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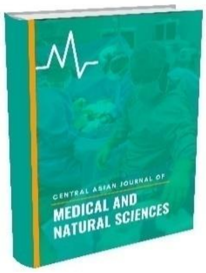

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Principal Component Analysis for ATM Facial Recognition Security

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Abstract: The Automated Teller Machine, also known as an ATM, has become the most common method by which individuals withdraw cash for their own use. The transactions that people conduct through the ATM ought to be protected, and the particulars ought to be kept private. Facial recognition will be used as the method of user authentication in this project so that Automated Teller Machine (ATM) transactions will be protected from fraudulent activities. The image of the account holder's face, as well as the faces of any beneficiaries, must be taken in well-lit conditions and then saved on a central server for face recognition to work. A camera is positioned within the automated teller machine (ATM) in such a way that it can take a picture of the person who is currently using it. After comparing the face of the cardholder to the account holder and beneficiaries, the system moves on to the PIN Validation step after recognising the cardholder's identity

Key words: Human Face Recognition, Automated Teller Machine, Principal Component Analysis, Eigenvalue, Eigen's face.

Introduction

When applied to the computer vision problem of human face recognition, a set of eigenvectors is called "eigenfaces." Sirovich and Kirby (1987) created the Eigenfaces method for recognition, which has been used by Matthew Turk and Alex Pentland for face classification [1]. The high-dimensional face image vector space is used to calculate the covariance matrix, from which the eigenvectors are calculated. The Eigenfaces provide a fundamental group of images from which to generate the covariance matrix [2-7]. This decreases the number of dimensions needed to represent the original training images, as the smaller set of basis images can do so. Comparisons of how different faces are represented in the basis set allow for classification. The process of facial recognition divides the data from images into distinct categories (persons) [8-15]. Although the input images are not completely random, they do have significant variation due to factors such as lighting and pose. All input signals share common characteristics despite their unique characteristics. Examples of universal patterns that can be observed in any signal include the presence of specific anatomical features (eyes, nose, mouth) in any given face and the distances between them [16-21]. Eigenfaces are the technical term for these distinguishing characteristics in the field of facial recognition (or principal components generally). Principal Component Analysis is a mathematical method for obtaining them from raw image data (PCA) [22-26].

Using principal component analysis (PCA), each image in the training set can be converted into an eigenface. By summing up the eigenfaces, PCA allows for the reconstruction of any image in the training set [27-31]. Keep in mind that eigenfaces are simply distinctive features of the faces. Therefore, the original face image can be reconstructed from eigenfaces by summing all the eigenfaces (features) together in the correct proportion. Some features of the face may or may not be present in the original image, but those features are all that are represented by each eigenface [32-37].

The proportion of an Eigen face's contribution to the "sum" of the Eigenfaces should increase if the corresponding feature is more pronounced in the original image. If the opposite is true, then that detail was likely added later and is not visible in the original image. A smaller (or null) contribution from the corresponding eigenface to the total number of eigenfaces is desired [38-41]. Therefore, a weighted sum of all eigenfaces must be constructed in order to reconstruct the original image from the Eigenfaces. Each eigenface contributes a certain amount to the final reconstructed image. The value of this weight indicates how prevalent the individual feature (eigenface) was in the base image [42-49]. Reconstructing the original images from the eigenfaces alone is possible if all the eigenfaces are used. However, a subset of the eigenfaces can be used instead. If this is the case, the reconstructed image will be close to the original. However, by leaving out certain eigenfaces, one can guarantee that losses are kept to a minimum [50]. To achieve this, we prioritise only the most essential characteristics (eigenfaces). Since computational resources are limited, eigenfaces must be ignored [51-57].

What does this have to do with biometrics? The fact that you can do both face extraction and eigenface extraction from a given set of weights is a hint [58-63]. The opposite approach would be to derive the weights from the eigenfaces and the target face. These values tell us exactly how dissimilar the target face is to the "typical" faces reflected by the eigenfaces, and nothing else. As a result, with these numbers, we can learn two very significant things [64-69].

Check to see if there is a face in the image. If the image's weights are drastically different from the weights of known face images, then it is unlikely to be a face [70-75]. Images of faces that are similar to one another share certain characteristics (eigenfaces) to a high degree (weights). Images can be organised into clusters using extracted weights from all available images. Similar faces are more likely to appear in all images with similar weights. Python, developed by Guido van Rossum and first released in 1991, is a popular high-level programming language used for a wide variety of purposes [76-81]. Python is an interpreted language with a design philosophy that prioritises code readability (most notably, it makes use of whitespace indentation to delimit code blocks rather than curly braces or keywords) and a syntax that enables programmers to express concepts in fewer lines of code than is possible in languages like C++ or Java. The language's features are meant to facilitate the creation of comprehensible programmes of varying sizes [82-87].

Review of Literature

Python is a flexible programming language that can be used for a wide range of projects due to its dynamic type system and built-in support for automatic memory management and programming styles like OOP, FP, and procedural code. It comes with a large and complete set of industry-standard books [88-101]. Python is a multi-paradigm language, meaning that it supports more than one style of programming. Object-oriented programming and structured programming are both fully supported, and the language also offers extensive support for aspect-oriented programming [102-109]. Extensions allow for the use of many different paradigms, such as design by contract and logic programming. Python's memory management is based on dynamic typing, reference counting, and a garbage collector that can detect cycles [110-115]. Python's dynamic name resolution (late binding) is a powerful feature that binds the names of methods and variables as the programme runs [116].

Python does away with the need for curly braces and keywords in favour of indentation to separate code blocks. After certain statements, the indentation level rises; when it falls, the current block ends. This aspect is also known as the "off-side rule" in some contexts [117-119].

The equals sign (token '=') in an assignment statement. This fundamental mechanism (including the nature of Python's version of variables) sheds light on a wide range of other language features and operates differently than in conventional imperative programming languages. To assign a value to a variable in C, as in x = 2, means to store the value 2 in the variable with the name x [120-127]. The right-hand value is copied into the memory location whose name is represented by the left-hand variable. The size of the variable's allocated memory is appropriate for the declared type. Using the same example, the simplest form of assignment in Python is x = 2, which means "(generic) name x receives a reference to a separate, dynamically allocated object of numeric (int) type with value 2." We connect the name to the thing by doing this [128-133]. It is incorrect to refer to the storage location by its name, since it does not contain the specified value. In the future, names can refer to anything from strings to procedures to complex objects with data and methods, and everything in between [135-138].

Because statements cannot be included in expressions, expressions such as lists, other comprehensions, and lambda expressions cannot contain statements [139-143]. The conditional expression of a conditional statement cannot contain an assignment statement like a = 1, as an example. As a result, you won't make the common C mistake of confusing the assignment operator = with the equality operator == in a condition. While the C code if (c = 1) ... is valid syntax (albeit unintentional), the Python code if (c = 1):... is not [144-149].

Methodology

The syntax instance.method(argument) is syntactic sugar for Class.method, which refers to a function that is attached to an object's class (instance, argument). In contrast to other object-oriented languages (e.g., C++, Java, Objective-C, or Ruby), Python's methods use an explicit self parameter to access instance data. One of Python's many strengths is its extensive standard library, which includes a wide variety of useful tools. This is on purpose, and is part of Python's "batteries included" philosophy. Internet-facing applications can use a wide variety of common file formats and communication protocols (like MIME and HTTP) [150-157]. Modules for GUI design, database connectivity, random number generation, floating-point arithmetic, regular expression manipulation, and unit testing are all provided. As of November 2016, over 92,000 packages offering a wide range of functionality were available from the Python Package Index, the official repository containing third-party software for

Python [158-167]. If the terminal in question is linked to the main database, then the online PIN will be verified. In banks, the customer's PIN is checked against both the reference PIN and the customer's own PIN. One drawback is that if the network goes down, the ATM can't be used until the problem is fixed [168-171].

Result

The ATM is not linked to a centralised database in off-line PIN validation. Off-line PIN validation necessitates that the ATM be able to check the entered PIN against a stored reference PIN. The terminal needs cryptographic processing power and access to appropriate encryption keys. The off-line verification method is painfully sluggish and ineffective. Since ATMs can now connect to a central server via secure wireless networks, offline PIN validation is no longer necessary [172-177].

In order to carry out a high-security interchange transaction, one of three PIN procedures must be followed. A secret cryptographic key is used to encrypt the supplied PIN at the entry terminal. The PIN, along with other transaction details, is sent to the acquirer's system in an encrypted format. From there, the acquirer's system sends the encrypted PIN to the HSM [178-181].

The secret number is revealed there. When an interchange cryptographic key is decrypted, it is immediately re-encrypted and sent to the issuer's system via the usual channels of communication. Finally, the routed PIN is validated using online local PIN validation techniques after being decrypted in the issuer's security module [182-185].

Message authentication, also known as "ZONE ENCRYPTION," is one of several transaction methods used in shared ATMs for PIN encipherment. In this system, a reliable third party is designated to act on behalf of a consortium of financial institutions to facilitate the exchange of messages regarding the approval of ATM payments [186-191].

Maintaining secure connections between financial institutions and ATMs requires a cryptographic module, also known as a security module. The safety component was built to withstand attempts at modification. Multiple tasks, including PIN verification, PIN translation during exchange, Key management, and message authentication, are handled by the security module. Since the security module can convert PINs to the interchangeable format, their use raises security concerns. Additionally, the security module creates, stores, and guards all user network keys [192-196] .

User-provided personal verification information is the first step in the personal verification process. A personal identification number (PIN) and the customer's banking details are stored in this manner. Skimming is a form of credit card theft in which criminals use a miniature device to steal card details during a seemingly legitimate credit or debit card transaction [197-199].

A skimmer is a device that records information from the magnetic strip of a credit or debit card as the card is swiped through it. Online or with fake credit cards, thieves use the stolen information to make unauthorised purchases.

Some employees in retail and dining establishments who regularly handle credit cards are occasionally recruited to join a skimming ring. During a routine transaction, these employees will use a portable device to steal your credit card information. For instance, we commonly use credit cards to pay the bill at restaurants. The waiter takes our credit cards and walks away, providing a dishonest waiter with a perfect opportunity to steal our money using a credit card skimmer.

The information can then be used to make fraudulent purchases in person using a cloned credit card, online using the victim's account, or resold online.

Bank robbery that involves the systematic theft of money from ATMs is called an ATM looting. The criminals conduct their plunder by using identity theft to fabricate counterfeit debit cards using the banking information of unsuspecting victims.

Discussion and Finding

We propose a solution to the aforementioned security issues. We have improved the safety and reliability of ATM withdrawals by adding a new layer of protection. Each bank account holder must have a valid e-mail id on file with the institution for our proposed system to work. In addition, multiple, well-lit photographs of the account holder's face are taken for processing purposes. In addition, the area around the ATM should be well-lit to facilitate quick and precise facial recognition. Our solution uses facial recognition technology to make using ATMs safer. The credit/debit card can only be used by the legitimate account holder. Those who choose to use this feature will have their accounts protected in a manner similar to online banking, but it is entirely voluntary.

The account holder's face is all that's needed for facial recognition. At the bank's location, the image is captured for the first time from a number of different perspectives by bank officials. Some processing is applied to these captured images in order to extract facial features that can then be used for recognition. The finalised picture is kept in a data warehouse. If the user has enabled this function, the recognizer software will receive a live feed from the ATM's camera following a card swipe. Facial features will be extracted from the live feed after being detected by the recognizer. The facial features are extracted and compared to previously extracted and stored facial features. If the facial features don't match, the transaction is flagged as a "Unauthorized transaction" and denied. Otherwise, the transaction will be treated as "Authorized" and processed accordingly. After the card is swiped, the PIN is entered.

When a customer opens an account with a specific bank, the primary process on the bank's end is the face registering process. The customer's face is photographed by the bank at a well-lit location and then used to determine who is permitted to use the account's ATM card. The eigenfaces are generated from the processed face scan. The captured image of the person is processed through dimension reduction to convert it from 2 Dimensional images to 1 Dimensional, thereby reducing the image size while maintaining the important characteristics used in the process. The Converted Eigenfaces are linked to the user's account in the central database, where they will be available for use in subsequent server operations. When a customer uses an ATM to withdraw money from their account, this action is taken. Here, the ATM's built-in cameras are used for face recognition in real time. The ATM will detect and record a live image of the user as soon as they approach the machine.

To decrease the file size of the live image captured by the ATM, its dimensions will be converted to eigenvalues. This eigenface will be used to find a matching photo in the database. The live ATM image will be transformed into an eigenface through this procedure. The converted value will be compared to the person's preexisting eigenface value in the database. In this procedure, PCA is used. Face values will be matched using principal component analysis.

If the card is used without the customer's permission and the PIN is attempted, a photo of the cardholder will be sent to the account holder via e-mail. Even though it's not a security boost, this will make sure that all transactions are recorded. The account holder can now visualise the fraudster in the event of fraudulent activity. It's also convenient in the event of a police report, as officers won't have to waste time waiting for the bank to release the relevant surveillance footage. The account holder's photo provides the police with a starting point for their investigation.

Facial recognition for ATMs with an e-mailing feature was implemented in this project as a novel approach to strengthening ATM security. Our new system offers a secure cash machine. This makes it possible to put a stop to fraudulent activities. We can take our work in a number of exciting new directions. Improved machine learning algorithms can process captured images of processes and store them in a central server for future recognition, speeding up and improving the accuracy of the recognition process. This allows for precision even in dim conditions.

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Conclusion

When a customer uses an ATM to withdraw money from their account, this action is taken. Here, the ATM's built-in cameras are used for face recognition in real time. The ATM will detect and record a live image of the user as soon as they approach the machine. To decrease the file size of the live image captured by the ATM, its dimensions will be converted to eigenvalues. This eigenface will be used to find a matching photo in the database. The live ATM image will be transformed into an eigenface through this procedure. The converted value will be compared to the person's preexisting eigenface value in the database. In this procedure, PCA is used. If both the live and stored images have the same eigenface values, PCA can be used to match the face values. After that, they'll be able to withdraw cash from an ATM. The captured image and the user's E-Mail address will be sent to a blacklist if the user tries to access the system.

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