscle movements, which represent static and dynamic, as well as geometric and appearance characteristics of facial expressions. This paper proposes an approach to solve this limitation using "salient" distance features, which are obtained by extracting patch- based 3D Gabor features, selecting the "salient" patches, and performing patch matching operations. The experimental results demonstrate high correct recognition rate (CRR), significant performance improvements due to the consideration of facial element and muscle movements, promising results under face registration errors, and fast processing time. Comparison with the state-of-the-art performance confirms that the proposed approach achieves the highest CRR on the JAFFE database and is among the top performers on the Cohn-Kanade (CK) database.

Methodology Used:

SVM as classifiers

Limitation:

Current approaches on FER in static images have not fully considered and utilized the features of facial elements and muscle movement.

2.2.5 Title: The Faces of Engagement: Automatic Recognition of Student Engagement from Facial Expressions (2021)

Author: Jacob whitehill, Zewelanji serpel, Yi-ching Lin, Aysha Foster and Javier, R. Movellan.

Abstract: Student engagement is a key concept in contemporary education, where it is valued as a goal in its own right. In this paper we explore approaches for automatic recognition of engagement from students' facial expressions. We studied whether human observers can reliably judge engagement from the face; analyzed the signals observers use to make these judgments; and automated the process using machine learning. We found that human observers reliably agree when discriminating low versus high degrees of engagement (Cohen's $\kappa = 0.96$). When fine discrimination is required (four distinct levels) the reliability decreases, but is still quite high ($\kappa = 0.56$). Furthermore, we found that engagement labels of 10-second video clips can be reliably predicted from the average labels of their constituent frames (Pearson r=0.85), suggesting that static expressions contain the bulk of the information used by observers. We used machine learning to develop automatic engagement detectors and found that for binary classification (e.g., high engagement versus low engagement), automated engagement detectors perform with comparable accuracy to humans. Finally, we show that both human and automatic engagement judgments correlate with task performance. In our experiment, student post-test performance was predicted with comparable accuracy from engagement labels (r=0.47) as from pre-test scores (r=0.44).

Methodology Used:

Boost, SVM, MLR models

Limitation:

Increasing student engagement has emerged as a key challenge for teachers, researchers and educational institutions.

2.2.6 Title: Evaluation Method of Teaching Effect Based on Visual Calculation in Classroom Environment.

Author: Yu Dai, Hailiang zhao, Xue Zhang.

Abstract: In order to improve the shortcomings of traditional classroom evaluation methods, a teaching effectiveness evaluation method based on computer vision technology is proposed. Attendance is obtained by face detection. The distance measurement function is obtained by using the

fitting method to calculate the distance between students in the classroom and the camera. The seat selection distribution is obtained according to the distance and direction analysis and quantitatively evaluated by using the curve fitting method. By using the head posture estimation technology and facial expression recognition technology to identify students' up-or-down state and expressions respectively, the ratios of students' raising their heads and positive emotions are obtained. Finally, a geometric mean function based on attendance, seat selection distribution, head up rate and the proportion of positive emotions, is suggested to evaluate the teaching effect. The experimental results show that the evaluation results of this method are highly consistent with those of teachers and students.

Methodology Used: Computer vision technique

Limitation: The classification of head states is not as widely studied as face detection.

2.2.7 Title: Detecting Student Engagement in Classrooms for Intelligent Tutoring Systems.

Author: **Hoang Tieu Binh, Hoang – Anh The Nguyen, Nguyen Quang Trung, Bui The Duy.**

Abstract: Detecting and tracking student engagement in a large classroom can help tutors or automatic learning systems easily control or summarize the situation. To come up with the advanced technique in machine learning, especially deep learning, nowadays, many schools can build an efficient system for supporting teachers or tutoring systems. In this paper, we propose a transfer learning method applying to a small dataset to classify student actions in the classroom. Another contribution is building a lightweight dataset with a limited number of images for each category for classification work. The experiments show the acceptable result in action recognition with high accuracy compared to other researches.

Methodology Used: CNN, SVM

Limitation: The comparison between researches is not appropriate because of the difference of the datasets and methods.

2.2.8 Title: Learning Sparse Representations for Human Action Recognition Author: Tanaya Guha (Student member, IEEE), Rabab kreidiah ward.

Author: Tanaya Guha (Student member, IEEE), Rabab kreidiah ward.

Abstract: This paper explores the effectiveness of sparse representations obtained by learning a set of overcomplete basis (dictionary) in the context of action recognition in videos. Although this work concentrates on recognizing human movements-physical actions as well as facial expressions-the proposed approach is fairly general and can be used to address other classification problems. In order to model human actions, three overcomplete dictionary learning frameworks are investigated. An overcomplete dictionary is constructed using a set of spatio-temporal descriptors (extracted from the video sequences) in such a way that each descriptor is represented by some linear combination of a small number of dictionary elements. This leads to a more compact and richer representation of the video sequences compared to the existing methods that involve clustering and vector quantization. For each framework, a novel classification algorithm is proposed. Additionally, this work also presents the idea of a new local spatio-temporal feature that is distinctive, scale invariant, and fast to compute. The proposed approach repeatedly achieves state-of-the-art results on several public data sets containing various physical actions and facial expressions.

Methodology Used: BoW model

Limitation: It cannot deal with multiple actions presented in one video sequence.

2.2.9 Title: Fully Automated Recognition of Spontaneous Facial Expressions in Videos Using Random Forest Classifiers.

Author: Mostafa K. Abd EI Meguid and Martin D. Levine, Life Member, IEEE.

Abstract: This paper discusses the design and implementation of a fully automated comprehensive facial expression detection and classification framework. It uses a proprietary face detector (PittPatt) and a novel classifier consisting of a set of Random Forests paired with support vector machine labellers . The system performs at real-time rates under imaging conditions, with no intermediate human intervention. The acted still-image Binghamton University 3D Facial Expression database was used for training purposes, while a number of spontaneous expression-labelled video databases were used for testing. Quantitative evidence for qualitative and intuitive facial expression recognition constitutes the main theoretical contribution to the field.

Methodology Used: Random Forest and SVM

Limitation: The framework achieved real time performance in a spontaneous environment, which as not previously been presented in the literature.

2.2.10 Title: Application of Emotional Recognition in Intelligent Tutoring System.

Author: Yan-Wen Wu, Wei LIU, Jian-BO WANG

Abstract: To meet the emotional need in traditional intelligent tutoring system (ITS), an intelligent tutoring system model based on emotional recognition technique was proposed in the paper. This model was added the emotional recognition module on the model of traditional intelligent tutoring system. The model of tutoring system based on emotional recognition was constructed with facial expression recognition and text recognition techniques, which can get, recognize and analyze emotional information of students' learning performance, then implement emotional stimulation and emotional tutoring according to different students' learning emotion.

Methodology Used: Convolutional Neural Networks

Limitation: One problem with CNN, however, is the high number of hyper parameters to define which can range from hundreds to thousands.

CHAPTER-3

PROBLEM STATEMENT AND OBJECTIVES

3.1 PROBLEM STATEMENT:

Manual attendance systems are plagued by **buddy-punching and time-theft**. Since the data is entered manually, it can easily be manipulated. The employee may provide inaccurate information for extra income, resulting in less productivity and increased costs. In traditional classroom environment, students' attendance management is one of the key factors to analyze the students' learning process and also to keep track of other factors like discipline, engagement and leads to effective learning and increase the success rate. There are several works in attendance management system to overcome the difficulties faced in a traditional classroom environment by using finger print, RFID, iris, wireless and face recognition-based methods. Also, there are many face detection based attendance management systems available in which they place a camera in a classroom, capture the image/video, recognize the students using face detection techniques.

3.2 OBJECTIVES:

The main aim of our project is to make automatic attendance system using the camera. In this proposed system, the manual errors will be avoided. We can save the teaching time and we can avoid the waiting time of students. Finally, it will provide the accurate attendance for the students.

- To reduce the attendance taking time.
- To avoid intervention of learning process.
- To reduce the manual errors.

CHAPTER-4

SYSTEM REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

1. Admin should open our application.
2. Admin create the dataset by collecting the information from the students like name, roll number, mobile number, face photos.
3. System will train the model using CNN algorithm.
4. Admin if they start taking attendance, System camera will be ON and recognize the student face using CNN.
5. System will create the attendance sheet for hourly wise.
6. System will calculate the final day attendance also.
7. Our system effectively mark attendance based on face recognition using CNN.

4.2 NON-FUNCTIONAL REQUIREMENT

These are requirements that are not functional in nature, that is, these are constraints within which the system must work.

- The program must be self-contained so that it can easily be moved from one Computer to another. It is assumed that network connection will be available on the computer on which the program resides.
- **Capacity, scalability and availability.**

  The system shall achieve 100 per cent availability at all times.

  The system shall be scalable to support additional clients and volunteers.
- **Maintainability.**

  The system should be optimized for supportability, or ease of maintenance as far as possible. This may be achieved through the use documentation of coding standards, naming conventions, class libraries and abstraction.

• Randomness, verifiability and load balancing.

The system should be optimized for supportability, or ease of maintenance as far as possible. This may be achieved through the use documentation of coding standards, naming conventions, class libraries and abstraction. It should have randomness to check the nodes and should be load balanced.

4.3 HARDWARE REQUIREMENT

- Processor Type: Intel Core TM– i5
- Speed: 2.4 GHZ
- RAM: 8 GB RAM
- Hard disk: 80 GB HDD
- Input Device: Mouse, Keyboard, Camera

4.3.1 CPU- INTEL CORE i5

Fig 4.1 INTEL CORE i5

Intel Core is a brand name that Intel uses for various mid-range to high-end consumer and business microprocessors. As of 2015 the current lineup of Core processors included the Intel Core i7, Intel Core i5, and Intel Core i3. 5th generation Intel® Core™ i5 processors empower new innovations like Intel® Real Sense™ technology—bringing you features such as gesture control, 3D captures and edit, and innovative photo and video capabilities to your devices. Enjoy stunning visuals, built-in security, and an automatic burst of speed when you need it with Intel® Turbo Boost Technology 2.0. Intel Core is a brand name that Intel uses for various mid-range to high-end consumer and business microprocessors. As of 2015 the current lineup of Core processors included the Intel Core i7, Intel

Core i5, and Intel Core i3. 5th generation Intel® Core™ i5 processors empower new innovations like Intel® Real Sense™ technology—bringing you features such as gesture control, 3D captures and edit, and innovative photo and video capabilities to your devices. Enjoy stunning visuals, built-in security, and an automatic burst of speed when you need it with Intel® Turbo Boost Technology 2.0.

4.3.2 RAM

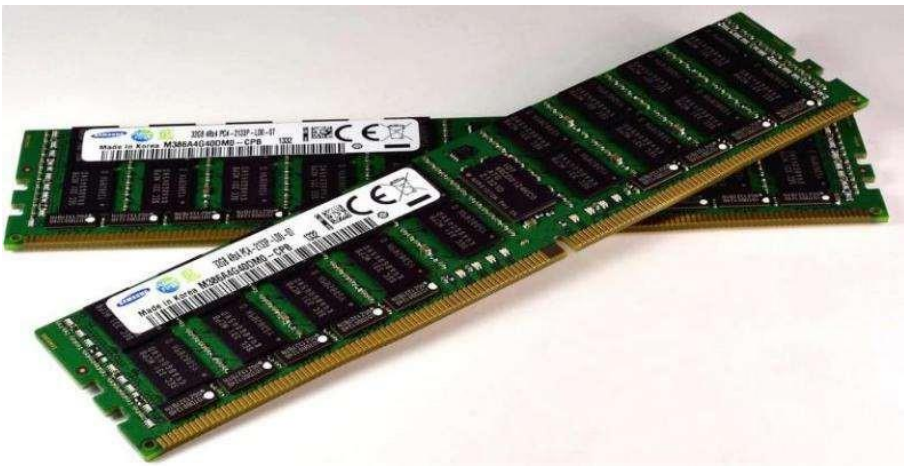


Fig 4.2 RAM 8 GB

When you load up an application on to your computer it loads into your available RAM memory. It is very quick type of memory. The more programs you load up, the more RAM is taken up. At the point where you have loaded up enough apps to take up all your free available physical RAM, your OS will create a swap-file on your hard drive. This file is used as a reserve for all additional apps you run.

The trouble with that is that hard drives are a lot slower to read and write from than RAM memory is. Therefore, your computer will perform much slower at that point. Although new generation of SSD hard drives are much faster than your traditional spinning drive, it is still best to have enough RAM available. If you are using Windows and want to want to know how much RAM you are using up, you can right click on task bar, then select start "Task Manager" and on the "performance" tab you will see a green bar indicating "Memory".

4.3.3 HARD DISK

Fig 4.3 Hard Disk Drive

A hard disk drive (HDD), hard disk, hard drive or fixed disk is a data storage device used for storing and retrieving digital information using one or more rigid ("hard") rapidly rotating disks (platters) coated with magnetic material. The platters are paired with magnetic heads arranged on a moving actuator arm, which read and write data to the platter surfaces. Data is accessed in a random-access manner, meaning that individual blocks of data can be stored or retrieved in any order rather than sequentially. An HDD retains its data even when powered off.

4.4 SOFTWARE REQUIREMENT

- Operating System: Windows 64-bit
- Programming Language: Python
- IDE: vs-code
- Front end: Tkinter
- Backend: Pandas, OpenCV

4.4.1 Introduction to Python

Python is a widely used general-purpose, high level programming language. It was created by Guido van Rossum in 1991 and further developed by the Python Software Foundation. It was designed with an emphasis on code readability, and its syntax allows programmers to express

their concepts in fewer lines of code. Python is a programming language that lets you work quickly and integrate systems more efficiently.

There are two major Python versions: Python 2 and Python 3. Both are quite different. Beginning with Python programming:

1) Finding an Interpreter:

Before we start Python programming, we need to have an interpreter to interpret and run our programs.

Windows: There are many interpreters available freely to run Python scripts like IDLE (Integrated Development Environment) that comes bundled with the Python software downloaded from http://python.org/.

Linux: Python comes preinstalled with popular Linux distros such as Ubuntu and Fedora. To check which version of Python you're running, type "python" in the terminal emulator. The interpreter should start and print the version number.

macOS: Generally, Python 2.7 comes bundled with macOS. You'll have to manually install Python 3 from http://python.org/.

Importance of Python

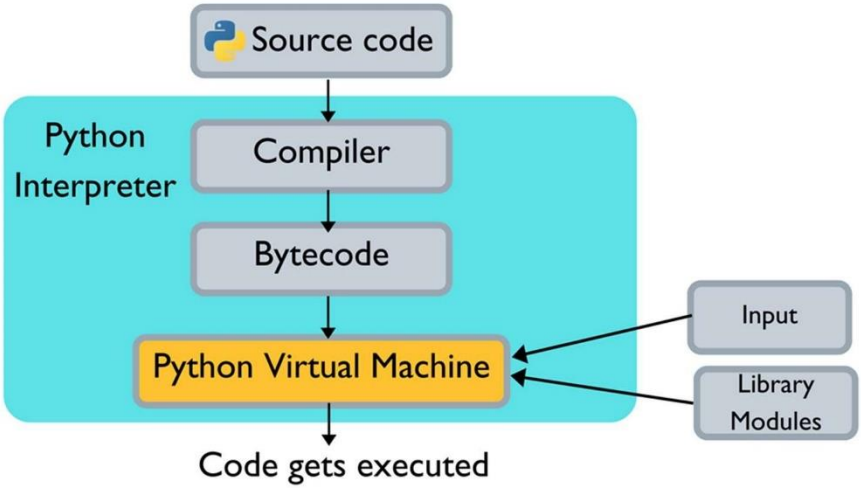
Python is a high-level, interpreted, interactive, and object-oriented scripting language. Python was designed to be highly readable which uses English keywords frequently whereas other languages use punctuation and it has fewer syntactical constructions than other languages.

It is used in:

1. Software Development
2. Web Development
3. System Scripting
4. Mathematics

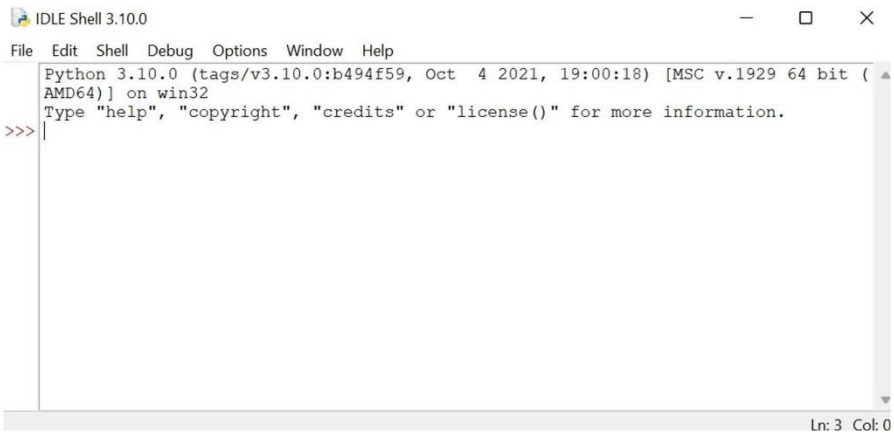
Python is Interpreted

It means that each line is processed one by one at runtime by the interpreter and you do not need to compile your program before executing it.



Python is Interactive

It means that you can actually sit at a Python prompt and interact with the interpreter directly, to write and execute your programs.



Python is Object-Oriented

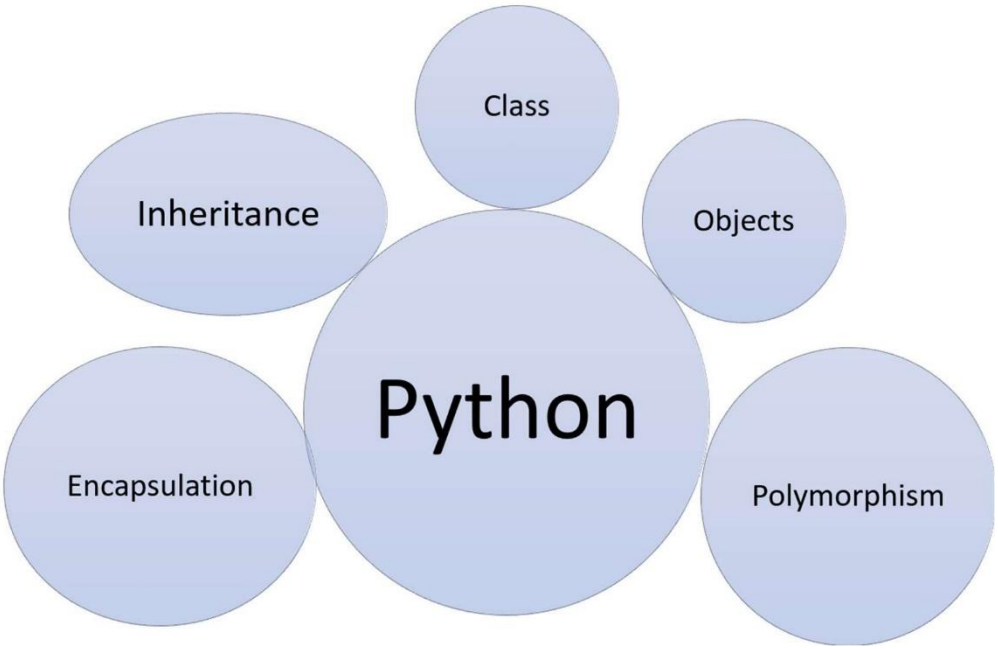
Python supports the Object-Oriented style or technique of programming that encapsulates code within objects.

Easy-to-maintain

Python's success is that its source code is fairly easy-to-maintain. One reason for that is, it is read and written like a lot of everyday English.

A Broad Standard Library

One of Python's greatest strengths is the bulk of the library, which makes it very portable and cross- platform compatible. Python has libraries for almost everything one can think of.

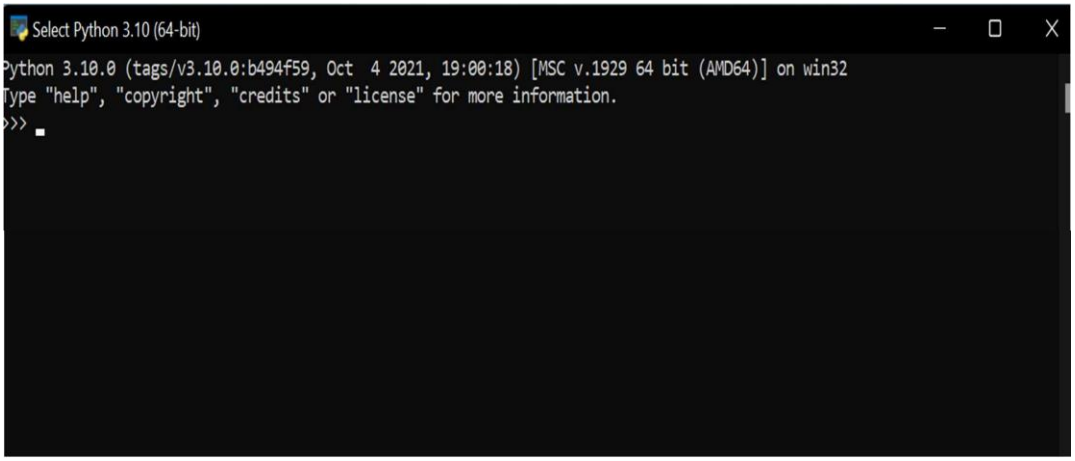


Python is Beginner's Language

Python is an excellent language for beginning programmers and facilitates the construction of a wide range of programs ranging from simple text processing to web browsers to games. Python does not have pointers, which is one of the main challenges that many of us have encountered when programming.

Interactive Mode

Support for an interactive mode in which you can enter results from a terminal right to the language, allowing interactive testing and debugging of snippets of code.



Portable

Python can run on a wide variety of hardware platforms and has the same interface on all

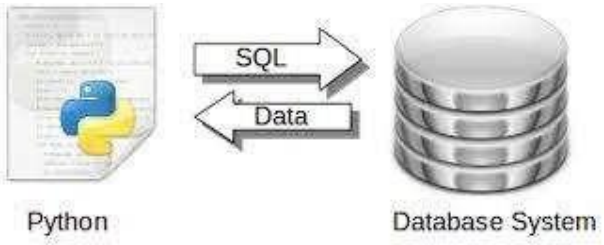
platforms. You can run the same python program on Windows, Linux, Mac, Raspberry Pi, Mango Pi, Android, etc.

Extendable

You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient. Generally, we do that using the PIP command.

Databases

Python provides interfaces to all major commercial databases. It has packages to communicate with SQL, NoSQL, etc. databases, ranging from MongoDB to MySQL.



GUI Programming

Python supports GUI applications that can be created and ported to many system calls, libraries, and windows systems, such as Windows, Macintosh, and the X Window system of Unix. It has libraries like Tkinter, WxPython, etc.

Scalable

Python provides a better structure and support for large programs than shell scripting. Apart from the above-mentioned features, Python has a big list of good features, few of them are-

- Support for functional and structured programming methods as well as OOP.
- It can be used as a scripting language or can be compiled to byte-code for building large applications.
- Very high-level dynamic data types and supports dynamic type checking.
- Supports automatic garbage collection.
- It can be easily integrated with C, C++, COM, ActiveX, CORBA, and Java.

CHAPTER-5

SYSTEM DESIGN

Systems design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could see it as the application of systems theory to product development. System design is one of the most important phases of software development process. The purpose of the design is to plan the solution of a problem specified by the requirement documentation. In other words, the first step in the solution to the problem is the design of the project. The design of the system is perhaps the most critical factor affecting the quality of the software.

5.1 SYSTEM ARCHITECTURE:

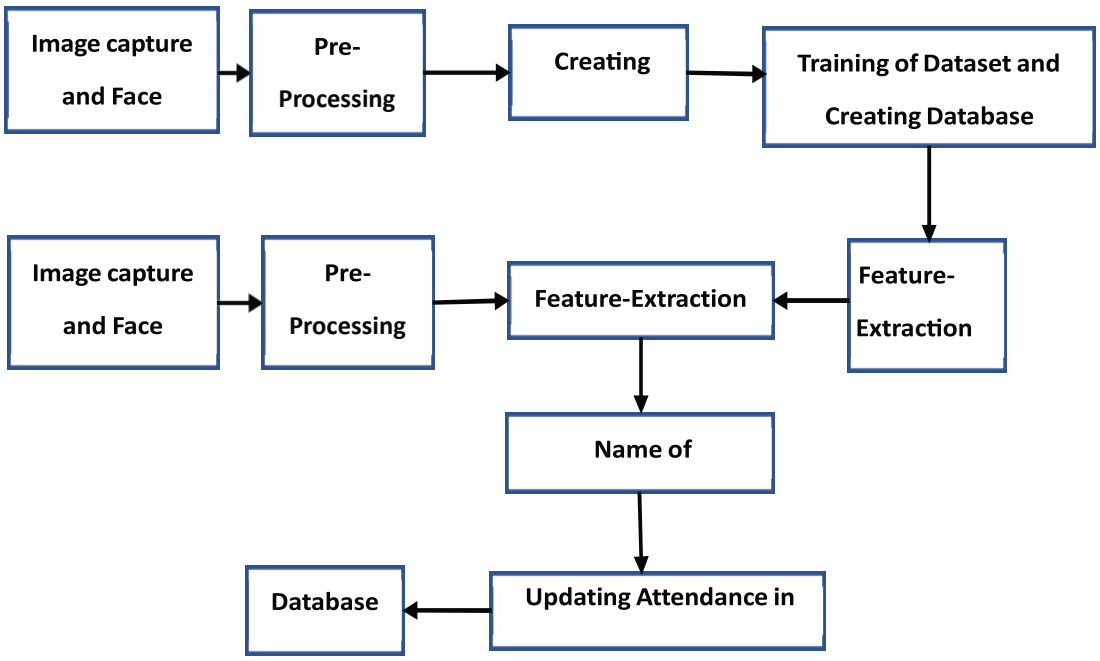


Fig. 5.1 System Architecture

We present an AI based attendance detection system It contains two phases First Training phase. In this phase students' images will be captured and detected face using Haar features. then converted to gray in preprocessing and stored in dataset folder, System use the dataset images to train the model using CNN algorithm and saved the training model. In the second phase students' images will be captured in real time and detected face using Haar features. then converted to gray in preprocessing, then system loads the CNN algorithm to recognize. If registered students are available in the current frame mark as present else absent. Save the generated attendance in the system.

5.2 DATA FLOW DIAGRAMS (DFD)/ FLOW CHARTS

captured in real time and detected face using Haar features. then converted to gray in preprocessing, then system loads the CNN algorithm to recognize. If registered students are available in the current frame mark as present else absent. Save the generated attendance in the system.

1. The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system.
2. The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.
3. DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.
4. DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.

Level:0

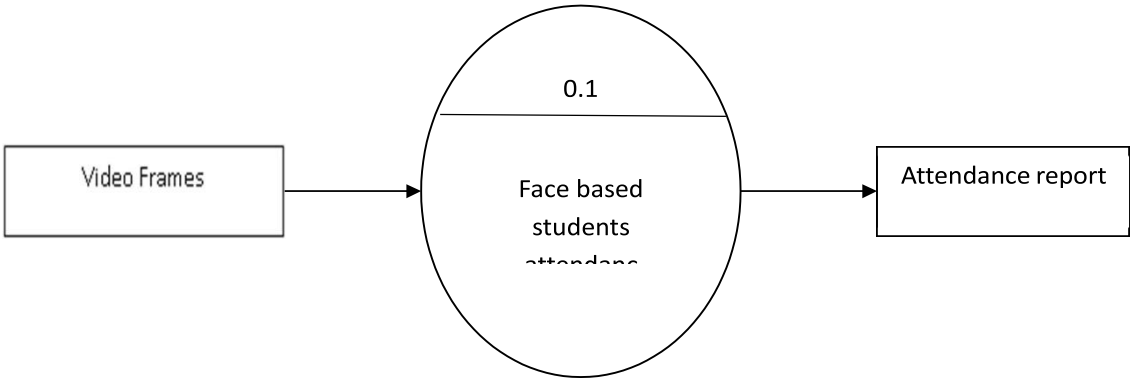


Fig 5.2 DFD Level:0

Level-0: Describes the overall process of the project. We are using captures video frames as input. System will use the OpenCV to detect face and it will generate attendance report in excel sheet.

Level: 1

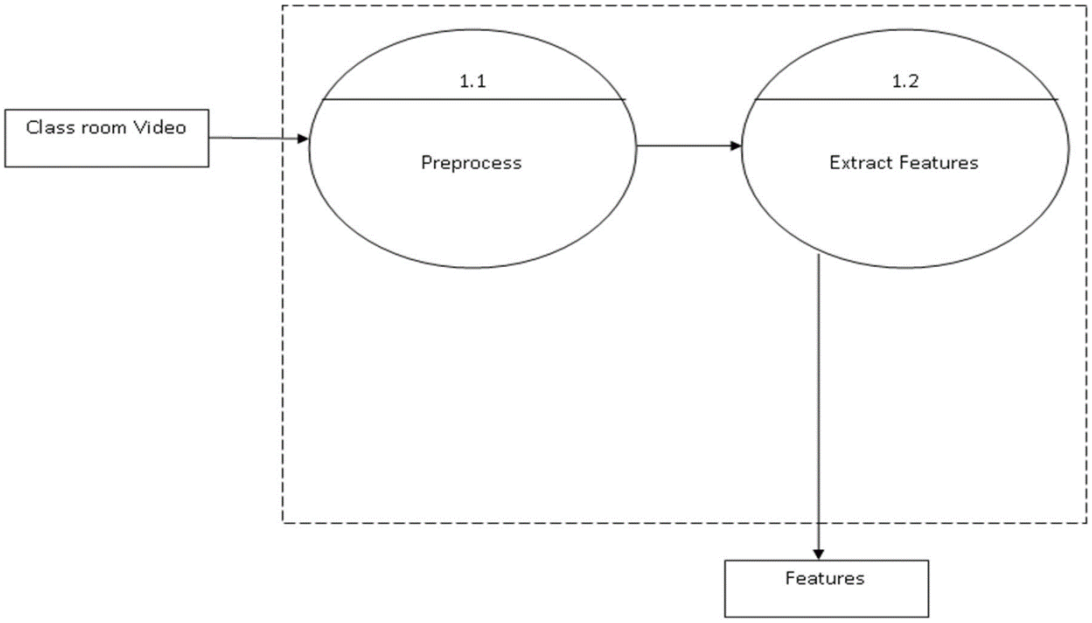


Fig 5.3 DFD Level:1

Level 1: Describes the first stage process of this project. we are passing face and voice as a input the system will perform the preprocess and extract the important features.

Level 2:

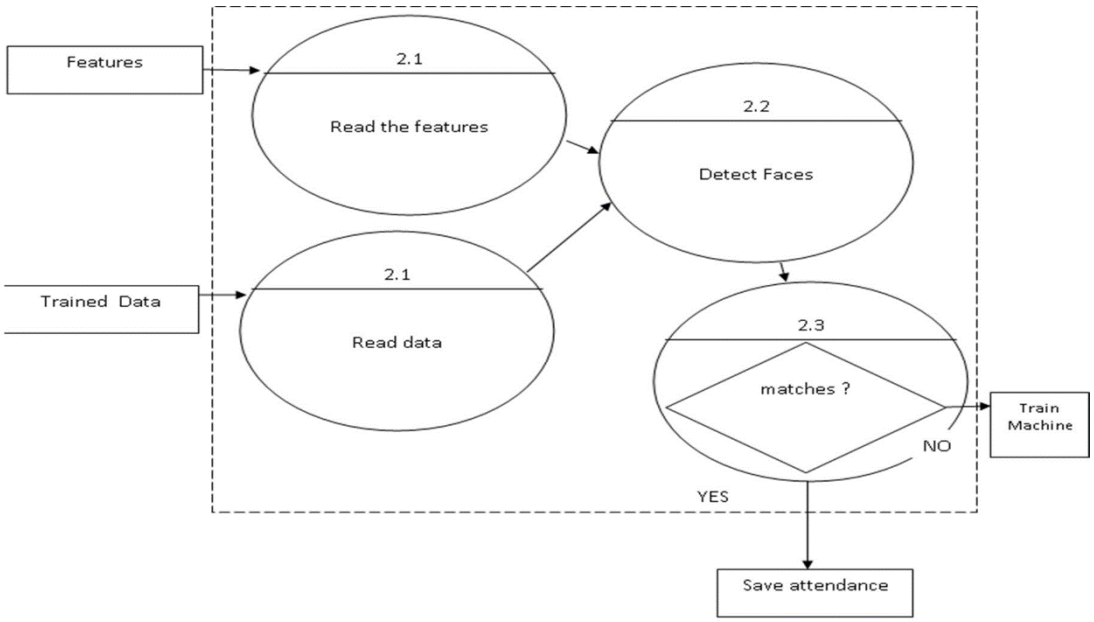


Fig 5.4 DFD Level:2

Level 2: Describes the first step of the project. We are using extracted features from level 1 and trained model as input. System will use CNN to recognize face and mark attendance automatically.

5.3 CLASS DIAGRAMS

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes. It explains which class contains information.

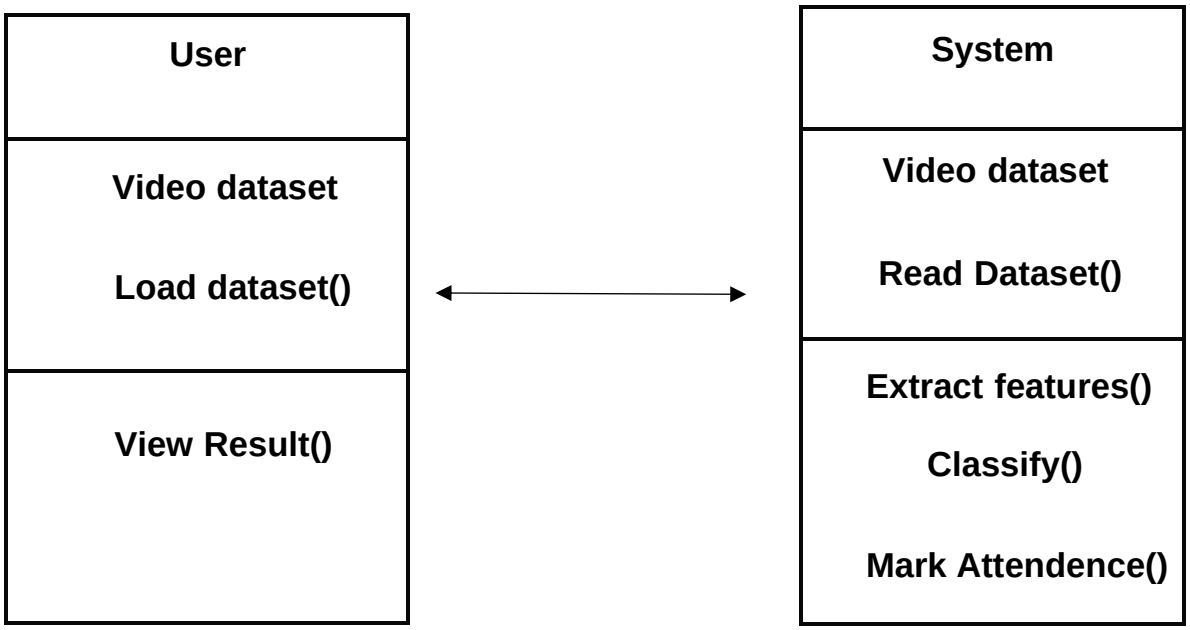


Fig 5.5 Class Diagram

5.4 SEQUENCE DIAGRAMS

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

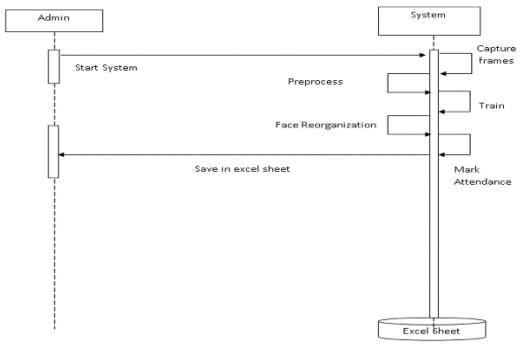


Fig 5.6 Sequence Diagram

5.5 USE CASE DIAGRAMS

A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

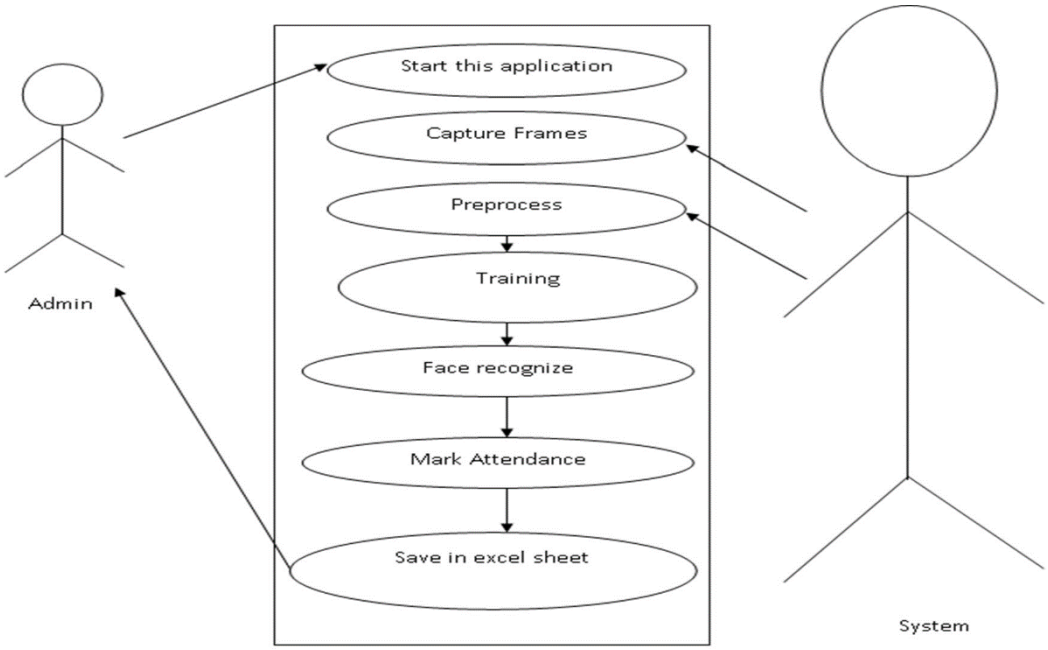


Fig 5.7 Use case Diagram

CHAPTER 6

COST ESTIMATION AND PROJECT PLANNING

6.1 COST ESTIMATION

Details	Amount
Laptop	40000
Labor	2000
Travel	2000
Document	2000
Total	**46000**

6.2 PLAN OF EXECUTION

6.2.1 OVERVIEW

During the execution phase, the project team develops the product or service and presents final product to customer
There are 3 execution phases

- **Build Deliverables:**

We have completed the first two phases of this project. We begin by reviewing the requirements of the project.

- **Monitor and Control:**

This is the part of the execution phase because we must follow several steps to ensure the project meets the requirements such as

1. **Time management**: During the time management process, we control the amount of time our team members spend working on each activity and monitor the stakeholders at the end of the project.
2. **Change management**: if a change in the project's scope of work we must formally request the change and get the changes approved.
3. **Risk Management**: This involves handling the potential disadvantages and drawbacks that

may arise during a project.

- **Review**: This helps you document the results of our project review , at the end of the execution project phase.
  - This is conducted at the end of the initiation, planning and execution phases within a project.
  - Project is currently delivering to schedule.
  - Risks have been controlled and mitigated.
  - Changes were properly managed.
  - Project is on task.

6.1.2 Gantt Chart

	Oct 15	Dec 10	Jan 10	Mar 10	Apr 15	May 15	Jun 25	Jun 26	Jun 30	Jul 1
Planning phase										
Literature survey										
Analysis phase										
Design phase										
Implementation										
Testing										
Deployment										
Documentation Report										

Table 6.1 Gantt Chart

CHAPTER 7

MODULES AND IMPLEMENTATION

We are planning to implement this project using following modules.

7.1 Modules:

Image Capturing

Training phase

Face recognition

Experimental Setup

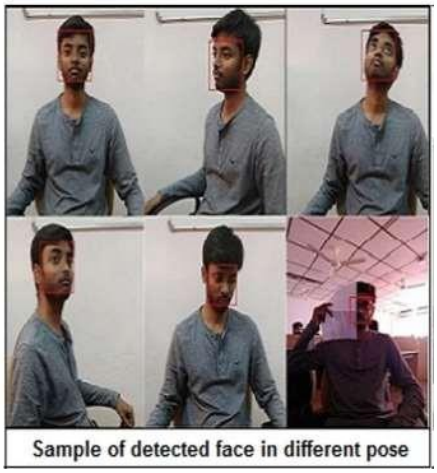
7.2 Module Descriptions:

Image Capturing:

Proposed System consists of a rotating high-definition camera, placed in the classroom to capture all the students. From these captured image frames, the students' faces are detected using OpenCV face detection technique.

Face recognition

We proposed face detection technique by incorporating Haar cascade classifier and CNN techniques. This technique does not play out any sub-sampling, but it optimizes over all sub- windows. This method is much accurate to detect all varied faces positioned frontal, tilted up/right/left/down and occluded faces with 99.69% accuracy. Following figure shows some samples of detected face using proposed method.



Sample of detected face in different pose

Experimental Setup

In this experiment we used OpenCV using Cascade model, the hardware platform is 64-bit operating system and Linux 16.4, processor 2.5 GHz, Memory 8 GB and 16 MP high-definition camera. The setup was tested in a real classroom that contains 20 students with all variation of poses. We tested the proposed face detection method and existing face detection techniques using the benchmark dataset (FDDB) . This dataset contains images of human faces in multiple poses. Out of 3500 of FDDB images, Haar Cascade Classifiers technique detects the face with an accuracy of 94.71%,

Training Phase:

The number of students detected depends on the seating arrangement of the students in the classroom. Fig1 contains frontal and occlude faces and Fig2 contains frontal, tilted and occlude faces. The proposed face detection technique can detect all faces presents in Fig1 and Fig-2 with the rate of 100% accuracy. From detected faces, we identified the students using face recognition algorithm, for Frame-1 the correctness of true identification rate is 100% while for Frame-2 it is 90%. The accuracy of student recognition can be improved by using more images of each student in the training phase.

7.3 Methodology:

7.3.1 HARR Cascade Face Detection:

Haar Cascade is a machine learning object detection algorithm used to identify objects in an image or video and based on the concept of features proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001.

It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images.

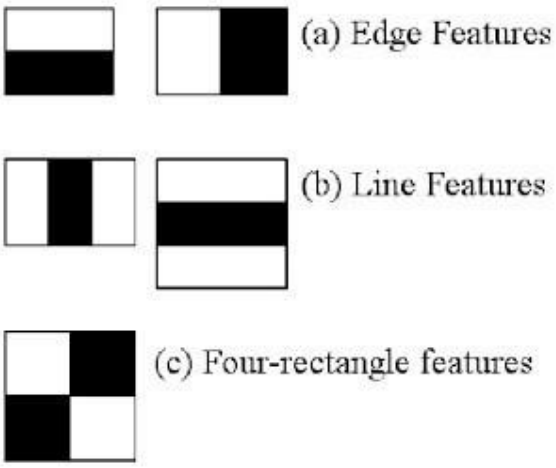
It is then used to detect objects in other images.

The algorithm has four stages:

1. Haar Feature Selection
2. Creating Integral Images
3. Adaboost Training
4. Cascading Classifiers

It is well known for being able to detect faces and body parts in an image, but can be trained to identify almost any object. Let's take face detection as an example. Initially, the algorithm needs a lot of positive images of faces and negative images without faces to train the classifier. Then we need to extract features from it.

First step is to collect the Haar Features. A Haar feature considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums.



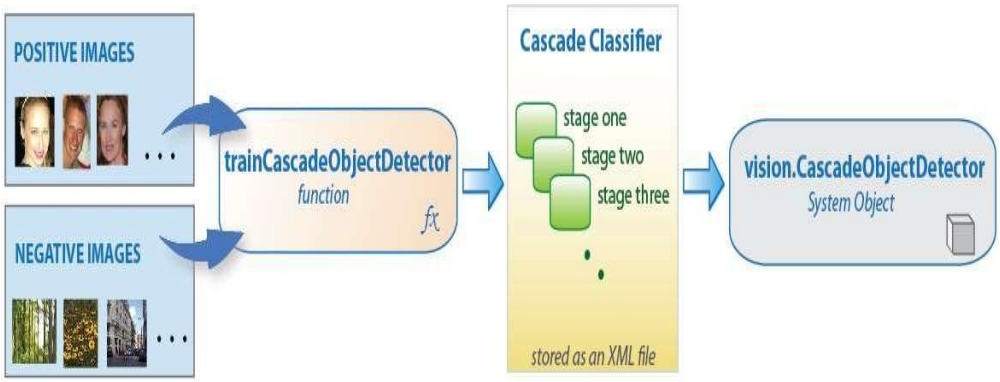
Integral Images are used to make this super-fast. But among all these features we calculated, most of

them are irrelevant. For example, consider the image below. Top row shows two good features. The first feature selected seems to focus on the property that the region of the eyes is often darker than the region of the nose and cheeks. The second feature selected relies on the property that the eyes are darker than the bridge of the nose. But the same windows applying on cheeks or any other place is irrelevant.

So how do we select the best features out of 160000+ features? This is accomplished using a concept called Adaboost which both selects the best features and trains the classifiers that use them. This algorithm constructs a “strong” classifier as a linear combination of weighted simple “weak” classifiers. The process is as follows.

During the detection phase, a window of the target size is moved over the input image, and for each subsection of the image and Haar features are calculated. You can see this in action in the video below. This difference is then compared to a learned threshold that separates non- objects from objects. Because each Haar feature is only a "weak classifier" (its detection quality is slightly better than random guessing) a large number of Haar features are necessary to describe an object with sufficient accuracy and are therefore organized into *cascade classifiers* to form a strong classifier.

Cascade Classifier



The cascade classifier consists of a collection of stages, where each stage is an ensemble of weak learners. The weak learners are simple classifiers called *decision stumps*. Each stage is trained using a technique called boosting. *Boosting* provides the ability to train a highly accurate classifier by taking a weighted average of the decisions made by the weak learners.

Each stage of the classifier labels the region defined by the current location of the sliding window as either positive or negative. *Positive* indicates that an object was found and *negative* indicates no objects were found. If the label is negative, the classification of this region is complete, and the detector slides the window to the next location. If the label is positive, the classifier passes the

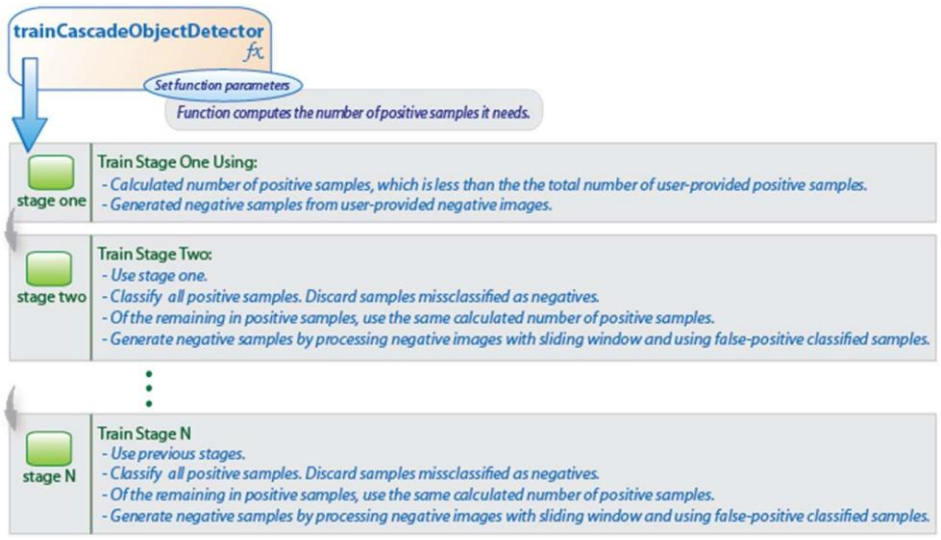
region to the next stage. The detector reports an object found at the current window location when the final stage classifies the region as positive.

The stages are designed to reject negative samples as fast as possible. The assumption is that the vast majority of windows do not contain the object of interest. Conversely, true positives are rare and worth taking the time to verify.

- A *true positive* occurs when a positive sample is correctly classified.
- A *false positive* occurs when a negative sample is mistakenly classified as positive.
- A *false negative* occurs when a positive sample is mistakenly classified as negative.

To work well, each stage in the cascade must have a low false negative rate. If a stage incorrectly labels an object as negative, the classification stops, and you cannot correct the mistake. However, each stage can have a high false positive rate. Even if the detector incorrectly labels a nonobject as positive, you can correct the mistake in subsequent stages. Adding more stages reduces the overall false positive rate, but it also reduces the overall true positive rate.

Cascade classifier training requires a set of positive samples and a set of negative images. You must provide a set of positive images with regions of interest specified to be used as positive samples. You can use the Image Labeler to label objects of interest with bounding boxes. The Image Labeler outputs a table to use for positive samples. You also must provide a set of negative images from which the function generates negative samples automatically. To achieve acceptable detector accuracy, set the number of stages, feature type, and other function parameters.



7.3.2 CNN Classification:

CNN model at present, the typical architecture of neural network is divided into the following categories: LeNet5, AlexNet, ZF Net, GooLeNet, and VGGNet, the following will LeNet5 architecture for a detailed analysis. LeNet5 is a CNN classic structure that existed long ago,and it is mainly used in the recognition of handwritten fonts. It contains a total of seven layersof structure, except for the input layer, each of the other has training parameters, and each layer contains a plurality of Feature Maps, we can extract the input features through a convolution kernel. And each feature contains multiple neurons. The picture below shows the architecture of LeNet5:

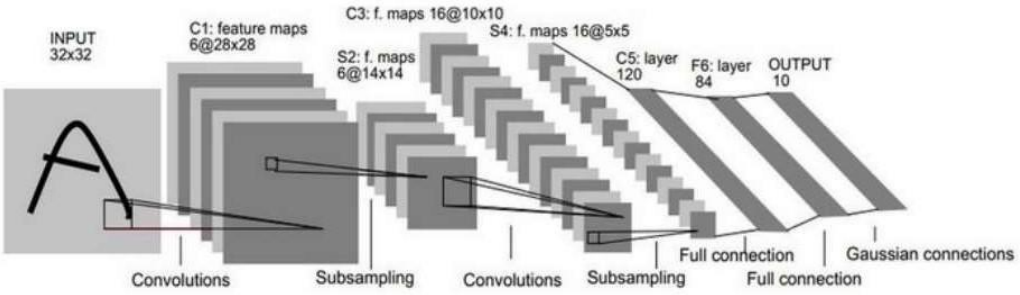


Fig7.1. CNN architecture

As shown in Figure 1, a size of 32*32 images through the input layer into the network structure. The layer in the input layer is a convolution layer, which is represented by C1. The number of convolution kernels is 6 and the size is 5*5. After this layer processing, the number of neuronsis 28*28*6, trainable parameters are (5*5+1) *6. The next layer of the C1 layer is a down sampled layer, shown in the figure, whose input is the output of the layer convolutional layer, 28*28 in size, 2*2 in the spatial neighborhood of the sample, and the way it is sampled Is to add 4 numbers, multiply them by a trainable parameter, and then add a trainable offset to output the result through the sigmoid function. The number of neurons in layer S2 is 14*14*6. After passing through the S2-layer sampling tube, the size of each feature plot it gets is a quarter of the output from its previous convolution layer. The layer after layer S2 is still a convolutional layer, with a total of 16 convolution kernels, and the size of each convolution kernel is the same as that of C1. This layer is called the C3 layer in the above figure. The size of the output feature layer in this layer is 10*10. The 6 features in the S2 layer are connected with all the features in the C3 layer. The features obtained in this layer the figure is a different combination of the output features of the previous layer. The S4 layer is the same as the S2 layer, and its sampling type is 16. So far, the network structure has reduced the number of neurons to 400. The next layer of C5 is still a convolutional layer, which is fully connected with the previous layer, the size of its convolution kernel is still 5*5, this time C5 layer image processing, the image size

becomes 5-5+1=1, which means that only one neuron output, in this layer contains a total of 120 convolution kernel, so the final output of neurons is 120. The last layer of F6, this layer is a fully connected layer, by calculating the input vector and the weight vector between the dot product, plus a bias, and finally through the sigmoid function to deal with the results.

CHAPTER 8
CONCLUSION

8.1 CONCLUSION

An effective contactless attendance management system is developed using artificial intelligence. The work has been developed as a touch-free system to prevent the students getting affected from contagious diseases, especially COVID'19. The traditional way of taking attendance has been substituted by this system, thereby reducing the efforts taken by the faculty during each class hour. It also avoids the proxy attendance given by the students, sometimes. The overall attendance for a class can be easily obtained by calculating the in-time and out- time of the students entering the class. A customized attendance report has been generated automatically and thus the system enables the faculty to save time for taking attendance in the class room.

8.2 FUTURE ENCHANCEMENT

In future, this work can be converted into web services, applicable for all domains. Also, the 3-D images can be incorporated in future for producing better accuracy.

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SMART ATTENDENCE SYSTEM USING BIOMETRIC AUTHENTICATION BASED ON REAL-TIME FACE RECOGNITION.

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Abstract: **The human face stands as a pivotal aspect of identification, uniquely distinguishing individuals. Leveraging facial characteristics as biometric data, a face recognition system can be deployed. Attendance marking remains a pivotal yet demanding task within organizational frameworks. Traditional methods prove cumbersome and intricate. This paper presents an approach utilizing the Open-Source Computer Vision Library (OpenCV) for face recognition. Integrated with a camera, the model captures input images, encodes and identifies faces, and marks attendance within spreadsheets. Haar Cascade Feature extraction algorithms facilitate feature extraction, while face recognition employs CNN deep learning algorithms. Incorporating cutting-edge technology, this system streamlines attendance tracking processes, enhancing efficiency and accuracy. Embracing the complexities of facial recognition, it offers a seamless solution for organizational needs. We use the concepts of artificial intelligence to monitor student attendance like capturing the motion pictures of the student when present in class to analyze the student data how much time student present in the class.**

Index Terms **- Face recognition, Biometric authentication, OpenCV, Attendance marking, Haar Cascade, CNN deep learning.**

I. INTRODUCTION

The field of biometrics revolves around identifying individuals based on their unique physical or behavioral traits. These traits encompass a range of characteristics, including movements, signatures, keyboard dynamics, fingerprints, faces, hands, iris patterns, and hand geometry. In a typical biometric system, specialized sensors capture these traits, and identity verification occurs by comparing this data to stored information in a database. The human face holds significant importance as a primary means of identification and communication worldwide. Its distinct features make facial recognition feasible in practical applications. While humans easily distinguish individuals based on facial characteristics such as color, nose shape, eye structure, and ears, computers face challenges in analyzing such data. Thus, computer vision technology becomes instrumental in recognizing human features accurately.

In recent years, face recognition techniques have undergone significant advancements due to the availability of various biometric methods. However, implementing face recognition systems on a large scale poses challenges. Variations in facial expressions, lighting conditions, facial styles, image resolutions, sensor devices, and viewing distances add complexity to system implementation. Multiple algorithms have been developed for face recognition, each with its strengths and capabilities. Currently, two primary approaches dominate face recognition methods. The first relies on local facial features, such as eyes, nose, and color, for identification. The second approach utilizes the entire face for recognition, offering a more comprehensive approach to identity verification. Deep learning, a subset of machine learning, utilizes deep neural networks to extract intricate representations from data. These networks, comprising multiple layers, have revolutionized various fields, including computer vision and natural language processing. In face recognition, deep learning algorithms analyze facial features across multiple layers, allowing for highly accurate identification. By leveraging representation learning, deep learning models can discern complex patterns in facial data, enabling robust recognition even in challenging conditions.

II. PROBLEM STATEMENT AND OBJECTIVE

Problem Statement

Manual attendance systems are plagued by buddy-punching and time-theft. Since the data is entered manually, it can easily be manipulated. The employee may provide inaccurate information for extra income, resulting in less productivity and increased costs. In traditional classroom environment, students' attendance management is one of the key factors to analyze the students' learning process and also to keep track of other factors like discipline, engagement and leads to effective learning and increase the success

rate. There are several works in attendance management system to overcome the difficulties faced in a traditional classroom environment by using finger print, RFID, iris, wireless and face recognition-based methods. Also, there are many face detection-based attendance management systems available in which they place a camera in a classroom, capture the image/video, recognize the students using face detection techniques.

Objectives

The main aim of this paper is to make automatic attendance system using camera. In this proposed system, the manual errors will be avoided. We can save the teaching time and we can avoid the waiting time of students. Finally, it will provide the accurate attendance for the students.

- To reduce attendance taking time
- To avoid intervention of learning process.
- To reduce the manual errors.

III. LITERATURE REVIEW

In 2023, Abhishek Kumar Singh, Sumit Kumar, Bhavesh Kumar, Dr. Alok Singh Chauhan [1] proposed "Face Recognition Using Machine Learning". This paper outlines the typical process of face recognition: data collection, preprocessing, feature extraction, and model training, comparing traditional methods like Eigenfaces and LBP with modern deep learning approaches such as CNNs and GANs. Variations in illumination, pose, occlusions, and expressions are some of the challenges in face recognition. The paper highlights advancements like deep learning models, cross-domain models, and 3D face recognition.

In 2023, Sindura Rajendra Dasi, Ekta Shantaram Gujar, Abdul Samad M I Ansari, Prof. Yaminee Patil [2] proposed, "Real-time Attendance Monitoring System using Machine Learning and Blockchain". This paper studies the development of a real-time attendance monitoring system using facial recognition integrated with blockchain technology. Facial recognition using OpenCV and the Haar cascade algorithm provides accurate detection and identification of students, addressing inefficiencies and inaccuracies in traditional attendance methods. The system uses blockchain for secure, immutable storage of attendance data, enhancing transparency and reducing the risk of manipulation. The integration of these technologies aims to create an automated, reliable, and tamper-proof attendance monitoring system.

In 2022, Lamis Ghoualmi, Mohamed El Amine Benkechkache [3] proposed "Feature Selection Based on Machine Learning Algorithms: A Weighted Score Feature Importance Approach for Facial Authentication". This paper explores advancements in facial biometric authentication through a novel feature selection method leveraging machine learning and genetic algorithms (GA). It reviews various machine learning techniques for the future importance, including mutual information, random forest, decision tree, chi-square, low variance, and support vector machine, highlighting their roles in enhancing facial recognition accuracy. This paper outlines the typical process of face recognition: data collection, preprocessing, feature extraction, and model training, comparing traditional methods like Eigenfaces and LBP with modern deep learning approaches such as CNNs and GANs. The proposed method, combining machine learning-based feature importance scores using a genetic algorithm, shows improved accuracy (from 93.5% to 95.62%) and reduced feature size (from 4096 to 964).

In 2021, Sahajpreet Singh, Sai Chandra Kumar C, Saksham Garg, Yash Giri, Manoj Kumar [4] proposed, "Efficient Face Identification and Authentication Tool for Biometric Attendance System". This paper highlights face identification for a attendance system which is mainly focuses on LBPH algorithm. LBPH (Local Binary Pattern Histogram) is popular method used in computer vision for face recognition. It includes LBP calculations, Divide image into cells, Histogram concentration, Feature Vector Construction, and Comparison using histogram Distance. It concludes digitization of educational and industrial organization towards biometric attendance system in upcoming years. So that chances human error, false attendance, complication in retrieving the data, etc. will be decreases.

In 2020, Ankur Sikarwar, Himachal Chandra, Indradeo Ram [5] proposed, "Real-time Biometric Verification and Management System Using Face Embeddings". The paper discusses an advanced biometric verification system using face recognition technology. They propose an end-to-end pipeline utilizing deep learning models—Zero-DCE for low-light image enhancement, MTCNN for face detection, and FaceNet for face recognition—aimed at achieving near real-time performance and high accuracy. The system's key features include biometric verification, attendance management, and user registration and deletion, with a user-friendly interface developed using Kivy. Testing on the Faces94 and Grimace datasets from the University of Essex demonstrates the system's robustness, achieving an overall accuracy of 96.76%, surpassing existing methods.

IV. METHODOLOGY

- **HARR Cascade Face Detection:**

Haar Cascade is a machine learning object detection algorithm used to identify objects in an image or video and based on the concept of features proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001.It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.

The algorithm has four stages:

1. Haar Feature Selection
2. Creating Integral Images

3. Adaboost Training
4. Cascading Classifiers

It is well known for being able to detect faces and body parts in an image, but can be trained to identify almost any object.

Fig 1,2: Examples of HARR Cascade algorithm

❖ **CNN Classification**

CNN model at present, the typical architecture of neural network is divided into the following categories: LeNet5, AlexNet, ZF Net, GooLeNet, and VGGNet, the following will LeNet5 architecture for a detailed analysis. LeNet5 is a CNN classic structure that existed long ago, and it is mainly used in the recognition of handwritten fonts. It contains a total of seven layers of structure, except for the input layer, each of the other has training parameters, and each layer contains a plurality of Feature Maps, we can extract the input features through a convolution kernel.

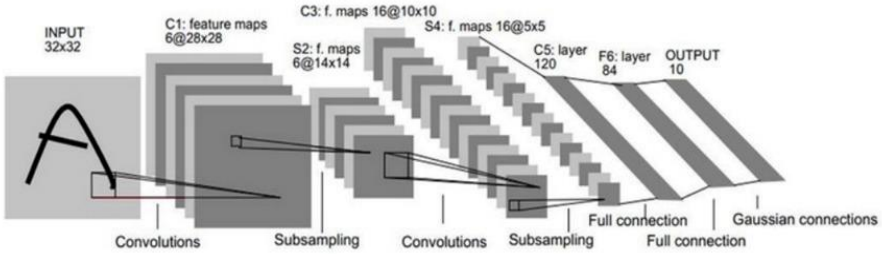

Fig 3: CNN Architecture (LeNet5)

System Architecture:

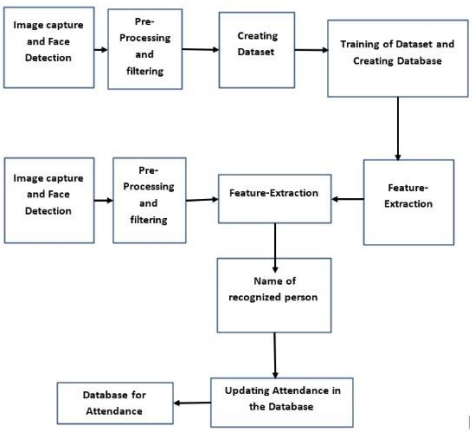

Fig 4: System Architecture

Systems design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. design is one of the most important phases of software development process. The purpose of the design is to plan the solution of a problem specified by the requirement documentation. The design of the system is perhaps the most critical factor affecting the quality of the software. We present an AI based attendance detection system It contains two phases First Training phase. In this phase students' images will be captured and detected face using Haar features. then converted to gray in preprocessing and stored in dataset folder, System use the dataset images to train the model using CNN algorithm and saved the training model. In the second phase students' images will be captured in real time and detected face using Haar features. then converted to gray in preprocessing, then system loads the CNN algorithm to recognize. If registered students are available in the current frame mark as present else absent. Save the generated attendance in the system.

Sequence, Class, and Use case diagrams:

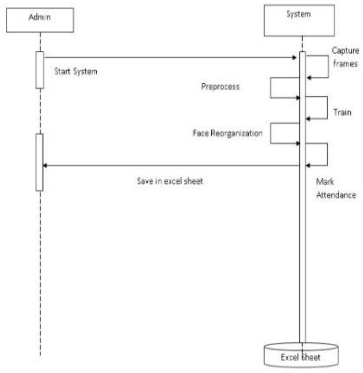

Fig 5: Sequence Diagram

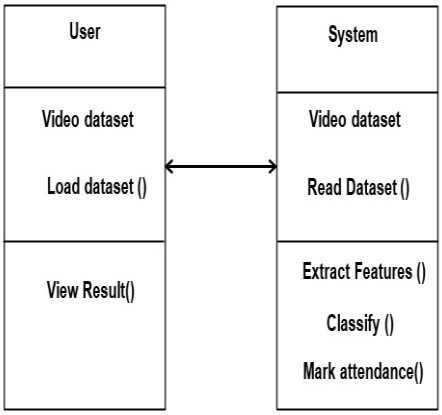

Fig 6: Class Diagram

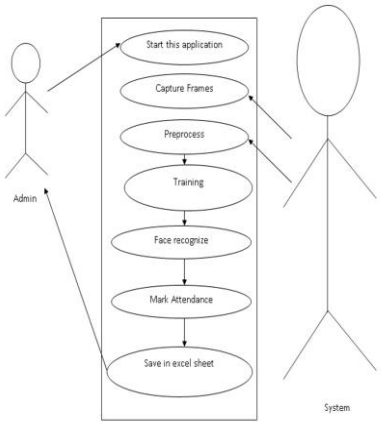

Fig 7: Use Case Diagram

In software engineering, the Unified Modeling Language (UML) provides several diagram types to describe different aspects of a system. A class diagram is a type of static structure diagram that illustrates the system's structure by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes, thereby indicating which class contains specific information. A sequence diagram, another UML construct, is an interaction diagram that shows how processes operate with one another and in what order, detailing the interactions as a Message Sequence Chart. These diagrams are also known as event diagrams, event scenarios, or timing diagrams. Additionally, a use case diagram is a type of behavioral diagram created from use-case analysis, designed to present a graphical overview of the system's functionality in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The primary purpose of a use case diagram is to show which system functions are performed for which actor, clearly depicting the roles of the actors within the system.

V. IMPLIMENTATION

We are implementing using following modules.

1) **Image Capturing:** Proposed System of a rotating HD camera, placed in the classroom to capture all the students. From these captured image frames, the students' faces are detected using OpenCV face detection technique.

2) Training Phase: The number of students detected depends on the seating arrangement of the students in the classroom. Fig1 contains frontal and occlude faces and Fig2 contains frontal, tilted and occlude faces. The proposed face detection technique can detect all faces presents in Fig1 and Fig-2 with the rate of 100% accuracy. From detected faces, we identified the students using face recognition algorithm, for Frame-1 the correctness of true identification rate is 100% while for Frame-2 it is 90%. The accuracy of student recognition can be improved by using more images of each student in the training phase.

Fig 8,9: Training data

3) Face Recognition: We proposed face detection technique by incorporating Haar cascade classifier and CNN techniques. This technique does not play out any sub-sampling, but it optimizes over all sub-windows. This method is much accurate to detect all varied faces positioned frontal, tilted up/right/left/down and occluded faces with 99.69% accuracy. Following figure shows some samples of detected face using proposed method.

Fig 10: Sample of detected face in different pose

4) **Experimental Setup:** In this experiment we used OpenCV using Cascade model, the hardware platform is 64-bit operating system and Linux 16.4, processor 2.5 GHz, Memory 8 GB and 16 MP HD. The setup was tested in a real classroom that contains 20 students with all variation of poses. We tested the proposed face detection method and existing face detection techniques using the benchmark dataset (FDDB). This dataset contains images of human faces in multiple poses. Out of 3500 of FDDB images, Haar Cascade Classifiers technique detects the face with an accuracy of 94.71%.

VI. CONCLUSION

The Smart Attendance System using Biometric Authentication based on Real-time Face Recognition offers an efficient solution to attendance management, overcoming the limitations of traditional methods. Leveraging facial recognition technology and deep learning algorithms, the system ensures accurate identification of individuals, minimizing errors and manipulation. By integrating OpenCV and Haar Cascade Feature extraction algorithms, it achieves robust performance in detecting facial features under various conditions. With rotating HD cameras for image capturing and a training phase for face recognition, the system provides real-time attendance marking with high accuracy. Overall, it offers a reliable, user-friendly solution for attendance tracking, enhancing productivity and accountability in educational and organizational settings.

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