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IoT-Enabled Healthcare System Development Using Blockchain and Electronic Health Systems

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ABSTRACT

Accurate patient identification remains a persistent challenge for many countries in the Sub-Asian region. However, ensuring correct patient identification is essential for the provision of safe and high-quality healthcare services. Several factors contribute to the flawed patient identification procedures in Sub-Asian hospitals. One common issue arises from the decentralized patient administration prevalent in larger hospitals. Here, various clinical departments possess some degree of financial and managerial autonomy, resulting in the proliferation of duplicate administrative patient management systems. Each department manages its own record-keeping, leading to patients having multiple department-specific medical records and ID numbers. Moreover, the absence of a master patient index (MPI) is a common scenario, with no centralized patient identification systems in place to reference departmental patient records. These challenges underscore the urgent need to enhance patient identification practices and streamline administrative processes for improved healthcare delivery.

Keywords— patients, healthcare, master patient index (MPI)

INTRODUCTION

Many hospitals today utilize encounter-centered filing systems rather than patient-centered ones. Under this system, patient files are organized in the archiving system based on their last encounter with the healthcare system. If a patient cannot recall the timing of this last encounter, retrieving their file becomes challenging. Weak patient identifiers are often employed, with the most common elements being patient names, dates of birth, or internal department-specific medical record numbers. However, these identifiers pose various problems:

Many patients lack precise knowledge of their date of birth, with even the year of birth sometimes being approximate.
Patient names may not be stable, as newborns often receive temporary names that change later on. Some patients may not even know the correct spelling of their own name.

As mentioned earlier, a single patient may have multiple medical record numbers within the same health facility. It is often impractical for patients to remember or keep track of all these numbers.

National identification instruments could significantly enhance unique patient identification practices in Sub-Saharan health facilities. However, only a few countries have successfully implemented accurate and comprehensive person-identification procedures that ensure the unambiguous identification of citizens from birth. In many places, fragmentary identification systems cover only part of the population:

a. In Rwanda, individuals receive a national ID card at the age of 16, which includes machine-readable identification codes suitable for health record identification. However, children under 16 years old, who are not covered by this procedure, represent a significant portion of the patient population. b. Similarly, in the Democratic Republic of Congo, all eligible adults receive a unique identification number in the form of a 'voting card'. However, children and other non-eligible citizens, such as immigrants, displaced people, military personnel, and mentally handicapped individuals, are excluded from this system.

LITERATURE SURVEY

Paper name : Mobile health (m- health) system in the context of iot
Author: S.H. Almotiri, M. A. Khan, and M. A. Alghamdi.

Year:2016
In recent days, various IoT systems were developed for health monitoring systems. Wang et al [6] designed a compatible IoT
system for medical devices which was having multiple communication standard. A resource-based data retrieving method (UDA-I IoT) was proposed by Xu et al [7] for information-intensive health applications.

Paper name : Internet of Medical Things
Author: Gulraiz J. Joyia, Rao M. Liaqat, Aftab Farooq, and Saad Rehman Year:2017
Peer-to-Peer (P2P) and IoT technologies were combined in a medical system called as a smart box to keep the patients in control.
Paper name : Smart Healthcare Monitoring using IoT
Author: Shubham Banka, Isha Madan and S.S. Saranya
Year:2015
Kolici et al [8] implemented that compared the experimental results for different scenarios. Web Real-Time Communication (WebRTC) was given by Sundholm et al [9] which focused mostly on the secured transmission of data multiple concurrent streams in an efficient manner.

Paper name : A Survey on Internet of Things: Case Studies, Applications, and Future Directions
Author: K. Perumal, M. Manohar
Year:2015
By enabling the electronic sphygmomanometer to communicate via Bluetooth, an Android application [10] was developed to record the data such as SBP-Systolic Blood Pressure, DBP - Diastolic Blood Pressure and Heart Rate. That application made it easy to transmit the recorded data using any mobile device and such data is then be recorded, abnormality is found out and message is conveyed to the people.

Paper name : The Internet of Things for Health Care: A Comprehensive Survey Author: S.M. Riazulislam, Daehankwak
Year:2015
A real-time application [11] was presented with distributed flow environment for the IoT healthcare. When the person under observation moves beyond range, data will be recorded in the local server and communicated later.

Paper name : Design and development of low investment smart hospital using Internet of things through innovative approaches
Author: P. Rizwan, K. Suresh
Year:2017
A Galileo board [12] is a IoT-based device with embedded medical platform for the designed for electrocardiogram (ECG) signal analysis and based on an algorithm, heart function is monitored.

Paper name : A comprehensive review on usage of internet of things (IoT) in healthcare system,
Author: K.R. Darshan and K.R. Anandakumar
Year:2017
In market, few IoT Portable Medical Devices [13] were introduced which upgraded the patient's mobility. But the security threats and few drawbacks were also there while using Portable Medical Devices. When we started to consider light-weight IoT devices, using the existing databases, diseases were predicted. But while such predictions, issues were in storage of databases and analysis using those databases.

Paper Name: . Internet of Things (IoT): Number of Connected Devices
Author: PK Pankaj Kumar
Year:2000
A new cloud-based fine-grained health information access control framework [14] was introduced which addressed the security challenges and the cloud reciprocity issues.
A proxy-based approach for end-to-end communication between the IoT-enabled living systems [15] was proposed to challenge the real world applications. A portable electric aid device[16] was designed specifically for the blind people in which ultrasonic range finders are mounted on the belt to find the obstacles present in the users way and to direct the blind people.

Paper Name: Formal specification and analysis of an e-voting system
Author: Kumar, D. A., & Begum, T. U. S,

Year : 2012
This paper describes a simple and secured method of polling vote by using biometric. The main aim at increasing the flexibility security, reliability, scalability of the model and provide less time consumption to announce the result. Fingerprint module is used here for voting. Fingerprint detail of a person is already stored in government database.

Paper Name: voting machine
Author :Hussien, H., & Aboelnaga, H, Electronic
Year :2020
Voting machine is connected to a computer, which contains the full database of the people who is eligible for voting. Touch screen is used because it is user friendly. The printers are used in-order to get the authentication poll. GSM module is used to send results to the corresponding authority.
biometric. During the time of the admission process, the bio-metric of every student is recorded and stored along with other necessary documents. Once the admission process is complete RFID-based identity cards are issued to every student.

Paper Name : Smart voting
Author: Bhuvanapriya, R., Rozil Banu, S., Sivapriya, P., & Kalaiselvi, V. K. G.
Year: 2010
(This ID card is the first identity proof for the election. The student who possesses a valid ID card can only participate in the election process. During the election process, the student places the RFID card on the card reader. To ensure that the card belongs to the same student who possesses it, the second level of authentication is used.

Paper Name: lectronic voting with biometric verification offline and hybrid EVMs solution
Author: Arooj, A., & Riaz, M, Year: 2017
In the second level biometric of the student is accepted using a fingerprint scanner available on the voting machine. This fingerprint is compared to that of the one stored in the database. If both the fingerprints match then only the student is permitted to vote. The necessary details are stored in the college database and the votes are stored in the voting machine itself.

Paper Name : Online voting system for India based on AADHAAR ID
Author: Agarwal, H., & Pandey, G. N,Year: 2013
Elections are an important feature of the democratic arrangement. To make the students understand the concepts of democratic structure and to inculcate leadership quality elections are conducted in schools and higher education institutions. Students' Council is the largest student body in an educational institution. It is through Students' Council students voice their opinions and express their grievances about the system. Technology has brought drastic changes in almost every field; the election process is not an exception to this. People rely on technology to make their work easy, fast, and accurate.

Paper Name: A cloud-based framework to modernize the Indian election voting system.
Author: Matharu, G. S., Mishra, A., & Chhikara, P, 2015, CIEVS
Conventional paper ballot based voting system is simple but it is not transparent and error-free [1]. To overcome the limitations of conventional paper-based ballots Authenticated Voting System (AVM) is introduced. It uses two levels of authentication namely Radio Frequency Identification (RFID) and
The voting system under discussion works for a maximum of three candidates for a single post. If there are more posts then a separate voting machine is to be used for each post. To speed up the voting process when there are more thousands of students, the entire college is logically divided into several blocks and the number of AVM units required is equal to the number of blocks, and each of the blocks contains a booth-level operator (BLO). Fingerprint data of students will be retrieved for the college database. To do so, Internet connectivity preferably Wi-Fi is needed.

PROBLEM DEFINATION

Introducing the Fingerprint-Based Medical System

We are developing a biometric identification system to access a centralized health record database, featuring fingerprint recognition technology. This innovative system promises to be the most efficient way to store and retrieve patients' clinical records. With fingerprint recognition, accessing a patient's past health records will be quick and effortless. The advantages of this system are groundbreaking and will significantly enhance the healthcare industry!

Some key features of the fingerprint-based medical system include:

Enhanced security: Biometric data ensures that only authorized personnel can access health records, preventing unauthorized breaches. Instant access to patient information: Healthcare providers can retrieve a patient's medical history instantly by scanning their fingerprint, leading to quicker and more accurate diagnosis and treatment. Streamlined processes: By eliminating manual record-keeping, the system reduces human errors and saves time, ultimately making the healthcare system more efficient.

This cutting-edge technology is set to revolutionize the medical field and elevate the quality of patient care. Investing in the fingerprint-based medical system represents a progressive step toward an advanced and secure healthcare infrastructure!

PROPOSED METHODOLOGY

Doctors can access the system by logging in with their fingerprints. Upon logging in, they will be presented with two options: to update or view patient information. Patients' fingerprints will serve as their identification, with the K-nearest neighbors (KNN) algorithm utilized for fingerprint matching.

For new entries, personal information will be added, and the system will store two additional fingerprints. For updates, existing records will be modified, and patient fingerprints will be revalidated for confirmation.

The K-nearest neighbors algorithm is a non-parametric method utilized in pattern recognition for both classification and regression tasks. It operates by identifying the k closest training examples in the feature space, and the output varies depending on whether KNN is applied for classification or regression purposes.

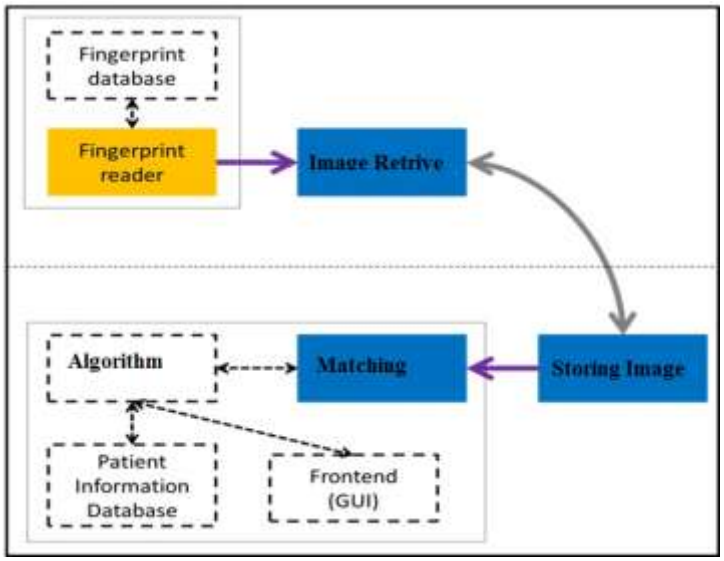

Fig 4.1. System Architecture

Module 1: Demo Model

- This was dummy model of the application.
- Here the basic idea about the project design was given.
- Through this module we have presented the general idea of our project

- Module 2: Login page
- This module has login page.
- The GUI design was also created in this module.
- The user log's in by entering password.
- Next page contains two section registration and verification
- Module 3: Registration
- This module is for user registration.

- User enters details like Aadhar number, patient name, date of birth, mobile number,address and the documents having medical details of patient.
- Then the fingerprint of the patient is registered and the patient information is saved.
- Module 4: Verification
- This is the last module of our project.
- So we have continued the verification module after the registration.
- In this module the patient details are verified using registered fingerprint and the medical details are download in form of document on respective system.

Fig 4.2. Login to Doctor

Fig 4.3. Update record

CONCLUSIONS

In our project, fingerprint verification serves as a crucial safeguard to protect the integrity and confidentiality of transmitted medical information. Patient data is securely stored and retrieved by connecting to the hospital database, enabling global access while ensuring data integrity and confidentiality.

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