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Surveillance Camera using Face Recognition for Automatic Attendance Feeder and Energy Conservation in Classroom

Jayakumar Kaliappan, R. Lokesh Kumar, Narayanan Prasanth, Jain Shreyansh

Abstract*: This works gives solution to two most important problems in the universities by equipping a surveillance camera with Artificial Intelligence (AI) technology. The first problem solved is unnecessary time wastage in manual and bio-metric (fingerprint based) attendance marking for students. The second problem solved is the unnecessary electricity wastage in classrooms without occupants. Using the videos getting recorded in surveillance cameras, the number of heads detection and face recognition is done. When there is no occupants in the class, the number of heads detected will be zero. So we can cut-off the electricity supply for that classroom. With the face recognition process the attendance for the students will be get automatically marked. The Intel movidius stick does the work of face recognition and finding the head counts.

***Keywords*: Artificial Intelligence, bio-metric, face recognition, surveillance cameras, attendance.**

I. INTRODUCTION

Marking attendance for the students is an important task in class. When the attendance was taken manually by reading out the student's name it takes nearly 5 seconds for a student. When the biometric (fingerprint) attendance is used, the biometric device is passed among the students and it also takes nearly 5 seconds for a student. A lot of productive time of the class is wasted in taking attendance. This project aims at reducing the attendance taking time.

Energy conservation is mainly needed for two main reasons. First is to save money by reducing our electrical bill. Second, is to lower the stress we put on the environment by using less energy. Homes and offices were responsible for nearly 50% of greenhouse gas emissions. Energy conservation measure implementation, in home and office can significantly reduce greenhouse gas emissions contribution. Due to negligence and laziness attitude of the students, most of the time the power supply is not switched off after class hours. When any housekeeping person crosses that classroom they will switch off the glowing lights and fans.

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* Correspondence Author
Jayakumar Kaliappan , School of CSE, VIT University, Vellore, India
R. Lokesh Kumar, School of CSE, VIT University, Vellore, India
Narayanan Prasanth, School of CSE, VIT University, Vellore, India
Jain Shreyansh, School of CSE, VIT University, Vellore, India

In this work a simple survilleance camera is upgraded as a smart camera which has technologies for face detection and face recognition. The face detection will helps in identifying the number of persons sitting in a classroom through which decision of the power supply requirement for a classroom is determined. The face recognition process will help in marking the attendance for the students in a class. Human beings are able to do face recognition automatically every day and practically with no effort. But it is a complex task for the computer, it requires the support of artificial intelligence for this purpose. The images of the students registered for the particular class will be trained by the neural network. With the help of the cameras fitted in the classroom the images of the student sitting in the classroom is captured. From this group photo, using the individual student faces are detected and recognized using face recognition module present in the Neuro Movidius stick 2. Once the student faces are identified, their attendance for this session will be marked. When the system is not able to find any human faces from the image captured in the classroom, the system checks for the power supply in the classroom and set it to OFF state.

II. LITERATURE SURVEY

Guo [1] have discussed about the various types occupancy detection techniques. The first one is PIR (passive infrared) occupancy or motion detector. The two main components in PIR are pyroelectric detector and a Fresnel lens. Depending on the infrared radiations emitted by the warm human body the occupants count is found. The two main drawbacks in this method are distance issue and line of sight issue. When the distance between the sensor and the object increases the object cannot be detected. If the object movement is behind a partition the sensor is unable to detect it.

Ultrasonic sensors emit ultrasonic sound waves. The emitted ultrasonic sound waves will fall on the objects in the room and get reflected back. There is a difference in the sound waves reflected back by the static objects and moving objects. Based on this property the occupancy in the room was found.

Audible sensor or passive acoustic sensor is a failure technology. This technology works by listening to the noise in a room using audio detectors. This is error prone because it captures the sound from adjacent sources also.

Light barrier technology uses infrared waves. The infrared receiver and transmitter are installed at the left and right side of the entrance.

When the person crosses the entrance, the infrared beam signal get interrupted and hence the occupancy count is get incremented to one. The video cameras and biometric systems are found to give accurate results on the number of occupants and some systems to output the identity of the occupants.

The previously discussed methods like PIR sensor, ultrasonic sensor, audible sensor and light barrier are not able find out the number of occupants.

Yang [2] in his work had worked on the factors to improve the heating, ventilation, and air conditioning (HVAC) systems in single occupancy and multi occupancy rooms. HVAC systems are playing a crucial role in energy conservation. In this paper he had found out the various occupant sensors performance individually and also in combination. After examining all sensor variable pairs, the combination that included the CO2 and door status yielded better results with an accuracy of 93.86% and an RMSE of 0.155.

Tianjun [3] in his work had developed a novel method called multi-scales head detection (MSHD) for crowd counting. The method was tested in Mall and UCSD dataset. His work was carried out in 3 stages. They are 1.foreground segmentation. 2. Multi-scale feature extraction.3.Calculation and addition of multi-scale density maps. This method achieves Avery good accuracy rate, in addition to it it takes small memory and minimum training time.

Mrutyunjaya [4] had developed a home security system. It is a smart door which is controlled by a smart camera. Using the face recoginition algorithm the identity of the visitor is found. ZigBee protocol establishes communication between the sensor (face detection) and the control module (door lock).If the visitor is a known person door lock is released. If he is a unknown person, with the help of embedded web server page and GSM an SMS or email alert is send to the house owner,

Naveed [5] had explained about the drawbacks in using biometric based devices like fingerprint, Iris, face and hand. They have developed attendance system which captures images of students from the camera fitted in the classrooms. Then detect the faces in images and compare the detected faces with the database and mark the attendance.

III. PROPOSED SYSTEM

The system is developed to automate the attendance marking process and to stop the electricity wastage in classrooms without persons. The proposed system consists of two phases of work. In first phase the face detection and recognition and attendance marking was done. In second phase, the electricity operation process is done.

A. Phase 1:

From the surveillance camera video, the frames are separated and sent to the face detection algorithm. The human faces in the classroom is detected and their count is maintained. Then the detected faces are passed to the face recognition algorithm. If the face matches with a facial image in the facial database then the details stored in the database is retrieved. The face detection and recognition is done using Haarcascades, Triplet Loss and facenet.

1) Haarcascades:

Haarcascades classifiers are used to extract the faces from the group image of the classroom. Haarcascades are fast and provide decent accuracy, the scale factor is set according to the image. As the images to be dealt with will be captured from the same distance (more or less) an efficient value can be determined for accurate and quick extraction of faces. Haarcascades are trained on many positive and negative images and thus are pretty quick and effective in detecting faces.

2) Triplet Loss

Triplet loss minimizes the distance between images with the same identity and maximizes the distance between images with different identities. Thus inducing heavy penalty in matching unequal images.

3) Facenet

Facenet is Siamese neural network trained on millions of data, it directly learns a mapping from face images to a Euclidean space. In this space distance between two sets of data corresponds to the similarity of faces. Face recognition, verification and clustering are easy implemented once this space is produces. A deep CNN is used to directly optimize the embedding. The triplet loss function is used to train.

Intel's' Movidius Neural Compute Stick enables the quick generation of embeddings and face matching as opposed to when run on CPU.As facenet is pre trained and accurate, we do not need many images for all students. Instead of thousands efficiency of above 90% can be achieved by using 50-60(recommended) image per student.

The database have the fields like rollno or any unique identity number. The identity of the recognized faces is retrieved from the database. The attendance for that rollno for the current date and time is marked as present.

The pseudocode of the phase 1 process is given below.

4) Pseudo Code

1. Start python code
2. Read students' list and class image
3. Extract name of students from the list (regNos)
4. Extract faces from the class image (and store in "./images") (haarcascades)
5. Connect to the NCS
6. Create embeddings of the students' dataset (dataset "./dataset/<regNo>") (facenet)
7. Create embeddings of the faces extracted from class image (facenet)
8. Initiate empty list, attendace_list
9. For each face in faces
10. For each student in dataset and not in attendace_list
    a. For all embedding's of that student
    b. If matches current face, increase score of that student (facenet)

11. Check which student has highest score for the current face, s
12. Add s in attendance_list
13. Return attendance_list
14. Save the attendace_list in a text file
15. Print the name of students attending class
16. Exit

B. Phase 2:

From the count of the number of faces detected (i.e.) head count, the energy conservation process is started. If the head count is zero, then with the help of the relay switch, the power supply to the classroom is stopped.

Steps:

1. From the surveillance video, the head count is detected.
2. If the head count is zero, cut off the relay.
3. The power supply get stopped.

IV. EXPERIMENTAL RESULTS

The 9 persons found in the group photo present in the Fig. 1 is used for testing. 40 different images of each person in the group photo except the women in saree are trained by the system. Fig. 2 shows the sample of the faces extracted from the photo. From this it is identified that the head count is not zero. From the faces detected the face recognition process is initiated. In the testing phase the algorithm is able to identify all the trained images in the group photo. Once the faces are recognized, their details are retrieved and their names are stored in the text file. Fig. 3 shows the recognised face along with details of the person. Fig. 4 shows the unrecognized face which is not trained.

Fig. 1. Group Photo

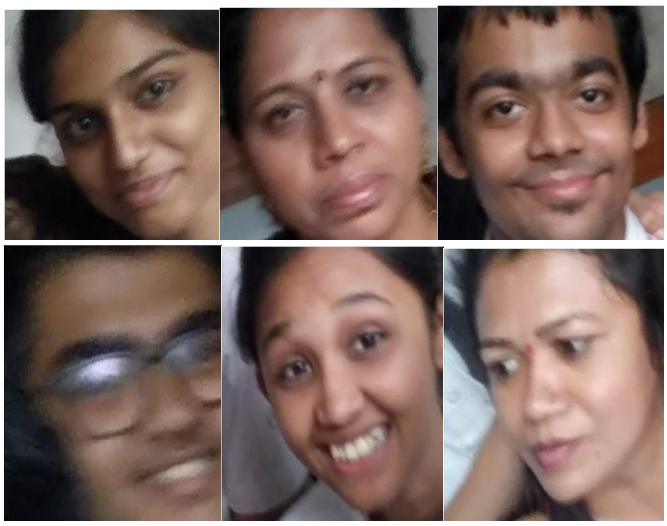

Fig. 2. Sample of Faces extracted

Fig. 3. Recognised Face (shreyansh)

Fig. 4. Unknown Face

V. CONCLUSION

Energy conservation is a very crucial work at this time to save our environment for our future generation. In large universities like VIT with huge student strength the energy conservation is a huge task, so there is a need for automatic energy conservation system, which is possible with Intel movidius stick. The productive class time can be saved with this attendance marking system. The triplet loss helps in identifying the person's image accurately. This enables facenet to give high accuracy (above 95%) by only using 128-bytes per face. With the help of NCS faster processing is obtained.

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AUTHORS PROFILE

Jayakumar Kaliappan received the B.E., degree in Computer Science and Engineering from M.K. University, India in 2002, M.E., degree in Computer Science and Engineering from Anna University, India in 2005 and Ph.D. degree in the field of Intrusion Detection Systems from Anna University, India in 2018. He is currently working as an Associate Professor at the School of Computing Science and Engineering, VIT University, Vellore, India. He has presented and published more than 20 papers in conferences and Journals. His current research interests include: Intrusion Detection Systems, Data mining and Machine Learning. He is a Life Member of ISTE.

Lokeshkumar R has 10 years of academic and one year of Industry experience. He completed his under graduation in Computer Science from Anna University Chennai by 2006 and post-graduation in Information Technology at Anna University of Technology by 2009. He is proficient in Data Structures and Algorithms, Big data Analytics. He is currently working on the field of Data Science. He published several papers in International Conferences and Reputed Journals. He is a life time member of ISTE and ACM and Senior Member in IEEE.

Dr. Narayanan Prasanth is an Associate Professor at School of Computer Science and Engineering, VIT Vellore India. He received his B.Tech IT from Pondicherry University, M.E CSE from Anna University and Ph.D CSE from M.S University Tirunelveli. His research interest includes Network Switch Scheduling, Switching architecture and SDN. He has published more than 20 papers in various conferences and journals. He is a life member of ISTE and member of CSTE.

Jain Shreyansh is studying B.Tech Computer Science and Engineering at Vellore Institute of Technology, Vellore, India. His primary interest in the area of Computer Networks, Distributed Computing and Soft computing.