Biometric-Based Patient Health Care System Using Machine Learning

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Abstract- Accurate identification of patients is a pressing issue for many countries in the Asian region. However, accurate patient identification remains the cornerstone of healthcare care and quality. There are several reasons for poor patient identification systems in regional hospitals: Larger hospitals tend to have poor patient management, and clinics exercise a level of financial and personal control that facilitates competition for patient management. system (each department must be responsible for its own bookkeeping). As a result, patients have multiple medical department records and identification numbers. In addition, the lack of a Master Patient Index (MPI) is a standard practice, meaning there is no centralized system for patient identification that cross-references available patient data.

Keywords - patients, healthcare, master patient index (MPI), biometric authentication in healthcare, patient records, medical records

I.INTRODUCTION

Many hospitals use central patient record systems instead of patient records. Patient information is organized in the database by last visit date. If the patient does not remember the last time he was seen, it will be very difficult to keep records. Patient IDs are frequently used: details are usually the patient's name, date of birth or private treatment room number. This category of information presents various challenges: Numerous patients lack awareness of their date of birth. Even the year of birth can be predicted. The patient's name is not fixed: Babies are often given a temporary name that changes later. Some patients don't even know the truth about their names. As mentioned above, a patient may have more than one medical number at the same hospital [4].

It is often impossible for patients to remember or even retain all of these recorded numbers. National personal identification tools could improve patient-specific education in sub-Saharan healthcare facilities. Regrettably, only a handful of nations possess the capability to establish precise and comprehensive identification systems ensuring the anonymous recognition of their citizens solely based on their date of birth. In many places, it is still possible to find a separate identification system that covers at least part of the population: Rwandans are issued a national identity card at the age of 16 that contains Machine-readable codes that can be easily used for health registration purposes [28]. However, children under the age of 16 constitute a significant portion of the patients, even if they are not included in the scope of the procedure. A comparable circumstance arises in the Democratic Republic of Congo, where each eligible adult for electoral participation will be assigned a distinct identification number for voting. Children and other non-entitled citizens such as immigrants, refugees, military personnel, and mentally ill people are again excluded.

In a rapidly changing world, the combination of biometrics and machine learning (ML) offers the opportunity to solve new medical problems. Biometric medical systems using machine learning algorithms represent the integration of new technologies that have the potential to transform all aspects of healthcare [25]. Biometric data, which essentially includes physiological identifiers such as fingerprints, iris scans, and facial features, is a powerful tool for capturing the intricate details of a person's behavior and health [10][20]. Using machine learning algorithms, doctors can unlock the potential hidden in this data so they can make smarter decisions, deliver more personalized treatment, and ultimately improve patient outcomes.

The revolutionary potential of biometric healthcare systems lies not only in their ability to analyze large amounts of biometric data but also in their ability to adapt and learn from it. This information is out of date [14]. Through continuous improvement and learning, machine learning algorithms in these systems can uncover complex patterns, relationships, and patterns that humans cannot see. This poor training process keeps doctors at the forefront of changes in healthcare, anticipating patient needs and intervening to prevent disease or complications.

Additionally, the integration of biometric medical systems with machine learning algorithms holds the promise of improving the efficiency and effectiveness of healthcare worldwide. By streamlining work, improving management processes, and improving resource allocation, these systems can reduce the burden on doctors, make work more efficient, and provide quality care for patients across cultures and regions [29].

As we explore the field of medical biometrics powered by machine learning, we begin a transformative journey toward a future where healthcare is not just data-driven and not just personal; more accessible, more equitable, and more responsive to the needs of individuals and communities.

Additionally, the integration of biometric medical systems with machine learning technologies has a significant impact on the independence of medical care [16]. These systems can overcome geographic barriers and health gaps, disseminating medical knowledge to underserved communities, closing the gap in access to care, and empowering people to take control of their own health and well-being.

As we stand on the precipice of this transformative time, the possibilities of biometric healthcare powered by machine learning are endless. From revolutionizing disease prevention and early diagnosis to revolutionizing the patient experience to analyzing clinical data, these systems hold the promise of a better future for everyone [23].

II. LITERATURE SURVEY

A fresh cloud-centric fine-grained framework for controlling access to health information was unveiled, specifically targeting security hurdles and grappling with concerns surrounding cloud reciprocity. An approach with proxy for end-to-end communication between the IoT-enabled living frameworks was proposed to challenge real-world applications. A versatile electric help gadget was outlined particularly for visually impaired individuals in which ultrasonic run discoverers are mounted on the belt to discover the impediments display in the user's way and to coordinate the daze individuals [2].

The examination displayed in this paper center around a specific gathering of clients. It caught composing data for examination. Fifty clients took parcel in these trial clients were not given rules while in travel to utilize PC. In this paper, it can reach out for other biometric qualities like and web utilize. The estimations are conceived noteworthy reasonable on keystroke components based on ceaseless confirmation system [5][8] [22].

The identification card serves as the primary form of identity verification for the electoral process. Only students in possession of a legitimate ID card are eligible to engage in the election procedure. Throughout the election proceedings, the student places their RFID card onto the card reader for verification. To verify that the card belongs to the student in possession, a secondary level of checking authentication is employed. The paper outlines a straightforward and secure approach to casting votes by utilizing biometric authentication. [7].The primary goal is to enhance the model's security, scalability, flexibility and reliability while also minimizing the time needed to declare the results. In this scenario, voting utilizes a fingerprint module, with individuals' fingerprint information pre-existing within the government database. Elections are an important feature of the democratic arrangement. Elections are held in schools and higher education institutions to impart an understanding of democratic principles and instill leadership qualities among students. Within an educational institution, the Students Council holds the position as the largest student body The Students Council provides a forum for students to voice their opinions and raise concerns about the system. The advent of technology has led to significant transformations across nearly every sector, and the election process is no exception to this trend. Individuals depend on technology to simplify tasks, expedite processes, and ensure accuracy. An Android application was devised to facilitate data recording from the electronic sphygmomanometer by integrating Bluetooth communication, encompassing parameters like SBP (Systolic Blood Pressure), Heart Rate, and DBP (Diastolic Blood Pressure) [6]. This application streamlines the process of transmitting recorded data through various mobile devices, allowing for the detection of abnormalities and the prompt delivery of messages to users. Conducted an implementation that involved comparing experimental results across different scenarios. Sundholm et al. introduced Web Real-Time Communication (WebRTC), a technology designed to facilitate real-time communication over the web. It enables secure data transmission and efficient management of multiple concurrent streams, making it suitable for applications like video conferencing, online gaming, and live streaming.

An application was introduced, showcasing a decentralized flow ecosystem designed specifically for healthcare in the Internet of Things (IoT) realm [12] [17]. If the individual being monitored moves out of range, their data will be stored on the local server and transmitted at a later time.

The traditional paper-based voting system is straightforward, yet it lacks transparency and is prone to errors. To tackle the drawbacks of the typical paper-based voting method, the Authenticated Voting System (AVM) is implemented It employs dual authentication levels, specifically Radio Frequency Identification (RFID). The voting system being discussed accommodates a maximum of three candidates for a single position If there are additional positions available, a distinct voting machine must be employed for every post. To accelerate the voting process for a large student body, the college is divided into multiple blocks. The number of Authenticated Voting Machine (AVM) units needed corresponds to the number of blocks, with every block supervised by a booth-level operator (BLO). The college database will gather the fingerprint data of students. To do so, Internet connectivity preferably Wi-Fi is needed.

Lately, a range of IoT systems have emerged specifically for health monitoring purposes [9].

There are many techniques used within the signature dynamic biometric however nonetheless want to beautify skilled forgeries. Future paintings of dynamic signature verification consist of fusion of non-identical classifier for splendid identity end result. There are many techniques used within the signature dynamic biometric however nonetheless want to beautify skilled forgeries. Future paintings of dynamic signature verification consist of fusion of non-identical classifier for splendid identity end result [15].

A medical solution known as the smart box merges Peer-to-Peer (P2P) and IoT technologies, enabling patients to maintain control over their health [11] [13] [18]. The Galileo board represents an IoT device equipped with an integrated medical platform specifically engineered for the analysis of electrocardiogram (ECG) signals. Through a sophisticated algorithm, it ensures comprehensive monitoring of heart function [21].

In market, few IoT Portable Medical Devices Enhancements were introduced to improve the patient's mobility [19] [24]. However, concerns regarding security and several limitations arose when utilizing Portable Medical Devices. As we transitioned to lightweight IoT gadgets and utilized existing databases, ailments were forecasted [1] [2]. Yet, during such prognostications, challenges emerged in data retention. of databases and analysis using those databases [27].

During the authentication of second level the student's biometric data is verified using a fingerprint scanner integrated into the voting machine. The fingerprint is cross-referenced with the one stored in the database for comparison. Voting authorization is granted only if the fingerprints match, ensuring the student's eligibility. All essential details are stored in the college database, while the votes are recorded directly within the voting machine.

The database which is multimodal actualized in examination collected for 24 clients. Thirty seconds of talk data and four hand formats is utilized for enrolling one supporter. To recognition the getting prepared data that picked from great purchase considers that exactness changed into accomplished by means of way of unimodal systems and from the affirmation of clients.The analysis of keystroke patterns relies on a supplementary authentication method. Data is scrutinized to recognize keystroke patterns, serving as a means to authenticate users. A verification test is conducted to validate user authentication. A novel approach introduces the concepts

of SFR (Stroke Feature Representation) and SFA (Stroke Feature Authentication) [23].
It creates confidential information based on registration patter ns and sends biometric information to
users. Provides excellent privacy not only for models but also for confidential information [24].
The voting machine is linked to a computer housing the complete database of eligible voters. A touchscreen interface is employed due to its user-friendly nature Printers are employed to produce the authentication poll. Results are sent to the corresponding authority using the GSM module. As students undergo the admission procedure, their biometric information is collected and archived together with essential documentation.

III.PROBLEM DEFINATION

We have created a biometric identification system that utilizes fingerprint devices to access a centralized health record database. Employing a Fingerprint based Medical System offers an efficient method for storing patients' clinical records. Utilizing fingerprint recognition technology, it enables quick and easy access to patients' past health records.

IV. PROPOSED METHODOLOGY

Doctors can log in to the system using their fingerprints.
Once logged in there will be two ways to update information or view patient information [30].
The patient's fingerprint will be stored for identification and we will use the KNN algorithm for fingerprint matching.
For new entries, personal information will be added and two additional fingerprints will be stored. If updated, the information will be updated and the patient's fingerprints will be re-examined to verify

k-Nearest Neighbor Algorithm

In the known pattern nearest neighbor algorithm (k-NN), K represents a non-parametric approach utilized for classification and regression.

V. ALGORITHM

The functioning of K-NN can be elucidated through the algorithm outlined below.

Step 1: involves choosing the quantity K representing the number of neighbors.

Step 2: compute the Euclidean distance for K neighbors.

Step 3: choose the K nearest neighbors based on the calculated Euclidean distance.

Step 4: within this group of K neighbors, determine the frequency of data points within each category.

Step 5: allocate the new data points to the category with the highest count among the neighbors.

Step 6: the model is prepared and fully operational.

Suppose we have a new data point and we need to put it in the required category.

To begin with the K-Nearest Neighbor (KNN) algorithm for machine learning, we'll commence by selecting the number of neighbors, opting for a value of k=5.

Afterward, we'll proceed to compute the Euclidean distance among the data points Euclidean distance, a concept familiar from geometry, denotes the distance between two points This can be computed as follows:

Upon applying the K-Nearest Neighbor (KNN) Algorithm for Machine Learning, the Euclidean distance calculations yield the nearest neighbors. For instance, we observe three nearest neighbors in category A and two nearest neighbors in category B, as illustrated in the image below In the realm of machine learning, the K-Nearest Neighbor (KNN) Algorithm stands as a pivotal tool. Examining the three closest neighbors reveals their affiliation with category A, indicating that this new data point likely aligns with category A as well.

Regarding the selection of K in the KNN Algorithm, it's crucial to consider several factors. Pinpointing the ideal "K" value in KNN involves a trial-and-error approach since no universal method exists. Among the range of options, K=5 is often favored.

Opting for too small a K, like K=1 or K=2, can introduce noise and vulnerability to outliers, impacting the model's accuracy.

Higher values of K generally yield favorable outcomes, yet they may encounter challenges. Upon closer observation, one can discern that as K expands, the boundary progressively smoothens. Eventually, with K reaching infinity, it tends to converge entirely to either blue or red based on the predominant majority.

Evaluating the training and validation error rates helps gauge the effectiveness of various K-values. Below is a depiction of the training error curve.

The rate fluctuates as the value of K varies.

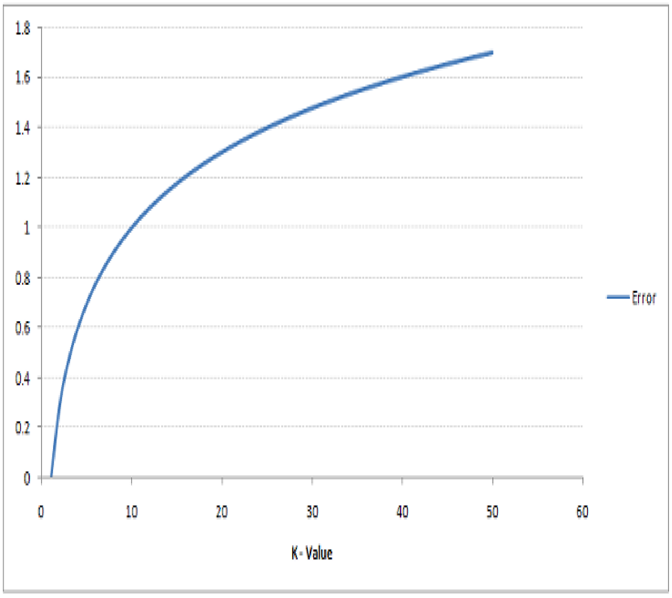

Fig.1 K value error curve

As evident, the error rate remains consistently zero at K=1 for the training sample. This occurrence arises from the fact that the closest point to any given training data point is itself, ensuring accurate predictions with K=1(Fig.1). Had the validation error curve exhibited a parallel pattern, we would have opted for K=1. Below is the validation error curve depicting variations K.(Fig.2)

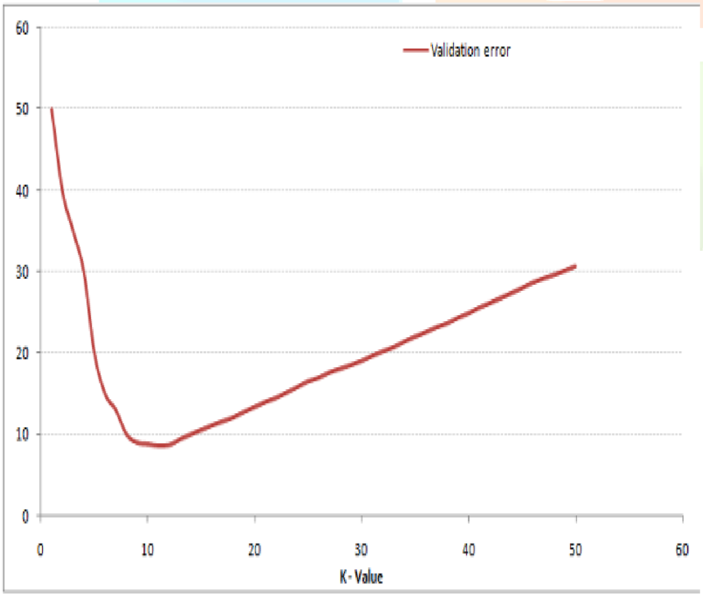

Fig.2 K value error curve

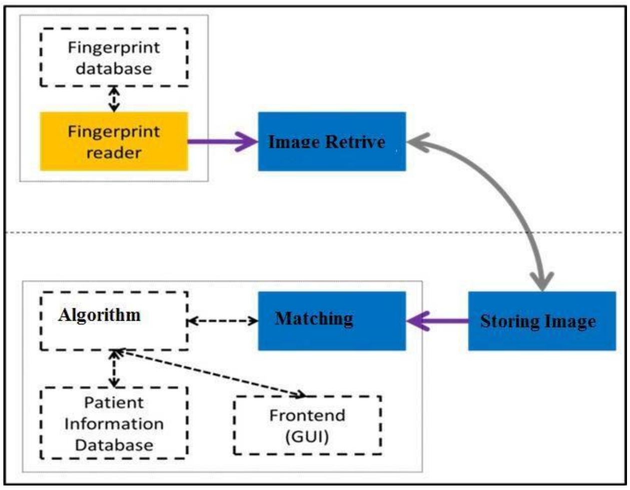

Fig 3. System Architecture

Module 1: Demo Model

This is a virtual mockup of the application.
Simple ideas for project design are given here. We share the entire concept of our project through this model.

Mode 2: Home page

This mode has a home page.
GUI design is also created in this module.
Users log in by entering their password.
The next page has two sections: registration and verification.

Module 3: Registration

This module is used for user registration.
User enters details like Aadhar number, patient's name, date of birth, phone number, address and files containing patient's medical information.
Then register the patient's fingerprint and save the patient information.

Mode 4: Research

This is the last module of our project.
So we continue to analyze the module after recording.
In this mode, identify patient details using fingerprints and download medical information into the system as files.

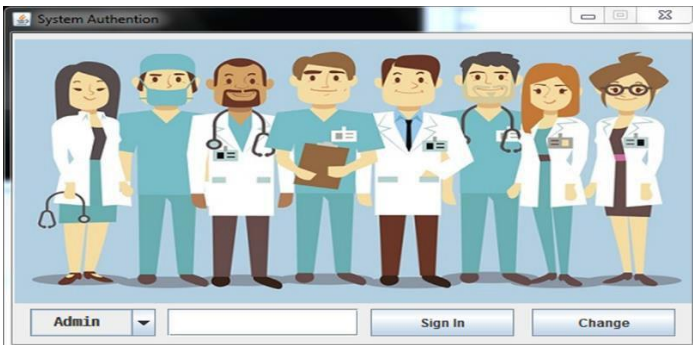

Fig 4. Login to Doctor

Fig 5. After Login

Fig 6. Update record

The system's output would likely consist of a comprehensive interface or report displaying both the patient's current biometric data and their medical history.(Fig. 5) This interface provides healthcare professionals with a holistic view of the patient's health, incorporating real-time biometric measurements such as heart rate variability, blood pressure, temperature, and activity levels. At the same time, it provides entry to the patient's previous medical history, encompassing past diagnoses, treatments, prescribed medications, and undergone proceduresThrough the integration of biometric data and medical records, the system equips healthcare professionals to make informed decisions and customize treatments according to individual patient health profiles, thereby elevating the caliber of care provided [31].

VI.MATHEMATICALMODEL

Sets

Let F represent the set of all folders in the system.

Consider U to represent the collection of all users authorized to access these directories.

Permission

Define a relation P as a subset of F x U to represent permissions.

In the realm of access control rules, access to a folder (denoted by 'f') by a user (denoted by 'u') is valid if and only if the pair (f, u) belongs to the set P, ensuring that only authorized users gain entry.

No unauthorized user should have access, expressed as F x U -

P = ∅.

The formula for calculating Euclidean distance is expressed as the square root of the sum of squared differences between corresponding coordinates.

Where:

For a new entry with a brightness value of 20 (Q_2) and a saturation value of 35 (P_2), we compare these to the existing entry's brightness (Q_1) and saturation (P_1) to compute the Euclidean distance (ref.Eq.1).

$$distance(P, Q) = \sqrt{\sum_{i=1}^{n}(Q_i - P_i)^2}$$

VII.ADVANTAGES

Fact: Machine learning algorithms can help accurately identify patients and diagnose diseases by analyzing biometric data with high accuracy.

Efficiency: Automation of patient identification and data analysis reduces human error and streamlines the medical process, thus improving the quality of medical services.

Personalize Medicines: Biometric data to customize treatment plans and interventions based on patient needs, providing more personalized treatment.

Early detection: Machine learning algorithms can detect changes in biometric data that may be an early indicator of disease [32]. Through remote monitoring, biometric sensors linked with machine learning enable real-time tracking of a patient's health status, facilitating prompt interventions and diminishing the necessity for frequent hospital visits.

VIII. DISADVANTAGES

Privacy concerns: The collection and identification of biometric data raises concerns about security and misuse of personal data. The precision and dependability of machine learning forecasts are contingent upon the caliber and volume of biometric data accessible for training, which can fluctuate.

Bias: Biases in reporting or procedures can lead to disparities in health outcomes and particularly affect disadvantaged populations, energy, celebrities, or questionable individuals.

Cost: Using machine learning to manage biometric healthcare can be expensive; It is necessary to invest in hardware, software, and personnel training.

Ethical Issues: The use of biometric data in healthcare raises ethical questions regarding consent, freedom, and discrimination. Genetic or physiological characteristics.

IX.APPLICATION

Patient identification and authentication: Use biometric authentication methods such as fingerprint, iris, or facial recognition to accurately identify patients in healthcare facilities, improve security, and ensure correct patient identification.

Diagnosis and monitoring: To analyze biometric data for early disease detection and regular monitoring of chronic diseases like as heart disease, diabetes, and neurological diseases to improve health outcomes with timely interventions. Remote patient monitoring involves employing biometric devices integrated with machine learning algorithms to observe patient vital signs and health status in real-time [33]. This facilitates
timely interventions and mitigates the necessity for frequent hospital visits.

Personalized treatment plans: Use machine learning algorithms to analyze biometric and genomic data to create personalized plans for treatment based on patient characteristics to improve treatment outcomes and reduce effects.

Health Behavior Analysis: Analyze biometric and contextual data to understand a patient's health behavior and risk, promote intervention and prevention plans to achieve better health for a healthy life and manage chronic diseases.

Clinical Decision System: Creating clinical decision systems that integrate biometric data with electronic health records (EHRs) to provide physicians with rapid insights and recommendations to improve accuracy and accurate results.

Medication compliance monitoring: By using biometric sensors and machine learning algorithms, patients' physical or behavioral measurements can be analyzed to monitor drug compliance, timely intervention, and support from medical experts.

Emergency response systems: Using biometric sensors algorithms for ML to develop emergency systems that can detect emergencies such as falls or heart attacks, improve patient safety, and shorten response time.

Health and wellness coaching: Follow health and wellness coaches who use machine learning to analyze biometric data and provide personalized recommendations to maintain a healthy lifestyle, manage chronic conditions, and achieve health goals.

Research and Drug Development: The use of biometric data in clinical research and drug development to identify biomarkers, stratify patients and evaluate treatments, and safely, and rapidly develop new treatments and precision medicines. Treatment plan based on the patient's genetics, lifestyle, and health to make treatment more effective and reduce negative side effects.

X. CONCLUSION

Although useful, the use of biometric technology using machine learning also brings challenges and risks that need to be carefully considered. While we can improve the accuracy, efficiency, and personalization of healthcare, issues of privacy, data quality, bias, cost, and ethics will need to insist on integrity and leadership. By establishing connections to hospital records, patient data can be stored and retrieved seamlessly, rendering it accessible on a global scale. Reduce medical misinformation. Global access to patient's medical history.

XI..FUTURE SCOPE

These components can be integrated similarly to how a Wi-Fi module functions as an external peripheral connected to a laptop. It's more advantageous if these components are built-in, simplifying the process and reducing complexity for integration. Additionally, we can utilize a free IoT account by registering on a specific website. It would be satisfactory if there's a capability to view the ECG graph directly on the server. In this project, we can also monitor blood pressure (BP) through the IoT server. Looking ahead, the future of biometric medical technology powered by machine learning is promising. Advances in sensor technology will lead to the development of smaller, more diverse sensors capable of capturing a variety of biometric data. Integrating [3] these sensors with the Internet of Medical Things (IoMT) promises to enable seamless data exchange across healthcare. Artificial intelligence will play a key role in predicting health outcomes, enabling early detection of diseases and personalized treatment plans. However, ethical, legal and regulatory issues need to be taken into account to ensure patient privacy and rights are protected. A human-centered design approach will increase user experience and accessibility. Interdisciplinary collaboration will lead to innovation, and the use of these technologies can help eliminate disparities in healthcare and increase access to care, making global health more equitable.

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