



Bias And Discrimination Are Inherent In Algorithms Used For Facial Recognition Technology In Criminal Identification: An Essential Ethical, Societal And Legal Consideration

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ABSTRACT

Facial recognition is a precise and non-intrusive method that automatically identifies and verifies individuals from digital images or video frames. This biometric technology has the potential to enhance safety and security, prevent crime, and reduce the need for human intervention. Its integration into real-time camera surveillance for criminal identification has established it as a reliable tool for strengthening public safety and as an indispensable identifier in criminal detection. Facial recognition technology [FRT] is widely used globally for authentication, authorization, verification, and identification. FRT represents a significant advancement in criminal identification by utilizing advanced image processing techniques to analyze videos or images captured by public area cameras. The technology provides agile, automated, and seamless verification, making it highly valuable in contemporary criminal investigations due to its enhanced security and expedited identification processes. However, it is essential to address the ethical, legal, societal, and security concerns associated with FRT to enhance security and protect personal rights during implementation. This paper introduces an innovative real-time criminal identification system that incorporates FRT for both face detection and recognition. It explores the ethical considerations, societal implications, and legal measures associated with its use in criminal identification.

KEYWORDS: Facial, Technology, Recognition, Criminal, Investigation

INTRODUCTION

Face recognition technology functions as a critical investigative tool for detecting and preventing criminal activity. It plays a significant role in mitigating threats to public health and safety, identifying individuals who are unable to identify themselves or are deceased, and enhancing overall security and officer safety. As a biometric technology, face recognition enables systems to make decisions by learning from previous data sets and identifying or verifying individuals from images and video frames. The increasing popularity of face recognition is largely attributed to the success of convolutional neural networks [CNNs] and deep learning

[DL] techniques. For instance, the deep face technique demonstrated strong results on the Labelled Faces in the Wild [LFW] dataset, which was trained on CNNs with over four million images. Although deep learning-based methods have shown impressive performance in recognizing still images in unconstrained environments, the development of robust facial recognition techniques for video-based applications remains an ongoing area of research.

FACIAL RECOGNITION TECHNOLOGY

Facial recognition and other biometric technologies, such as fingerprint, palm print, eye scanning, gait, voice, and signature recognition, represent the forefront of innovation and advancement. Major contributor to computer vision and machine learning, Rama Chellappa, said face recognition seeks to recognize individuals based on their facial appearances, often under challenging conditions such as varying illumination, ageing, occlusions and expressions [chellappa, R. wilson, C.L. and Sirohey, S 1995]. Ruud Bolle, an IBM research scientist in biometrics, defines face recognition technology as using a person's facial image to create a biometric template that can then be compared to others for identification or authentication. [Bolle, R.M. et al. 2008]. Josef Bigun, a specialist in pattern recognition, face recognition involves extracting features from the face and matching them to stored representations, aiming to achieve robustness to changes in pose, lighting and appearance [Bigun J.2006]. Matthew Turk and Alex Pentland's face recognition is the process of identifying an individual by analysing the characteristics of a person's face captured in an image or video, focusing on extracting key features that are distinct yet stable under various conditions [Turk, M. and Pentland, A. 1991]. Stan. Z. Li, a pioneer in face recognition research, defines face recognition as the process of automatically identifying or verifying a person from a digital image or a video frame, based on the spatial geometry of their facial features [LI, S.Z. and Jain, A.K. 2011]. Anil. K. Jain, a leading expert in biometrics, defines face recognition as a biometric method that uses distinctive features of the human face to identify or verify the identity of an individual. It involves the changes in lighting, pose and expression. [Jain, A.K., Rose, A. and Prabhakar, S, 2004].

ALGORITHM: ITS USE IN FACIAL RECOGNITION TECHNOLOGY

Algorithms encompass mathematical calculations, data processing, and automated reasoning and are extensively utilized within information technology and play a pivotal role in determining the accuracy of face recognition. It is highly recommended that organizations thoroughly assess algorithm performance before procuring a face recognition system. Regarding facial recognition, "Convolutional Neural Networks" [CNNs] are widely regarded as the most effective algorithm for identifying faces in images. These methods are widely used to extract features and effectively identify faces in images. Unlocking the potential of face recognition through the power of "Principal Component Analysis" [PCA] and "Support Vector Machine" [SVM] algorithms, utilizing Principal Component Analysis [PCA] to streamline image dimensions and accelerate calculations. Several algorithms are used for face recognition technology, such as Deep Face, Eigenfaces, Microsoft Azure Face, HAAR cascade, VGG Face, LBPH, feature extraction, face alignment algorithm, etc. The effectiveness of facial recognition algorithms hinges on addressing two critical types of errors: false positives and false negatives. Understanding these distinctions is requisite for enhancing facial recognition technology's reliability: a false positive occurs when the algorithm mistakenly identifies two images depicting the same person, which can lead to serious security threats, such as allowing unauthorized access to sensitive areas due to such misidentifications. Prioritizing the reduction of false positives is essential to ensure safety and security in various applications. Conversely, a false negative occurs when the algorithm fails to recognize that two images depict the same individual. This oversight can result in missed opportunities to identify individuals who may pose risks. We can strengthen facial recognition systems by reducing false positives and negatives, ensuring they are accurate and trusted in critical security scenarios. Focusing on two fundamental types of errors—false positives and false negatives can improve the effectiveness of facial recognition algorithms. A clear understanding of these errors is essential for enhancing facial recognition technology.

Face recognition technology utilizes several algorithms to identify and verify individuals effectively. Some of the most important algorithms and techniques in face detection include:

1. Convolutional Neural Networks [CNNs]: Convolutional neural networks [CNNs] effectively enhance image analysis by utilizing a series of specialized filters organized in layers, which allows for a thorough

examination and processing of visual data. In the first convolutional layer, filters effectively analyze small segments of the image, enabling the detection of essential features like edges and color. This foundational step sets the stage for more complex processing in subsequent layers.

2. **HAAR Cascade:** This algorithm is a cutting-edge machine learning-based object detection method and is an incredibly effective solution, particularly for face detection tasks, significantly enhancing both accuracy and efficiency in several applications.
3. **Viola-Jones Algorithm:** Essential techniques are enhancing the streamlining of face detection. This algorithm transformed facial detection technology. Paul Viola and Michael Jones developed it.
4. **Single-Shot Detector [SSD]:** This one places a grid of numerous anchor boxes on the image, which is made during the training stage. These boxes identify features of the needed objects [e.g. faces] and their position.
5. **Face Net :** An innovative strategy that effectively generates embedding to represent faces in a multi-dimensional space.
6. **Local Binary Pattern [LBP] :** is a method for filling in the texture information of face images.
7. **Scale-Invariant Feature Transform [SIFT]:** A Process formulated to detect and explain local image features invariant to scale and rotation.
8. **Speeded Up Robust Features [SURF]:** An efficient alternative to SIFT, improving speed while maintaining robustness.
9. **Eigenfaces :** A groundbreaking method for facial recognition that utilizes principal component analysis [PCA].
10. **Microsoft Azure Face:** A comprehensive enterprise business solution to enhance algorithms for detecting, recognizing, and analyzing human faces.
11. **You Only Look Once [YOLO]:** A highly efficient single-stage detector that analyses the complete image during test time, ensuring rapid and accurate results.
12. **Fisher Face:** A method that improves upon Eigenfaces by using linear discriminant analysis [LDA] to enhance the separation between different classes [face].
13. **Deep Face:** A cutting-edge system that employs deep learning techniques to achieve high accuracy in face recognition.

CRIME AND CRIMINAL : AS REFLECTION OF SOCIETY

The relationship between crime, criminals, and society is dynamic and deeply complex. Crime is a significant social and universal phenomenon that plays an evidentiary role in depicting societal dynamics. All societies have both crimes and criminals. Crime is normal because a society exempt from it is utterly impossible [Durkheim,1895]. Crime can undermine community cohesion, instill fear among residents and create significant challenges to public safety. Crimes are more effectively prevented by the certainty than the severity of punishment [Beccaria,1764]. Unequivocally, crime represents a social phenomenon that highlights the values, norms, and conflicts within a society. It is an act that is punishable by law. Marx stated 'Crime is the product of social inequality and exploitation'. It encompasses actions breaching legal standards, which can differ significantly among cultures and communities. Crime is an infraction of societal norms, and the criminal is the violator; society is both the creator of social norms and the victim of crimes. Crime is a normal response to the strain experienced when socially approved goals are denied' [Merton,1938].Without a criminal, there is no crime. The concept of criminals is multifaceted, reflecting large social values and the continue debate about justice and morality. Criminal behavior is learned in interaction with other persons in a process of communication [Sutherland, 1939]. The criminal is often driven by unconscious conflicts. Societal structures that sustain educational disparities, inequality and unemployment foster an environment where poverty thrives and also create conditions ripe for crime to flourish. Several causes, like illiteracy, poverty and inequality, can increase crime rates. Societal structures that perpetuate these issues can encourage the environments where crime can flourish. 'The situation remains normal until crime rates reach a minimum level, but when crime exceeds a certain threshold, it becomes a significant issue for society. [Lombroso, 1876] in an opinion

criminals as individuals influenced by biological and social factors, though modern criminology emphasizes social causes more. A criminal is an individual who commits an act that is legally defined as a crime and is punishable by law. [Tappan, 1947] an intentional act in violation of criminal law committed without defense or justification sanctioned by the state. Crime cannot happen without someone to commit it. Individuals absorb behaviors and attitudes primarily from their families, friends and the media. When one is consistently exposed to violence or crime within one's surroundings, it can lead to the normalization of such actions. Swift societal transformations driven by urbanization, industrialization and technological progress often shake the foundations of traditional social systems. This upheaval can foster a rise in criminal behavior. Crime and criminals are socially constructed phenomena highly influenced by socio-cultural and economical and psychological causes. Social regulation and change break social order and harmony.

CRIMINAL IDENTIFICATION: WHY IS FACIAL RECOGNITION TECHNOLOGY BEING ADOPTED

Face recognition technology [FRT] has stood out as a transformative asset in crime prevention, equipping law enforcement and security agencies with cutting-edge solutions to bolster public safety in unprecedented ways. FRT can significantly aid in crime deterrence and investigation.

1. Enhance public safety

It is important to use high-quality images and algorithms for face recognition to minimize errors and optimize workflows to quickly process and analyze facial recognition data. Share insights and intelligence to prevent and investigate crimes.

2. Enhance the surveillance method

In facial recognition systems [FRS], the surveillance method leveraging cutting-edge technologies and approaches to surveil and oversee individuals, vehicles, or areas is crucial for deterring, probing and addressing criminal behavior. It plays a significant role in advanced law enforcement and crime prevention. There are several technologies which are being used in surveillance, such as artificial intelligence [AI] and machine learning [ML], video analytics, data mining, predictive policing, geospatial analysis, cyber forensics, network analysis, radio frequency identification [RFID], sensor technology and cloud-based surveillance.

3. Right balance between surveillance and privacy

Implemented robust access controls to ensure that only authorized personnel can access facial recognition data. Create an effective risk mitigation policy to address recognized privacy concerns proactively. Moreover, prioritize compliance with key privacy regulations, such as GDPR and CCPA, to protect individual rights and foster trust.

4. Fostering equity and embracing diversity

To eliminate bias in face recognition technology, it is important to implement various strategies, such as de-biasing algorithms. Fostering diverse development teams can supply various perspectives that enhance the design process. Ensuring that face recognition models are interpretable is crucial, allowing us to understand bias and fairness issues better. Constant audits should also be conducted to verify that the technology remains fair and unbiased.

5. Streamlined detection of potential suspects

Facial recognition technology offers a fecund solution for identifying potential suspects and strengthening security measures. This technology empowers law enforcement and security teams to respond swiftly in ticklish situations by employing advanced algorithms to analyze individuals' faces. Prioritizing accuracy and processing speed improvements is vital in enhancing safety in public spaces and perpetuating a greater sense of security within communities.

6. Promoting essential public safety

Establish strong independent oversight mechanisms to ensure transparency and accountability. Leverage facial recognition technology within innovative city initiatives to significantly enhance public safety and protect communities.

7. Enhancing crime scene investigation practices

Equip investigators with advanced training in face recognition technology and leverage expert testimony to interpret results in court effectively. Integrate 3D facial reconstruction techniques to enhance investigation capabilities and ensure more accurate outcomes. It can also eliminate noise effects from images.

8. Strengthening security measures

Safeguard facial recognition data by storing it in robust, encrypted databases that ensure maximum security in criminal identification. Establish comprehensive backup and recovery procedures to protect against data loss. Utilize advanced firewalls and intrusion detection systems to block unauthorized access effectively. Adopt secure communication protocols, such as HTTPS and SFTP, to safeguard data in transit.

9. Promoting the international standard

International standards such as ISO/IEC 19794-5 [face image data interchange format standard], ISO/IEC 30107-1 [face recognition performance testing and reporting standard], ISO/IEC 30107-3 [face recognition data interchange format standard] play a crucial role in ensuring the highest quality and accuracy in face recognition technology for criminal identification. By establishing guidelines that reduce errors and minimize biases, these standards contribute to more reliable and trustworthy applications in criminal identification. International standards facilitate compliance with different national and regional regulations.

ETHICAL CONSIDERATION

Face recognition technology can infringe on individuals' right to privacy. Artificial intelligence systems and discrimination in FRT can potentially retain existing biases. They may lead to discriminatory treatment against particular groups, along with racial or ethnic groups, women and individuals with disabilities. Algorithms may perpetuate existing biases, leading to discriminatory outcomes. Lack of transparency in face recognition technology can lead to mistrust and misconceptions, making it difficult to understand how the technology arrives at its conclusions. Ensuring accountability for error or biased outcomes is essential. FRT raises concerns about accountability as it can be challenging to determine who is responsible for errors or misuse. [Miller, 2022] Facial recognition raises serious ethical concerns regarding privacy, surveillance and disproportionate harms in society.

Racial bias

Racial bias in facial recognition technology [FRT] is a concerning issue, mainly due to the inaccurate identification of individuals with darker skin tones. To elaborate on the accuracy and fairness of these systems, it is crucial to improve the diversity of racial representation within the algorithmic data. Research indicates that FRT demonstrates higher accuracy for Asian and Caucasian individuals when developed within an Asian context, highlighting the significance of inclusive practices in technology development for achieving equitable outcomes. 'Emotion analysis technology assigns more negative emotions to black men's faces than to white men's faces [Rhue, 2021]. The predominant factor leading to racially disparate results is the inadequate diversity of training images. Enhancing the effectiveness of algorithms' image selection for algorithm training is paramount. Human bias, coupled with data availability constraints, plays an important role in shaping the racial distribution of faces included in algorithm training, which frequently favor individuals with lighter skin tones. It is necessary to address these issues to promote fairness and inclusivity in algorithmic outcomes. Facial analysis technologies exhibited higher error rates for darker-skinned and female faces [Buolamarini, 2018]. For facial recognition technology to be effective and fair, engineers must prioritize diversity in the training images. This means considering racial balance, carefully evaluating the available datasets, and, when necessary, creating new datasets that emphasize racial diversity, even if it comes with additional costs. Several factors play a crucial role in shaping this landscape, including the intentional selection of facial features in earlier algorithms and the need to address image quality disparities that disproportionately affect individuals with darker skin tones. By acknowledging and addressing these issues, we can significantly enhance the effectiveness and fairness of facial recognition systems [Buolamarini, 2020]. Facial recognition systems show significantly higher error rates for darker skinned women compared to lighter skinned men. Collectively, these problems lead to facial recognition technology that performs unevenly across races, usually showing poorer accuracy for individuals with darker skin tones. The accuracy of the results is inherently linked to the quality of the data used. Therefore, striving for equal racial representation within the dataset is essential for

developing truly unbiased and reliable technology. This commitment to inclusivity will enhance outcomes' reliability and promote a more just technological landscape. Achieving diversity in publicly available image datasets can be challenging, as many tend to lack representation. For instance, the Labelled Faces in the Wild dataset, which is well-known in the field, predominantly comprises 83.5% white individuals. This presents an opportunity for researchers and developers to actively seek and create more inclusive datasets that better reflect the variety of human faces. By following this essential process, we can avoid the pitfalls of unevenly trained algorithms and build technology that works reliably for everyone.

Gender bias

Gender is a nuanced social construct that relates to how we express our anatomical sex. Gender classification in facial recognition technology [FRT] is fundamentally inconsistent among various companies due to algorithm variances. This inconsistency highlights the urgent need for more equitable and accurate technologies. This disparity is particularly concerning, as some technologies lean heavily on outdated gender stereotypes. As a result, individuals who present as feminine through makeup and attire can be misidentified as either male or female, depending on the algorithm applied. Facial recognition algorithms have typically been less accurate when applied to nonwhite people [Perkowitz, 2021]. Facial recognition technology [FRT] operates under the flawed assumption that gender can be accurately identified based solely on physical appearance. Research has demonstrated a link between short hair and how FRT classifies gender, which has significant implications. As a result, black women with afros face higher rates of misgendering and misidentification compared to their white counterparts. This discrepancy highlights the urgent need for improved approaches to ensure accurate and equitable representation in technology. Some algorithms incorporate traditionally gendered features like dress patterns and moustaches in gender identification. The second form of gender bias, much like the racial bias in facial recognition technology [FRT], emerges when the technology fails to accurately identify individuals who present as female compared to their male counterparts. Commercial gender classification systems performed best on lighter males and worst on darker females [Gebu and Buolamwini, 2018]. This flaw also leads to the misidentification of transgender individuals and those who challenge conventional gender norms outside the male-female binary. Such inaccuracies not only perpetuate discrimination but also underscore the urgent need for technology that recognizes and respects all identities. This technology's gender bias affects transgender and non-binary individuals as well as anyone who does not conform to stereotypical gender norms. Embracing a spectrum beyond the traditional binary of male and female allows for a more accurate and inclusive understanding of human identity. These disparities may be introduced unintentionally at multiple stages of designing and deploying a facial recognition system [Garvie, 2016]. Depending on the algorithm, individuals wearing makeup and dressing as stereotypically presenting females are classified as male and female. Facial recognition [FRT] cannot accurately classify self-identified gender labels such as non-binary, gender or genderqueer. While these individuals may experience lower misidentification rates than male or female identifiers, FRT ignores their self-identified genders. By restricting its classifications to only male or female, the technology not only undermines the diversity of gender identities but also reinforces the outdated notion that gender is strictly binary. This limitation highlights an urgent need for advancements in FRT to recognize and respect the full spectrum of human identities. [Gebu and Raji, 2020]. Biometric systems like facial recognition involve sensitive data significant ethical tensions and societal risks.

SOCIETAL IMPLICATION

The biases inherent in face recognition algorithms reflect wider social inequalities. When technology reinforces existing prejudices, it can perpetuate systemic disparities, particularly within law enforcement and the criminal justice system. Discrimination can manifest in various forms, from biased policing practices to the uneven impact of the justice system on specific demographic groups, thereby further entrenching these inequalities. [Johnson, 2020] said technologies like AI systems are shaped social values and structures influencing accountability privacy and surveillance in society. The application of biased face recognition technology can undermine trust between law enforcement and communities, especially among those disproportionately affected by misidentifications. This erosion of trust can significantly damage relationships, particularly in communities that feel targeted or misrepresented. By fostering a collaborative approach and actively involving affected communities, we can create solutions that enhance accountability and ensure that

technology uplifts all members of society. Using biased face recognition technology can erode trust between law enforcement and communities, particularly among those adversely affected by misidentifications. When members of these communities feel targeted or misrepresented, it can lead to a significant breakdown of trust. If marginalized communities feel targeted or unfairly treated, it can lead to fear, resentment and disengagement from law enforcement. Algorithmic bias in facial recognition reflects broader social and data inequalities [Raji, 2019]. This distrust can hinder effective policing and community cooperation. Examine how face recognition technology impacts different genders in the context of criminal identification. Studies could focus on how societal perceptions of crime and victimhood intersect with gender roles and how these perceptions change with the advent of new technologies. Analyze how face recognition is portrayed in the media and its influence on public opinion regarding crime and security. This includes looking at sensationalized reporting of crimes that involve facial recognition outcomes and their effects on societal fears and attitudes toward crime.

LEGAL STEPS

Facial recognition technology provides several inherent benefits. While technology has significant potential, implementing facial recognition technologies raises numerous legal, policy and regulatory issues. Addressing these challenges thoughtfully can help us leverage the benefits of this technology while ensuring compliance and safeguarding individual rights. Automated facial recognition is a technological advancement that systematically captures individual facial features and contours. This process facilitates the development of a database intended for potential comparative analysis in the future. Such technology presents significant applications in security and identification, offering opportunities for enhanced accuracy and efficiency in various sectors. Facial recognition technology provides numerous valuable advantages that can greatly enhance security and efficiency in various applications. The direct implementation of automated facial recognition technologies has not been recognized by law in India. Therefore, it is essential to establish detailed legal frameworks enacted by the Parliament of India that authorize the implementation and maintenance of these technologies. Currently, there is no specific law in India that permits the deployment of such technologies. Implementing automated facial recognition technologies holds significant potential for enhancing security and efficiency in various sectors across India. However, to unlock this potential, we urgently need comprehensive legal frameworks established by the Parliament of India that authorize and regulate these technologies. Creating clear regulations ensures these technologies are used responsibly, addressing public concerns while fostering innovation and progress. It is essential to consider this issue carefully to ensure that such technology's implementation respects and upholds the privacy rights of individuals while still pursuing its valuable applications. Facial recognition technology tends to infringe upon individuals' fundamental right to privacy, as established under Article 21 of the Constitution of India. Addressing this issue is crucial for fostering public trust and ensuring that the implementation of such technology aligns with ethical standards and the protection of personal freedoms. By proactively developing comprehensive guidelines and safeguards, we can effectively leverage this technology while protecting personal privacy rights and fostering public confidence.

CONCLUSION

In conclusion, bias and discrimination are complex and deeply ingrained issues in criminal identification using face recognition technology, which is a complicated and rapidly evolving field with significant benefits and challenges. The government should establish regulatory frameworks to govern the use of face recognition technology, ensuring transparency, accountability and privacy protections. Public education and awareness campaigns can help individuals understand the benefits and risks of face recognition technology and promote informed debate. Face recognition technology should be continuously evaluated and monitored to ensure its effectiveness, fairness and transparency.

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