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Touchless ATM Using Augmented Reality Using TOTP Haar Cascade Algorithm

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Abstract: ***Touchless ATMs, a new technology, offer a contact-free, hygienic, and convenient financial transaction experience. This innovative solution uses Augmented Reality (AR), Time-based One-Time Passwords (TOTP), and the HAAR Cascade Algorithm to create an interactive virtual interface, reducing physical contact and enhancing transaction security. The system uses a dual-layered authentication mechanism, utilizing facial recognition and time-based, one-time passwords (TOTP) to validate user identities and generate dynamic, session-specific codes. Financial institutions can deploy this system to upgrade their ATM networks, catering to diverse user demographics. Challenges include developing robust gesture recognition models, ensuring low latency in AR interactions, and integrating these advanced technologies into existing ATM infrastructures. However, advances in hardware and software, coupled with the decreasing cost of AR and machine learning technologies, make this solution viable and scalable.***

Keywords: Touchless ATM, Augmented Reality (AR), Time-based One-Time Password (TOTP), HAAR Cascade Algorithm, Facial recognition, Secure Authentication.

I. INTRODUCTION

Touchless technology has completely changed a number of sectors, including banking, where user experience and automation are essential. The idea of a touchless ATM redefines how consumers interact with ATMs by combining cutting-edge technology like the HAAR Cascade Algorithm, time-based one-time passwords (TOTP), and augmented reality (AR). This cutting-edge solution addresses contemporary issues in financial transactions by enhancing security and sanitation and offering a more user-friendly interface. ATMs have historically required physical contact with keypads, screens, or cards, which raises the possibility of fraudulent activities like skimming or unauthorized access in addition to posing hygienic concerns. By using augmented reality (AR) to show a virtual interface, a touchless ATM removes the requirement for physical contact and enables users to interact with the system via gestures or mobile devices. This method guarantees a clean and easy-to-use transaction process. The touchless ATM has cutting-edge technologies to handle security, which is a top priority in banking systems. The first layer of security uses the HAAR Cascade Algorithm for facial recognition, verifying individuals by identifying their unique facial traits. This technique lowers the possibility of theft or duplication by replacing conventional PINs or cards. In order to provide safe, session-specific authentication, the second layer uses TOTP (Time-based One-Time Password), which creates a distinct, time-sensitive code for every transaction.

Additionally, the system integrates machine learning-powered real-time object detection, which allows precise gesture recognition for smooth virtual interface interaction. Because of this integration, touchless ATMs can accommodate a wide range of user behaviors while remaining extremely accurate and responsive. In addition to improving transaction security, touchless ATMs are in line with the global trend toward contact-free and hygienic solutions, particularly in the wake of health emergencies like the COVID-19 epidemic. Additionally, the integration of AR and machine learning technologies guarantees scalability and adaptability, paving the way for widespread deployment across banking networks.

The touchless ATM, The integration of augmented reality with TOTP and the HAAR Cascade Algorithm represents a significant breakthrough in the development of banking systems. This solution provides a glimpse into the future of financial services by addressing the pressing needs for security, convenience, and hygiene through the integration of cutting-edge technologies with practical applications.

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II. LITERATURE REVIEW

Augmented Reality in Interactive Systems: Augmented reality (AR) is being used by many to create dynamic and captivating user interfaces. According to studies, augmented reality (AR) can enhance user experience by overlaying virtual features on the physical world [1]. The use of AR in banking is still mainly unexplored, despite studies by Azuma et al. (1997) highlighting its use in a variety of industries, including retail, healthcare, and education. AR's usability and effectiveness in providing a seamless, touch-free experience are demonstrated by current implementations in payment systems, such as virtual retail assistants and contactless menus in restaurants.

Time-based One-Time Password (TOTP) for Secure Authentication: Static PINs have given way to dynamic, time-sensitive alternatives like TOTP as authentication methods in financial

transactions. The HMAC-based One-Time Password (HOTP) technique served as the foundation for TOTP, which offers a secure, session-specific authentication code that dramatically lowers the danger of replay attacks and credential theft [2]. According to research by O'Gorman (2003), TOTP is a dependable part of the suggested touchless ATM system since it increases the robustness of transaction systems by thwarting unwanted access.

HAAR Cascade Algorithm for Facial Recognition: In contemporary systems, facial recognition is an essential biometric security feature [3]. Viola and Jones (2001) presented the HAAR Cascade Algorithm, a machine learning method for object recognition in real time. It is a popular option for facial recognition systems, including surveillance and authentication applications, because of its ease of use and effectiveness. Recent research highlights how well the system recognizes facial features in spite of changes in illumination and viewpoints, which qualifies it for touchless ATM user authentication.

Gesture Recognition in AR Systems: Touchless interfaces now require gesture recognition in order to provide user-friendly interaction with digital systems. Researchers have used Convolutional neural networks (CNNs) and other machine learning models to enhance the precision of gesture recognition [4]. Research by Pavlovic et al. (1997) highlights the difficulties of real-time gesture identification, such as user variability and ambient noise. An intuitive and clean substitute for physical touchscreen contact is the integration of gesture detection into AR-based banking systems.

Hygienic and Contact-Free Solutions in Banking: The COVID-19 epidemic underscored the need for sanitary banking solutions [5]. According to studies by Gupta et al. (2020), user convenience and hygiene are the main factors driving the increasing use of contactless payment technologies. While existing systems, like mobile banking apps and cardless ATMs, only provide partial solutions, combining augmented reality with biometric authentication offers a full strategy for improving security and cleanliness.

It addresses the crucial optimization issue in modern ATM networks [6]. ATM cash management guarantees sufficient amount of cash at all times. Too little currency can cause ATMs to run out, causing user dissatisfaction, while too much can hamper storage, replenishment, and usage. The study aims to lower cash replenishment and keeping costs.The optimisation step comprises routing ATM cash replenishment vehicles. Our goal is to discover the most efficient routes for these trucks to save transportation costs (fuel and time) and ensure cash availability at ATMs [7]. "Secure Authentication for ATM Transactions Using NFC Technology," examines how NFC technology might improve ATM security and convenience. The paper evaluates viability and potential. They tried to make ATM transactions using Transaction through NFC but NFC Technology is not In every smartphone.

Advanced ATM System Using Iris Scanner introduces an iris scanning-based ATM authentication method to boost security [8]. Identification and fraud prevention employ human iris patterns. High precision and reliability due to the human iris' unique and stable nature. PIN and card vulnerabilities were removed for security. Iris scanners are added to ATM hardware and software in the suggested system. PIN entry is replaced by iris-based authentication for increased security.

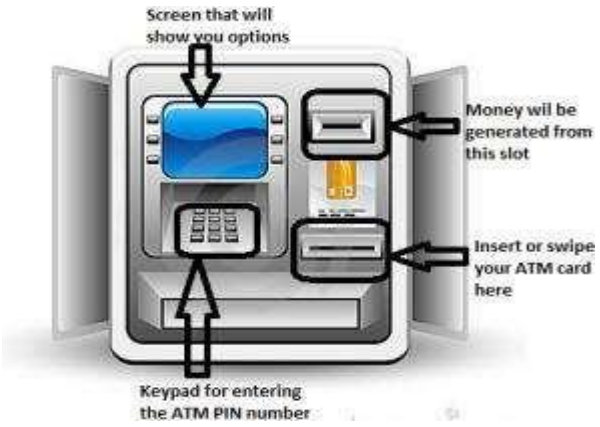
One Touch Multi-Banking Transaction ATM System Using Biometric and GSM Authentication [9] by Apurva Taralekar, Rutuja Tangade, Gopal Singh Chouhan, and Nikhilkumar Shardoor presents multi-banking automated teller machine (ATM) systems [10]. The system incorporates biometric authentication and verification based on GSM technology, enabling the streamlining and protection of transactions across numerous banking accounts [11].

Finger shield or biometric based ATM is the advanced level which has been developed by introducing definitely additional security, which is the fingerprint in its system [12]. By adding finger print authentication, ATM can be skimming and PIN incomplete [13]. Though it mayoffer the additional authentication there is possibility of accessing the ATM with false or duplicated finger prints. And also this existing model requires physicaltouchon the machine which is not suit for the someof the critical situations like this covid period. To overcome these limitations we have proposed a touchless ATM based on the Augmented Reality [14].

III. TOUCHLESS ATM USING AUGMENTED REALITY

A. Touchless ATM

By eliminating the need for users to make physical contact with the ATM while doing transactions, resolving concerns about hygiene, and improving user convenience, touchless ATMs are revolutionizing the traditional ATM experience. Touchless automated teller machines (ATMs) provide a banking solution that is safe, effective, and user-friendly. Technological breakthroughs like augmented reality (AR), time-based one-time passwords (TOTP), and HAAR cascade algorithms enable these ATMs. In light of the fact that public health goals are shifting toward reducing the number of physical interactions that take place in shared areas, the COVID-19 pandemic has further highlighted the necessity of such systems.



[Fig.1: Current ATM Machine]

Authentication via the Contactless Method: For the purpose of identifying users without the need for physical

input, biometric facial recognition uses algorithms such as HAAR Cascade. We use Time- Based One-Time Passwords (TOTP) to enhance the security of financial transactions. A User Interface for Augmented Reality: Virtual keyboards can be projected onto the user's device or an interactive surface. Gesture-based controls enable users to navigate and perform transactions. Transactions That Are Hygienic: The absence of physical contact significantly reduces the risk of transferring infections. NFC, QR codes, or mobile applications can facilitate contactless communication for authentication and cash withdrawal. Stronger Safety Measures: The use of biometrics, one-time passwords, and device-based verification are all components of multi-factor authentication. Artificial intelligence-powered anti-fraud systems monitor suspicious activities.

B. Augmented Reality

A technique called "augmented reality" (AR) superimposes digital sights, sounds, and data over the real world. This technology improves user perception. Augmented reality (AR) delivers interactive, contextual experiences by incorporating virtual elements into real-world situations, unlike virtual reality (VR), which immerses viewers in a digital world. AR systems require hardware and software to work: Cameras and sensors capture reality. Explore sensor data and execute augmented reality apps on CPUs. Smartphones, tablets, smart glasses, and heads-up displays bring augmented reality to life. Augmented reality software interprets and anchors digital stuff to the physical world. Apple's ARKit, Google's ARCore, and Vuforia make augmented reality app development easier.SLAM maps the environment and tracks the user. 3D rendering creates realistic virtual objects that blend into the actual world.

C. TOTP Haar Cascade Algorithm

TOTP algorithm (Time-based One-Time Password) Working Process: A User wants to log into TOTP 2FA protected app or website. To run OTP authentication, the user and server TOTP need to share a static parameter (secret key) by default. When the customer logs into the secured website, he must confirm that he has the secret key. So their TOTP token combines the start and current time step and creates a HASH value by running a predefined function HASH. This value is basically the OTP token that the user sees on the token. Since the secret key, function HASH, and time step are the same for both ends, the server performs the same computation as user creator OTP.

TOTP = Truncate (HMAC (Key, Time))

Where:

HMAC: Hash-based Message Authentication Code.

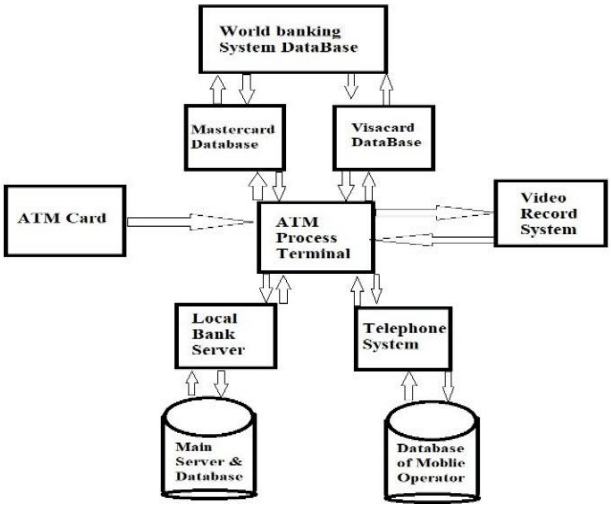
Key: Shared secret key.

Time: Current time in seconds divided by the interval (e.g., 30 seconds).

Truncate: Function to convert the hash into a short numeric OTP.

Working Process of TOTP HAAR Cascade Algorithm

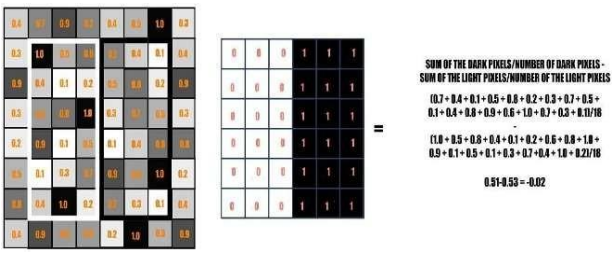
```
key = base64.b32decode(secret, casefold=True)
time_step = int(time.time() // interval)
time_bytes = time_step.to_bytes(8, 'big')
hash_algorithm = {
'SHA1': hashlib.sha1,'SHA256': hashlib.sha256,
'SHA512':hashlib.sha512
}.get(algorithm, hashlib.sha1)
hmac_hash = hmac.new(key, time_bytes,
hash_algorithm).digest()
offset = hmac_hash[-1] & 0x0F
   truncated_hash = hmac_hash[offset:offset + 4]
   code = int.from_bytes(truncated_hash, 'big') &
0x7FFFFFFF
otp = code % (10 ** digits)
   return str(otp).zfill(digits)
```



[Fig.2: Touchless ATM Using Augmented Reality]

D. HAAR Cascade (Object Detection Algorithm)

It find faces in an image or a real detection appearance. The principle is given a lot of positive images consisting of faces real time video. The algorithm uses edge or line. The simplicity, efficiency, and accuracy of this method revolutionized real-time object detection, especially face and object detection in photos and videos. It remains essential in computer vision, especially for rapid, lightweight jobs.



[Fig.3: Line Detector]

The rectangle on the left is a sample personification of an image with pixel values of 0.0 to 1.0. The rectangle in the mid is a haar core that comprise all the radiant pixels on the left and all the dark pixels on the right. Haar is estimated by getting the difference in average pixel values in the darkest region and average pixel values in the lightest region. If the change is close to 1 then there is an bound found by the haar feature.

Vforia Cloud - Vuforia Cloud Recognition Service is an business-level photo detection solution that allows

developers to host and conduct photo targets online. Usage is determined by the total number of photo appreciation, or "recos," per month that your application enforce, and is estimated when the target matches. Vuforia Cloud Recognition Service is flawlessly suitable for practice that use many goals or purpose that need to be updated frequently. Customers using the service can take advantage of the following benefits:

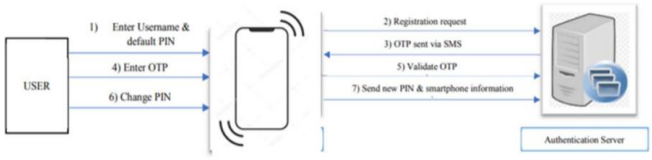
- Greater than 1 million goals can be used in the applications.
- Flexibility: assimilation with actual content administration entity.

```
void Enter()

{
 List<int>inputCode = new List<int>() {1,2,3,4};
if(index == inputCode.Count)
{ boolisCorrect = true;
for (inti = 0; i<inputCode.Count; i++)
  {
if(cod[i]!= inputCode[i])
{ isCorrect = false; break;
    }
}
if(isCorrect)
 {
text.GetComponent<Text>().text = textCorrect;
  }
```

Image Target Recoginition

Image targets are the images that Vuforia Engine can detect and track. The engine detects and tracks the image by comparing natural features extracted from the camera image with a known target source database. Once the target of the image is detected, Vuforia engine will track the image and increase your content smoothly using the best image tracking technologies on the market.



[Fig.4: Block Diagram of ATM Transaction Using Augment Reality]

IV. RESULT

Because their authentication has been compromised, a person has a great deal of ability to use these technologies. The ATM uses the user's provided PIN number in addition to their ATM card to identify them. Despite the fact that the issue necessitates a simpler procedure compared to the original one, it still needs to be addressed. A valid ATM card must be entered in the ĐTM group by one person; the other is the number pinning, which must be supplied via the widget. Consequently, we split security into two distinct categories. Instead, we implement an Android application that is developed on the Android study platform that can access the ATM keypad.

Table 1: Transaction Table

Issues	Problem Occurred
Traped ATM Card	0
Cannot Dispense Cash	456
Delayed Cash	32
Over Billing	54

A. Comparision With Existing System

An ATM card is necessary to withdraw cash from a traditional ATM. Third parties can occasionally misplace or damage ATM cards, preventing us from using them for cash withdrawals. Existing techniques used biometric-based access to withdraw funds, which required the user's proper authentication using the Enhanced Reliability Technology. When the user has to withdraw some cash, they may simply access their nearby ATM and withdraw the cash using the augmented reality app that recognizes the ATM and generates a virtual key for effortless accessing and withdrawal. Here as we can observe the table out of 10000 transactions 744 were unsuccessful.

Table 2: Existing Transaction Table

Issues	Problem Occurred
TrapedATM Card	34
Cannot Dispense Cash	592
Delayed Cash	46
Over Billing	72

In the proposed system the total number of unsuccessful transactions are 542 out of 10000 transactions. As by recorded data we observe that the efficiency of ATM currently used is 92.56 % which means that every 8 transactions out of 100 are unsuccessful.

In the model proposed efficiency of ATM is 94.58 % which means that only 5 transactions were unsuccessful out of 100, hence using this model our efficiency will be increased and also the risk of corona virus spread will be 0 % as there will be no touch of ATM machines.

V. CONCLUSION

Traditional ATMs, albeit vital for banking, have many flaws that reduce efficiency and user experience. Overbilling, late transactions, missing ATM cards, and cash distribution issues negatively impact the reliability of the system. Although biometric access boosts security, it also causes accessibility, installation, and hygiene difficulties. The suggested touchless ATM system employing augmented reality (AR) and time-based one-time password (TOTP) overcomes these difficulties by providing a safe, card-free, and sanitary way to withdraw cash. AR technology lets users interact with the ATM interface digitally without touching it, simplifying fund withdrawals. This strategy improves transaction success rates, reducing trapped cards, cash dispensation delays, and other operational issues. The proposed approach improves ATM technology by using TOTP authentication and eliminating ATM cards. Current system statistics show it is more dependable, accessible, and simple to use than traditional banking, with fewer transaction failures. AR and

TOTP for ATM transactions could change automated banking by boosting security, efficacy, and usability. After the pandemic, adopting this modern technology could boost consumer pleasure, banking security, and hygiene.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

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