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Facial recognition Systems

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Contents

Abstract

This technical report discusses the use of facial recognition technology for monitoring attendance in university lectures. Keeping track of attendance with day to day activities is a challenging and inefficient task. The conventional method of calling the name of each student is time consuming and there is always a chance of proxy attendance. The advantages of implementing facial recognition systems in order to tackle this problem will be examined, as well as the ethical problems and the fears of an Orwellian invasion of privacy coming with it. In addition, several documented cases will be used as an example to prove the inability of facial recognition systems to correctly recognize people of colour and women. The inaccurate system could misidentify a person which could lead to racial discrimination and many other problems. As a conclusion all the statements discussed will be summed up and it will be clear to the reader whether it is rational to use facial recognition at universities taking the advantages and disadvantages into account.

Introduction to Facial Recognition

Facial recognition is inevitably becoming a part of our lives. Classified as a biometric technology it uses facial features and patterns of a person in order to identify him. It artificially recognizes and stores a face, comparing it to a facial recognition database with the purpose of distinguishing the person. Facial recognition is becoming increasingly important and popular with Allied Market Research expecting its value to grow up to $9.6 billion by 2022. It is used in several different ways increasing the security in the society and making our everyday lives easier. Safety and security are some of the main benefits of Facial recognition. The technology is used widely by the police to expose criminals and find missing or kidnapped people. For example, in New York law enforcement agents were able to catch a sex offender within 24 hours after threatening a woman using facial recognition technology. In addition, businesses install such systems in their buildings and stores in order to detect blacklisted customers or individuals known to be dangerous. Airports are starting to implement facial recognition systems into their security checkpoints to provide extra protection and decrease the errors that the security personnel might make. Knowing that a person is monitored and can be recognized immediately it is less likely for him to make a crime. That is why schools are also applying facial recognition so to protect students by detecting and stopping known offenders, drug dealers or other hazardous individuals when entering the school premises. Nowadays, facial recognition is also widely utilized in order to improve our everyday lives. Smartphones are being equipped with such features for more protection and convenience. It is believed that in the future facial systems will be implemented in payments in stores. People won't need to take out and use their debit/credit cards or money, they will need to only show their face to make a payment instead. This tends to make shopping easier and faster, reducing queues and increasing sales. But the focus of this report is the usage of facial recognition in schools and universities in order to record and keep track of the attendance of students.

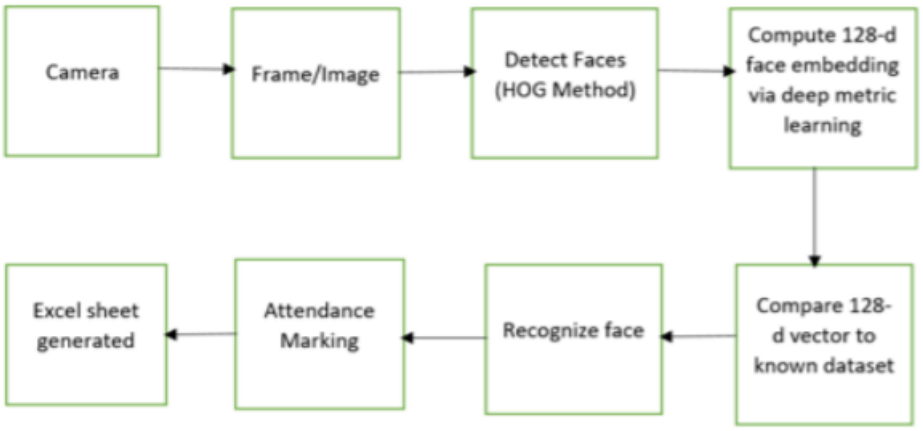
Facial recognition tracking attendance

Plenty of research has proven that the number of lectures a student has attended is closely related to the knowledge and results of particular subjects. Therefore, it is vital for schools and universities to keep attendance as high as possible in order to sustain a good student's academic performance. Every organization requires a stable and robust way of tracking the attendance of their students. Most associations use the old way of marking the attendance on a piece of paper by calling the names of the students during lecture/class hours but this is an extremely time consuming activity and could take up to 25% of the lecture time which means less time for the actual educational process. The automation of some of the teachers' daily responsibilities could lead to better performing teachers, therefore better performing students and higher results. In addition, storing the attendance digitally makes it easier for the records to be processed and calculated. The data could help the university administrators design a more suitable and comfortable academic environment improving the efficiency and scheduling of lectures. They will be able to see which classes are the most or least prevalent and modify the timetable accordingly in order to increase students' performance. Without this data universities will find it hard to organize and keep track of their lectures' popularity and students' performance. That is why attendance systems which use fingerprint, iris scanning, or smartcard scanning were introduced. But they came with their flaws, proving to be lacking accuracy. Besides, they could be misused or tricked which may lead to fake attendance. Facial recognition is believed to be a better solution with its higher accuracy and speed. It reduces the chance of proxy attendance and provides more convenience with it being a passive way of identification meaning that it does not require any action from the students and teachers themselves. The students will only need to be in the lecture hall and their attendance will be recorded automatically. They won't need to stand in queues to scan their fingers or cards.

Structure and way of processing

While the digitalization of the world is being accelerated every hour, biometric technologies like facial recognition are becoming a vital part of our lives. Biometric identification uses data taken from measurements. This data is unique and stays that way throughout the person's life. Facial recognition is done in two steps. The first one involves detection of the faces in the classroom and the second one – identification of the faces found by comparing them with an existing database. There are different variations of facial recognition. Some scan the features of the whole face, while others are feature based and use only certain parts of the human face like nose, mouth, eyebrows etc. Before any facial recognition, a dataset of the students' needs to be created which may consist of the student's name, student number, email, department and several images of the student in different poses and angles. After that, deep learning is applied to the images in order to extract the facial features and store them in a face data file. For the facial recognition process a high definition camera is positioned in the middle of the lecture room in order to cover the whole of it and is used to acquire images of the students. Then a face detection algorithm is applied in order to find the human faces in the classroom images. In most cases the HOG method is used to achieve this. After all faces have been detected, deep learning is used again so to extract their features and store them in data files. Next, these data files are compared to the ones in the database. If a file matches 60% with the existing dataset the student is marked as attending in an Excel Sheet and this is stored in another database keeping the attendance records of the students. This system basically uses an HD camera, a database and several Python scripts in order to work and is

shown in Fig. 1. Another system uses the Viola Jones algorithm instead of HOG for face detection. Then the detected face is resized to the standard format for the system and processed by linear stretch contrast enhancements. Finally, it is recognized using PCA/LDA. These are some basic approaches, but many others are also known. The main disadvantage of these systems is that the camera cannot be very far from the students in order to be accurate. This could be resolved by putting the camera at the entrance of the lecture hall, marking the students upon entering or leaving. Another drawback is that every single face should be compared to all database records in order to find a match which is time consuming and not very efficient for the system.



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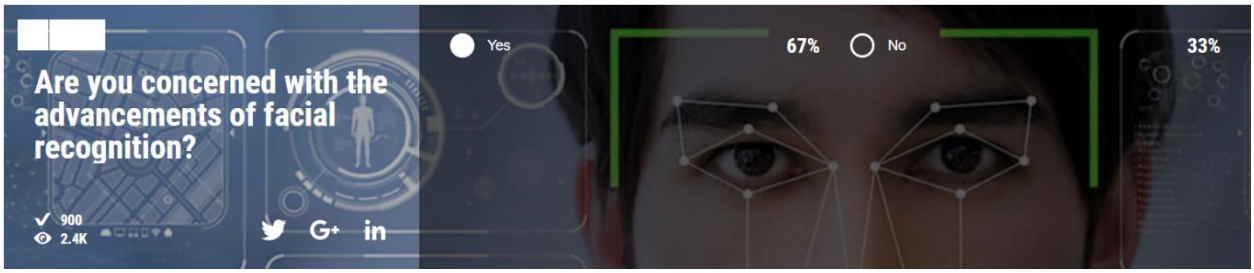
Ethical considerations

Even though, facial recognition has a huge potential it also invokes a lot of criticism regarding its legality and ethics. The technology hides a lot of risk of violating human's rights especially regarding people of colour and women. Several studies have proven that facial recognition is less accurate for people with darker skin and women. Some even report up to 35% inaccuracy when tested on dark skinned women. Evidences of facial systems being tested on children and teenagers is scant which means that more research and improvements must be done. But the risk is real and the possibility of facial recognition igniting racial discrimination against people who have faced prejudice and exclusion is big. Civil rights activists have been fighting for decades to establish equality between people of colour and white people. Now facial recognition could ruin their progress with it not being able to identify women and dark-skinned students. The system won't be able to record these people's attendance which would lead them to trouble and having to deal with the university administration and authorities. These students will have to prove their attendance in a different way and if they couldn't, they may be investigated and punished for no reason. The stress this could put on students is huge. In New York, the public Lockport City School was planning to implement facial recognition technology worth $1.4 million into their buildings for security and attendance tracking but confronted with serious concerns from officials and parents the project was stopped with the statement of being intrusive to students' privacy. The US government is considering on banning facial recognition in public places until at least 2022 until further research is convicted and the technology itself is improved. Some cities have already planned on banning real-time facial recognition use like San Francisco, Cambridge and Massachusetts. Besides the racial and gender discrimination this could cause other problems. Every person living in a free democratic country has the right of privacy and free expression and facial recognition technology is

believed to be interfering with the right of life, protected under Article 8 in the Human Rights Act. This is because facial features are personal and are threated just like fingerprints and DNA. The knowledge that students are constantly monitored during classes can make them censor themselves and discourage them from expressing their feelings and ideas. The presence of facial recognition cameras in the lecture halls could prevent students from interacting with each other and with the lecturers freely affecting students' mental wellbeing and resulting in lower academic performance. In China, Nanjing university has already installed facial recognition cameras in some of their premises for attendance tracking which caused a lot of debates and controversy worldwide. Chinese officials stated that the classrooms are public spaces and the cameras won't invade student's privacy. But is this true and how are the cameras going to affect students is still unknown. China's use of high-tech surveillance has always been controversial. The website Newsweek conducted a survey with their readers to find out the general opinion about the usage of facial recognition. More than 2400 people answered with 67% stating that they are concerned about the advancements of facial recognition and 33% stating the opposite. Another concern that bothers the public is related to security. The valuable information collected from facial recognition systems and saved to databases could be abused from the authorities and used not only to track students' attendance but also their behavior, habits routines etc. In addition, this information could be stolen from hackers and sold which would be a massive breach in privacy. Universities will have to invest in systems that are guaranteed to be secure in order to protect the students' data, but this should not come with the cost of speed and accessibility.



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Conclusion

Facial recognition technology has a huge potential and is already affecting our society. Even though it provides a new level of safety and convenience it is still a pretty new knowhow and requires more research to be convicted in order to find out how these system influence students' everyday lives. With its present flaws and inconsistent accuracy, the technology could cause more harm than just not marking attendance properly. Racial and gender discrimination are a serious and delicate subject nowadays and facial recognition could easily spark controversy. And still the main question stands: Are these systems ethical or will the society turn into a Big Brother society like in "1984" with every our step being followed and analyzed? Will people be able to express their feelings and opinions freely without being pressured from the constant monitoring? These questions are to be answered in the future.

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Images:

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