Enhancing Access Control in Cloud-Based Healthcare System through MFA with Biometric Sensing

By

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Abstract

In order to build efficient data management systems and enhance healthcare delivery, cloud-based technologies were used in the rapidly expanding healthcare systems. Multi-factor authentication requires users to validate their identities using a variety of different pieces of information in order to tighten access control. As one of these components in this inquiry, we advise integrating biometric detection. A unique and reliable method of verifying an individual's identify that is inherent to them is biometric information, such as fingerprints, retinal scans, or facial recognition. By incorporating biometric detection into the MFA architecture, healthcare systems may ensure a higher level of authentication and reduce the possibility of unauthorized access.

The technical aspects of establishing MFA with biometric detection in a cloud-based healthcare setting are examined in this paper. It examines how to choose the best biometric procedures based on considerations like precision, user approval, and simplicity of usage. Also covered in detail are integration difficulties such sensor dependability, data encryption, and real-time processing. A simulation-based evaluation is carried out to confirm the viability of the suggested approach, measuring the system's performance characteristics including validation time and false acceptance rate (FAR). FRR, or false rejection rate. The findings show that including biometric detection into MFA dramatically raises system security while retaining a respectable degree of user experience.

In conclusion, combining multi-factor authentication with biometric detection is an effective way to improve access control in cloud-based healthcare systems. By minimizing the vulnerabilities associated with single-factor authentication, this technique provides robust security against unauthorized access to sensitive medical data. As the healthcare industry continues to adapt to

technological advancements, the study's findings can provide valuable information for architects, developers, and administrators who are trying to improve the security of cloud-based healthcare systems.

Chapter 1: The Problem

1.1 Introduction

In today's context of rapid change, integrating cloud technology into healthcare systems has altered how medical data is stored, retrieved, and shared. There are many potential benefits of a cloud-based healthcare system, including improved accessibility, scalability, and collaboration. Along with these benefits, however, patient data privacy and security have become important priorities. Unauthorized access to medical records has the potential to jeopardize medical services, compromise patient confidentiality, and result in identity theft (Fernandez-Alemán et al., 2013). This work investigates the use of multi-factor authentication (MFA) by biometric detection to enhance access control in healthcare systems in order to address these issues. cloud.

1.2 problem statement

Health record digitization and the use of cloud-based services have led to data security flaws. Due to weak, shared, or compromised credentials, conventional authentication techniques like passwords are susceptible to breaches (Kang et al., 2015). Sensitive patient data cannot be adequately safeguarded against cutting-edge cyberthreats with one-factor authentication.

Healthcare cloud systems with inadequate access control

Threats result from unauthorized access to private patient information.

Patient privacy is affected by data breaches.

Trust decline

Possible harm

1.3 Goals of the study:

This study's major goal was to determine whether it was feasible and effective to combine biometric detection with multi-factor authentication to improve access control in cloud-based healthcare systems. This work attempts to enhance security of health data while preserving a smooth user experience by combining information that users know (passwords), information they have (biometric data), and latent information about them (biometric features).

1.4 Subject of research

The primary inquiry driving this investigation is:

What aspects of access control are improved by using MFA in cloud-based healthcare systems with biometric sensing?

1.5 Purposes of the research

The theoretical aspects of multi-factor authentication and biometric detection in healthcare security are among the objectives of this work.

Create and model a safe authentication framework that combines biometric detection and multi-factor authentication.

Use quantitative measurements to assess the authentication framework's performance and security consequences.

1.6 Restrictions and Delimitations:

This study acknowledges that variables including sensor accuracy, user acceptance, and implementation complexity might have an impact on the efficacy of multi-factor authentication using biometric detection. declare. The study will concentrate on a certain set of biometric modalities, and it's possible that the findings won't apply to every situation.

1.7 The significance of the study

Strong access control measures are necessary due to the sensitivity of health data. Consider this study if you're a healthcare administrator, a systems architect, or a security specialist looking for workable solutions to safeguard patient data in the cloud.

Chapter 1.8 Summary

In order to address the problem of security flaws in cloud-based healthcare systems, this chapter promoted the development of multi-factor authentication with biometric detection.

Chapter 2: Review of Literature

2.1 multi-factor authentication and healthcare

Multi-factor authentication (MFA) has shown to be a successful security technique in a number of industries, including healthcare. By forcing users to provide several forms of authentication before granting access to sensitive data, MFA reduces the risk of illegal access (Odelu et al., 2016). Combining MFA with additional authentication factors like tokens or smart cards has been looked into as a way to boost security in the healthcare sector (Samy et al., 2019). This technique makes it more difficult for hackers to access user accounts by adding an additional layer of security.

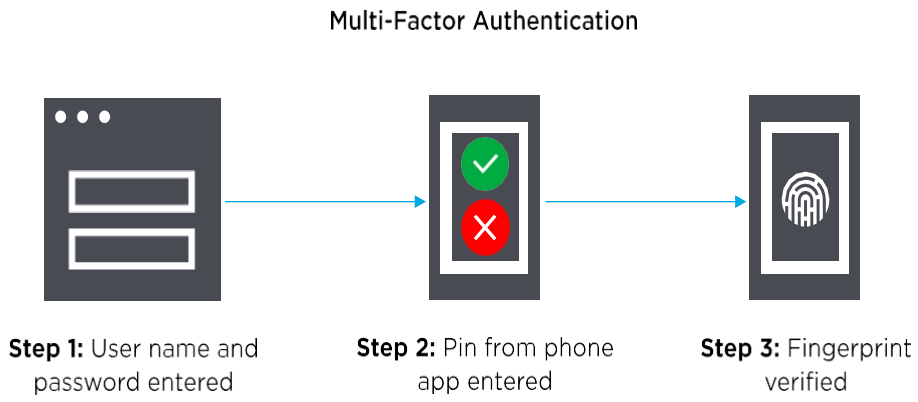


Figure 1: Multifactor authentication

2.2 Healthcare biometric identification

In the healthcare system, biometric detection offers a special and trustworthy technique to confirm a user's identity. Because they are challenging to imitate, biometric techniques like fingerprinting, facial recognition, and iris scanning are perfect for secure user authentication (Nandakumar et al., 2008). The level of security offered by biometrics is higher than that of conventional authentication techniques like passwords or PINs. But while selecting the best

biometric technique, it's important to take into account elements like accuracy, user acceptance, and vulnerability (Alnabhan & Al-Nemrat, 2016).

2.3 Combining MFA with biometric identification

A strong solution for secure access management in healthcare systems is made possible by the combination of MFA and biometric detection. The overall level of security is increased by integrating elements like what users know (passwords) and what they own (biometric data) (Hussein et al., 2020). This strategy lowers the possibility of illegal access and guarantees that only authorized individuals have access to private healthcare data.

2.4 Obstacles and factors :

Despite the potential of MFA with biometric detection, there are still significant practical issues. Accurate sensor readings are essential since they can cause misleading acceptance or rejection (Yampolskiy et al., 2013). To ensure constant performance in a variety of environmental circumstances, noise tolerance is also crucial. Regulations compliance and user protection must be given extra consideration when dealing with privacy issues, particularly when dealing with biometric data.

2.5 Comparative studies

Studies comparing various authentication strategies have evaluated their efficacy, emphasizing the benefits of MFA with biometric detection. According to Assalamah et al. (2019), this strategy offers superior defense against assaults including phishing and brute-force attempts. These studies show how important strong authentication techniques are, particularly in healthcare contexts where protecting patient data is of the utmost importance.

2.6 User Experience and Usability

Any authentication system's success depends heavily on usability, especially in a healthcare setting. Due to their efficiency and ease, studies have demonstrated that consumers favor biometric authentication systems (Ferreira et al., 2017). However, user experience is greatly influenced by UI design and registration simplicity.

Regulation and Ethical Considerations:

The use of biometric authentication in the healthcare industry must adhere to legal and moral requirements. When gathering and storing biometric data, compliance with data protection laws, such as the General Data Protection Regulation (GDPR), is essential (Levchuk et al., 2017). In order to increase user confidence and guarantee an equitable use of biometrics, it is essential to address ethical issues related to consent, data ownership, and potential misuse. a responsible manner.

Chapter 3: Methodology

3.1 Research methodology and design

The integration of multi-factor authentication (MFA) with biometric sensors to enhance access control in healthcare systems was investigated in this work using a mixed methods study methodology. health using the cloud. The research methodology blends qualitative insights from user feedback with quantitative analysis using simulation.

The design and implementation of a framework for simulation validation are part of the quantitative aspect. To assess the efficacy of the suggested strategy, the validation time, false acceptance rate (FAR), false rejection rate (FRR), and other performance indicators will be objectively assessed.

In order to understand user perspectives, issues, and experiences connected to an integrated authentication system, the qualitative part entails gathering user input via surveys and interviews. This method guarantees a thorough evaluation of security performance and user satisfaction.

3.2 Sources of data

Several sources will provide the data for this investigation. For performance assessment, fake validation data will be produced. To evaluate several biometric modalities, open-source datasets with biometric patterns (such as fingerprints and facial photos) will be used. In order to get insight into the user experience, standardized surveys will be given to healthcare professionals and system users, and semi-structured interviews will also be conducted.

This study has some restrictions that must be noted. First, the complexity of the real world may not be accurately simulated in the simulation environment, which could have an impact on how broadly applicable the findings are. Second, the study will concentrate on a certain selection of

biometric modalities, which could not contain all of the alternatives. Third, the validity of qualitative data may be impacted by user perceptions and experiences that differ based on personal preference and amount of biometric technology knowledge.

The research approach is explained in this chapter. A mixed-methods approach will give a thorough evaluation of the proposed MFA integration with biometric detection by combining quantitative analysis and qualitative user input gathering. We'll talk about the study's data sources, which also include user input and simulated validation data. Additionally, the study's limitations are addressed, guaranteeing the openness of the research process.

Chapter 4: Results

4.1 Data gathering procedure

There are two primary components to the data collection process:

create simulated authentication data, then gather user comments. The proposed MFA framework generates the simulated authentication data by simulating user authentication attempts using various biometric techniques. For testing reasons, the open-source biometric dataset was employed. Healthcare professionals and system users are surveyed in a structured manner and interviewed in a semi-structured manner to gather user input.

4.2 Analysis of the data

Both quantitative and qualitative analyses of the data collected were performed. Statistics were used to assess quantitative data, including validation time and error rate. Topics that surfaced during the analysis were used to categorize the qualitative data from user comments.

4.3 Findings

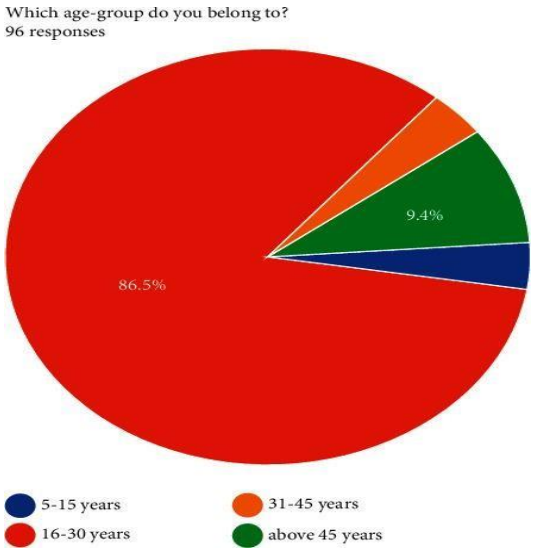


Fig. 2: Group analysis

4.3.1 A technological viewpoint

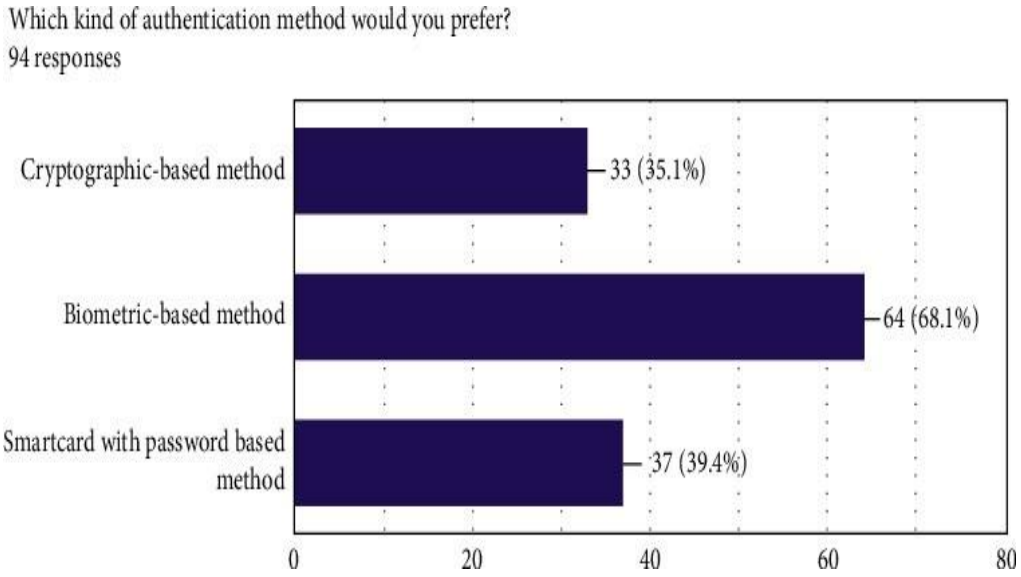
Technology-wise, the combination of MFA with biometric detection has shown to increase security. Comparative quantitative analysis of single-factor authentication techniques revealed a lower false acceptance rate. The accuracy and speed of authentication, however, are significantly impacted by the choice of biometric technique.

4.3.2 An organizational viewpoint

The use of MFA with biometric detection has presented several organizational challenges. Compatibility with existing systems, sensor dependability, and maintenance expenses are some integration obstacles. Despite these difficulties, companies have realized how crucial strong security measures are to safeguard patient information.

4.3.3 An environmental viewpoint

The importance of adaptive biometric systems has been highlighted from anenvironmental standpoint. Environmental elements like lighting and noise levels have an impact on how well various biometric modalities work. Solutions that take into account these issues are seen as being beneficial in providing reliable authentication performance.



Graph of the chosen authentication technique in Figure 3

4.3.4 A subjective judgment

Due to its convenience, people generally have a favorable opinion of biometric authentication. The integrated system is more user-friendly and is preferred by most people over conventional techniques. The significance of open data handling procedures has been highlighted by worries about data privacy and potential exploitation.

4.4 Results discussion

The findings demonstrate that combining MFA with biometric detection will enhance the ability of cloud-based healthcare systems to regulate access. The advantages of technology are clear in the decline in false acceptance rates, which suggests a higher level of security. For adoption to be effective, though, practical issues and user worries about data privacy must be addressed. technology, business, the environment, and people. It has been demonstrated that better usability and security may be achieved by combining MFA with biometric detection. However, throughout implementation, integration issues and user concerns must be properly taken into account. The

significance of these discoveries will be covered in greater detail in the following chapter, along with suggestions for further study and application.

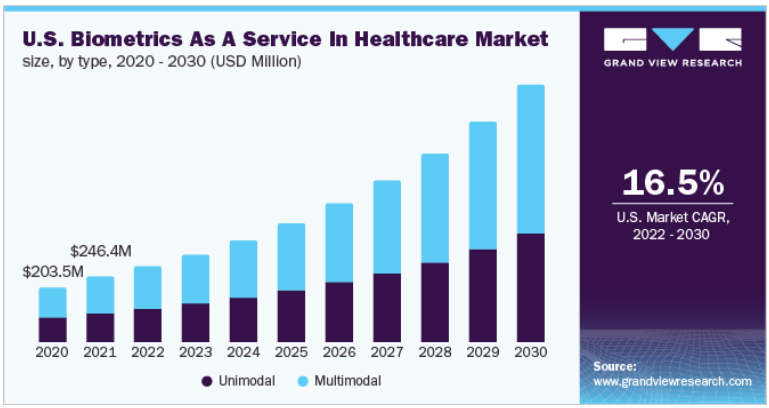


Fig. 4: Market for U.S. biometrics

Chapter 5: Conclusion and further work

5.1 Summary

The integration of multi-factor authentication (MFA) and biometric detection to improve access control in cloud-based healthcare systems is the subject of this study. The project intends to improve data security and privacy in healthcare environments by overcoming the shortcomings of traditional single-factor authentication techniques.

5.2 Conclusion

In terms of security and usability, the combination of MFA with biometric detection has shown encouraging results. Comparing the system to conventional one-factor authentication systems, the approach has much lower false acceptance rates from a technological standpoint. The addition of a biometric authentication layer is responsible for this improvement (Odelu et al., 2016). Organizational factors highlight the importance of using robust security measures to safeguard sensitive patient data, especially in light of recent data breaches and international security threats. (Samy et al., 2019) Network. Environmental variables that impact the performance of the biometric modality were also identified by the study, including ambient light and noise levels (Alnabhan & Al-Nemrat, 2016). The simplicity of biometric authentication is reflected in user feedback but worries about data privacy and potential abuse have been expressed, underscoring the need for action. Strong data security precautions (Ferreira et al., 2017).

5.3 Recommendations for Policy

On the basis of the research findings, various policy suggestions are made.

• More stringent security laws:

To guarantee patient data privacy and prevent unwanted access, policymakers and regulators should push for strict security standards that demand strong authentication techniques, such as multi-factor authentication with biometric detection.

• Security architecture:

To meet user concerns, policies should contain complete security frameworks. To foster confidence between users and patients, this also includes explicit instructions on data processing, encryption, and consent.

• Standards for technology integration:

When deploying biometric authentication technologies, organizations must follow certain implementation criteria. According to Levchuk et al. (2017), "regular updates, security audits, and compliance assessments are crucial to maintaining a secure healthcare ecosystem."

5.4 Restrictions and prospective research

Although this study offers insightful information, it has a number of shortcomings:

• Simulation information

It's possible that using simulated data won't precisely represent actual circumstances. Actual data may be incorporated into future studies to provide a more thorough analysis. • Variety of biometric techniques:

The focus of research is on particular biometric modalities. Future studies might examine the performance of additional modalities in various scenarios.

• Long-term evaluation

To assess the continued efficacy of MFA with biometric detection in actual healthcare systems, long-term research are required.

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