Enhancing Medical Data Privacy and Security in Wireless Networks Via Smart Card and QR Code

[1st]Prof.Shah S.N, [2nd]Prof.Kokare.S.N, [3rd]Vaibhavi Ghadge, [4th]Ayushka Pawar, [5th]Vaishnavi Takawale
[1]HOD, Department of Computer Engineering, Sharadchandra Pawar college of Engineering and Technology Someshwarnagar Pune, India
[2]Assistant Professor, Department of Computer Engineering, Sharadchandra Pawar college of Engineering and Technology Someshwarnagar Pune, India
[3,4,5]Student, Department of Computer Engineering, Sharadchandra Pawar college of Engineering and Technology Someshwarnagar Pune, India

***Abstract*— This paper presents an approach to improving medical data accessibility and security in healthcare systems using QR codes and smart cards. As medical data continues to grow rapidly, traditional storage methods— primarily hard copies of case records stored in hospitals—are becoming increasingly inefficient. Our proposed Health-Care Portal system introduces a streamlined solution by generating a unique QR code and smart card for each patient, linking to their comprehensive medical history and treatment details. This system incorporates features such as clinical operation management, case records, complaint information, and secure access to patient data. By integrating QR codes and smart cards, healthcare providers can quickly retrieve essential information, enhancing both operational efficiency and data security. This approach ensures that critical medical information is accessible in real time while upholding high standards of patient privacy, making it highly applicable for modern healthcare environments.**

Keywords: **Medical Data Management, Healthcare Portal, QR Code, Smart Card, Patient Accessibility, Data Security, Case Records, Clinical Operations, Health IT, Patient Privacy.**

I. INTRODUCTION

The main objective of this system is to create a platform where individuals can securely input and manage their medical information. The system is primarily designed to allow quick access to this data during emergencies. It enables users to view essential details of a person who may require medical assistance. These details include both personal information and recent medical history. All data is stored in a centralized database, and a QR code is generated containing the relevant user information. In emergency situations, this QR code can be scanned from a smart card, allowing instant retrieval of the stored data.

II. METHODOLOGY

System Design: Develop a comprehensive framework that integrates Smart Cards and QR Codes for secure access to medical data in wireless networks.
Data Encryption: Implement encryption algorithms to protect sensitive medical information both during transmission and at rest.
Smart Card Authentication: Use smart cards to authenticate users, ensuring that only authorized personnel can access the medical data.
QR Code Generation: Create unique QR codes linked to medical records, enabling secure, quick access through scanning while maintaining data privacy.
Testing and Evaluation: Conduct rigorous testing in simulated wireless environments to assess the system's security, usability, and performance against data breaches and unauthorized access.

System Architecture
The architectural design, as shown in Figure b, not only maps out the structural components of the system but also emphasizes the logical flow of data and the dynamic interaction between various service layers and modules, providing a clear picture of the system's integrated functionality This provides a unified overview of the sequence of events, indicating which action takes place at what time and on which device within the system.

III. ALGORITHMS

We are developing an application that allows users to log in through a secure authentication process and

access their personal account, where they can input their personal and medical information. This data is securely stored in a database, and a unique QR code is generated containing essential user details. During emergencies, scanning the QR code provides immediate access to the stored medical data, significantly reducing the time required to begin patient treatment.

This approach not only streamlines the process by eliminating paperwork but also ensures secure data handling and quick retrieval. It enables medical professionals to initiate treatment without delays, ultimately improving patient outcomes. When a patient visits the hospital for the first time, they complete a registration process within the system. Later, doctors can scan the patient's QR code to view their medical history and previous treatments.

Each time the patient is checked by a doctor, their updated information is added to the system and reflected through the QR code. Additionally, diagnostic tests such as CT scans, MRIs, blood tests, and X-rays are linked with the QR code, ensuring that all treatment steps are recorded efficiently. If necessary, a digital wallet feature can also be integrated to allow for instant and online payments. With this system, patients no longer need to carry physical reports or documents — the QR code serves as a digital tag for all their medical records.

A. QR Code Technology: - QR Code, which stands for Quick Response Code, is a type of 2D barcode used to quickly store and retrieve data. It can handle various types of information such as numbers, letters, binary data, and even Japanese characters like Kanji. Black squares are placed in a grid layout on a white background to form the QR code. These codes are readable using cameras or barcode scanners. "Even if some parts of a QR code are missing or damaged, it can still be decoded accurately using error correction methods like Reed–Solomon." Data is read from a QR code by examining how its patterns are positioned across the horizontal and vertical lines.

Fig.1: QR Code

B. QR Code Representation: - With the rise in smartphone usage and the integration of cameras into nearly all mobile devices, QR codes have become a widely accepted method for transferring information quickly and easily. Designed to enable efficient data exchange between printed sources and digital platforms, QR codes emerged as an ideal solution. Originally developed in 1994, this visual encoding system can hold up to 2,953 bytes of data within a matrix measuring 177 by 177 modules. A standout feature of QR codes is their robustness against minor physical damage, made possible by embedded error correction mechanisms. These mechanisms are categorized into four levels — L, M, Q, and H — which enable data recovery even when 7%, 15%, 25%, or 30% of the code is compromised, respectively. For this implementation, Level L was selected to prioritize higher data storage while still providing basic error resistance.

C. One Time Password (OTP): - A One-Time Password (OTP) is a temporary, secure code used to authenticate a user's identity during login or verification steps.. This password is valid for only one session or transaction, making it highly secure against replay attacks. For further understanding, you may refer to resources that explain how to generate OTPs or unique verification URLs, which are often used in secure login systems and digital identity verification.

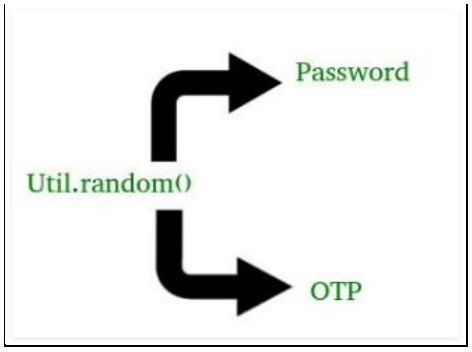


Fig.2: OTP

D. AES Encryption: -

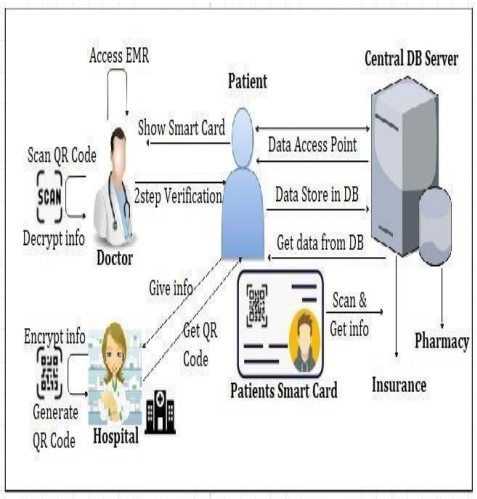
The Advanced Encryption Standard (AES) algorithm is used to securely encrypt medical data, with support for encryption up to 128 bits. When a patient visits the laboratory for the first time, they are provided with a unique personal key. This key is required for both encrypting and decrypting their lab reports. Using the labSeq-p application, the patient can ensure that their sensitive data is securely encrypted before being stored in the database.

V. LITERATURE SURVEY

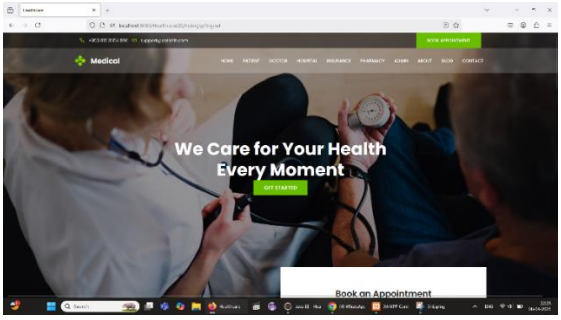
1) Sharemind: a framework for fast privacy-preserving
Computations
Author: Dan Bogdanov, Sven Laur, and Jan Willemson
Description: This work proposes SHAREMIND, a secure and efficient virtual environment developed for confidential data processing. It utilizes secure multi-party computation (SMPC) techniques to allow confidential data processing without compromising data privacy.

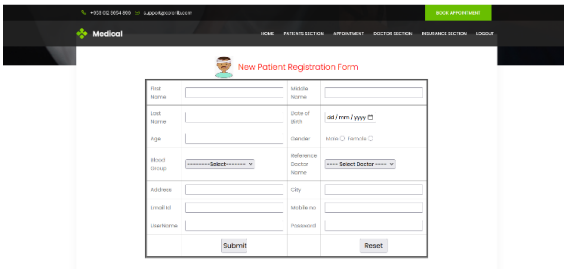
2) Real-Time and Secure Wireless Health Monitoring
Author: S. Dagtas, G. Pekhteryev, Z. S¸ahinoglu, H. Cam, and N.Challa
Description: This paper proposes a wireless health monitoring system using body sensor networks (BSNs). The system ensures real-time detection of vital signals, energy-efficient data transmission via ZigBee technology, and secure handling of medical data within the network.

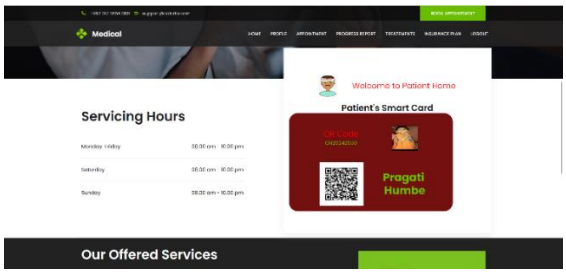
VI. SYSTEM ARCHITECTURE

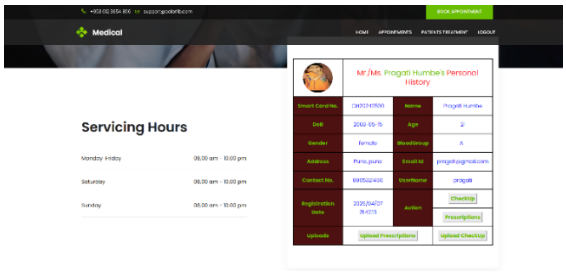


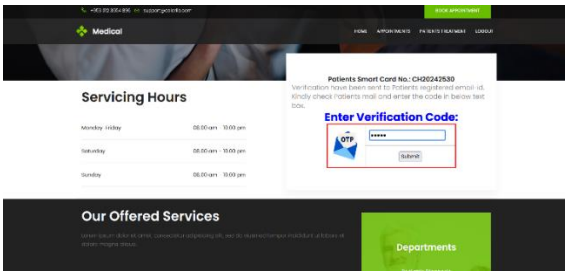
VII. RESULT

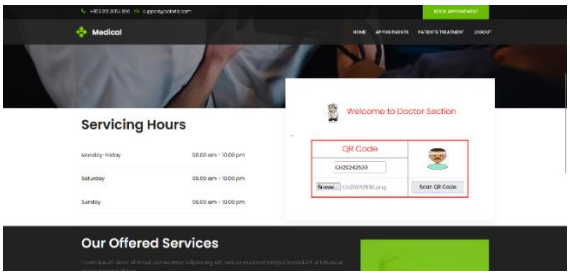


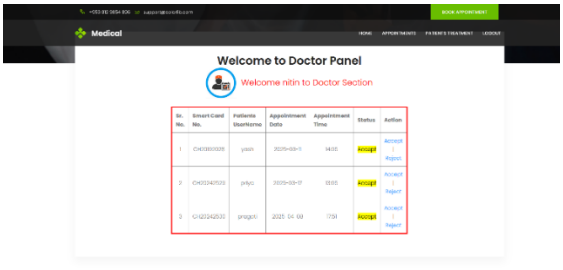












VIII. ADVANTAGES

A. Enhanced Security

The integration of smart cards and QR codes enables two-factor or multi-factor authentication, significantly increasing the difficulty of unauthorized access.

B. Data Privacy Protection

Smart cards securely store encrypted credentials, thereby minimizing the risk of data theft even if the device is lost or compromised.

C. Fast and Efficient Access

QR codes facilitate quick and user-friendly data transmission, enhancing the speed and convenience of authentication and access procedures.

D. Reduced Human Error

By automating the login and access process through scanning, the system minimizes errors typically associated with manual data entry.

E. Cost-Effective

In comparison to complex biometric or hardware-based systems, the use of smart cards and QR codes presents a more affordable yet effective security solution.

IX. CONCLUSION

All The project titled "Enhancing Medical Data Privacy and Security in Wireless Networks via Smart Card and QR Code" offers a transformative solution to safeguarding patient information, combining QR code technology with smart card authentication to allow quick, secure access to medical records—particularly crucial in emergencies where immediate data access can save lives. This system exemplifies the effective merging of advanced technology with healthcare, addressing critical privacy concerns through robust encryption and secure data management in wireless networks. By promoting best practices in data security and providing training for healthcare professionals, this project not only enhances data privacy but also fosters transparency and collaboration among providers. Ultimately, it sets a standard for future healthcare systems that prioritize both patient privacy and accessibility, marking a significant advancement toward more secure, efficient, and responsive healthcare environments.

REFERENCES

[1] Raza, A., et al. (2023). "Secure Medical Data Transmission in Wireless Networks Using QR Codes and Smart Cards." *Journal of Medical Systems*, 47(2), 1-12.

[2] Khan, R., et al. (2023). "A Comprehensive Review on Security Techniques for Healthcare Data in Wireless Networks." *IEEE Access*, 11, 25034-25051

[3] Yadav, A., & Singh, R. (2023). "Smart Card Based Secure Healthcare Information System." *International Journal of Information Management*, 63, 102470.

[4] Zhao, T., et al. (2023). "Smart Card Authentication for Secure Wireless Healthcare Applications." *Future Generation Computer Systems*, 142, 103-112

[5] Sinha, S., & Gupta, P. (2022). "A Survey on Secure Medical Data Management Techniques in Wireless Networks." *Journal of Network and Computer Applications*, 210, 103490.

[6] Wang, Y., & Li, J. (2022). "Privacy-Preserving Healthcare Data Sharing via Smart Cards and QR Codes." *IEEE Transactions on Information Technology in Biomedicine*, 26(5), 1200-1210

[7] Singh, P., & Sharma, R. (2022). "Implementing Smart Card Technology for Secure Medical Data Management." *International Journal of Medical Informatics*, 165, 104832