Research

Individual Project Semester 6
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Can Security by Design Principles Improve the Security of Quiz Game Project?

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Introduction

In recent years, the rise of cyber threats and data breaches has proven the importance of ensuring the security of software applications and systems. To reduce such risks, the concept of "Security by Design" has gained increasing attention among software development. This approach involves integrating security considerations and practices throughout the entire software development life cycle, rather than treating security as an afterthought. This research explores the application of security by design principles in the context of this semesters' software project - The Quiz Game. While the project is done for the purposes of a university project, the quiz game can also be considered as an effective tool for training and education purposes. However, given the sensitive nature of the data involved (e.g., personal information), it is important to ensure that the system is secure and protects the privacy of users.

The research aims to answer the following questions:

- How can security by design principles be applied in the development of a small quiz game project?
- What are the benefits and challenges of adopting a security by design approach in this context?
- To what extent does the implementation of security by design principles improve the security and privacy of the quiz game system?

To answer these questions, the research will analyze the development process of the quiz game project, identify potential security risks and threats, and propose and implement security measures based on security by design principles. The research will also evaluate the effectiveness of these measures in improving the security and privacy of the system.

How can security by design principles be applied in the development of a small quiz game project?

Security by design principles can be applied in the development of a small quiz game project by considering security as an integral part of the development process. This involves identifying potential security risks and threats and implementing appropriate security measures to mitigate them. Some specific ways that security by design principles can be applied in the development of a small quiz game project included:

- Conducting a thorough security risk assessment to identify potential vulnerabilities and threats to the system. Before the development of the quiz game begins, an evaluation was performed on the potential risks and vulnerabilities that the system may face. This was done by considering what user data is going to be needed in the system and estimating how to prevent unauthorized access and other cases where things might go wrong – security-wise.

- Using secure coding practices and secure software development methodologies to ensure the system is designed and implemented securely. To ensure this in the Game Quiz project I've decided to make a use of a secure coding language – C# and a web application framework – ASP.NET that provides a set of tools and libraries for building secure web applications. Principles like input validation and error handling have been included in the design planning before the start of the implementation and have been kept consistent during development.

The planning also includes authentication of users and enforcing access controls to ensure that only authorized users have access to system resources.

- Incorporating data protection and privacy measures to ensure that any sensitive information collected by the quiz game system is kept secure. This includes using encryption to protect data in transit and at rest, and implementing access controls to restrict who can view or modify the data.

By integrating these security by design principles into the development of a small quiz game project, the system can be designed to be more secure and resilient to potential attacks.

Authentication and Authorization

Authentication and authorization are important parts of security by design because they help ensure that only authorized users can access the system and its resources. In the means of the Quiz Game project – the users have to be authenticated in order to be authorized to play the game and build up their score. The concept of having a game where you can play, collect score points and compete with other players and their score points becomes redundant if a proper authentication and authorization system is not implemented. If the system does not provide any kind of authentication to the user – it cannot ensure that the user's data – personal information and game progress is secured and only accessible by the user himself/herself.

Auth0 is an identity and access management (IAM) platform that helps developers integrate secure authentication and authorization into their applications. By leveraging Auth0's platform, the development can be focused on the Quiz Game and leave the complexities of security and identity management to the experts at Auth0. Auth0 provides various features and services that align with the security by design principles. Firstly, Auth0 provides authentication and authorization features that help developers implement secure user authentication and access control in their applications. Auth0 supports various authentication protocols such as OAuth 2.0 and OpenID Connect, and provides user management features such as user authentication, user registration, and password reset. Secondly, Auth0 provides secure application programming interfaces (APIs) that enable developers to build secure and scalable APIs for their applications. Auth0 offers features such as API authorization, token verification, and rate limiting, which help protect APIs from unauthorized access and abuse. Thirdly, Auth0 provides identity features that help developers manage user identities securely. Auth0 offers identity management features such as single sign-on (SSO), multi-factor authentication (MFA), and passwordless authentication, which help improve user experience and reduce security risks.
In addition, Auth0 provides various SDKs and libraries that can be used to integrate Auth0 with ASP.NET Web API.

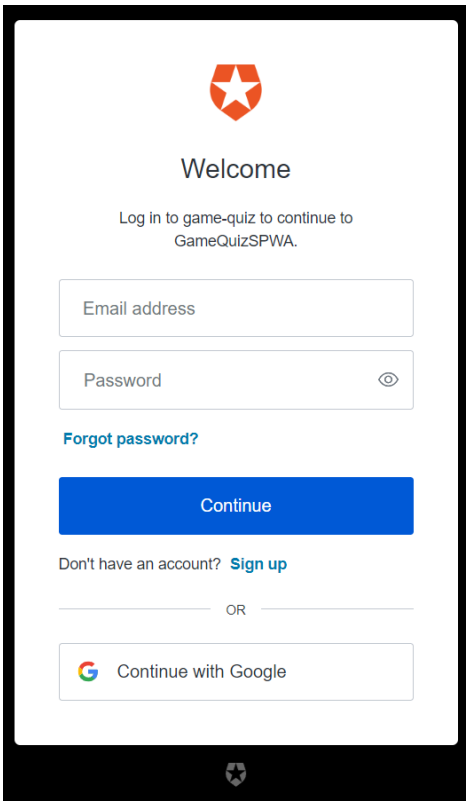

Figure 1 - The Login Module as seen from the Game Quiz Dashboard UI

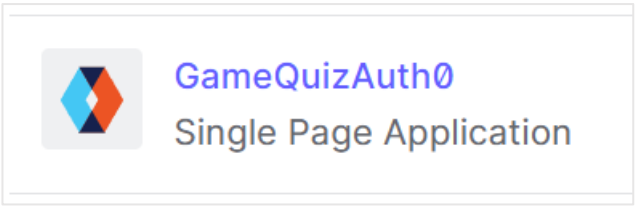

Figure 2 - The Game Quiz Application registered service in the Auth0 system

```
builder.Services.AddAuthentication(options =>
{
    options.DefaultAuthenticateScheme = JwtBearerDefaults.AuthenticationScheme;
    options.DefaultChallengeScheme = JwtBearerDefaults.AuthenticationScheme;
}).AddJwtBearer(options =>
{
    options.Authority = "https://game-quiz.eu.auth0.com/";
    options.Audience = "[redacted]";
    options.TokenValidationParameters = new TokenValidationParameters()
    {
        NameClaimType = ClaimTypes.NameIdentifier
    };
});
```

Figure 3 - The Game Logic ASP.NET Web API Configuration settings for configuring the Auth0 authentication service

What are the benefits and challenges of adopting a security by design approach in this context?

Adopting a security by design approach in the development of a small quiz game project can have several benefits and challenges:

Benefits:

- A security by design approach helps to identify and mitigate security risks at the early stages of development, leading to a more secure and robust system. Having thought of this in the pre-development stage ensured the smooth building of the two game services – without the worry of any data leakage.
- Addressing security concerns early in the development cycle can help to avoid expensive rework and potential data breaches, which can be costly in terms of both time and money. In this case – having addressed security issues at an early stage helped me stay on track with my planning and execute tasks on time and as they have been set.
- Users are more likely to trust a system that has been designed with security in mind, which can lead to improved user engagement and retention – making the Quiz Game a reliable application.

Challenges:

- Integrating security into the development process requires additional time and resources, which can be a challenge for small projects. However, being the project of a research-based semester, it wasn't long before this challenge was overcome. With the proper amount of trial-and-errors – the implementation of the Auth0 authentication service into the Game Logic Service became reality.
- Adding security measures can sometimes make the user experience more inconvenient, which can impact the adoption and success of the quiz game project. In this case, however, Auth0 provides many alternative options to the regular sign-in options using a username and password. The user can register or login with just a couple of clicks using his Google account credentials.

Overall, while there are challenges to adopting a security by design approach, the benefits of doing so, such as improved security and user confidence, outweigh the challenges.

To what extent does the implementation of security by design principles improve the security and privacy of the quiz game system?

Implementing security by design principles can significantly improve the security and privacy of the quiz game application.

- Auth0 provides a secure and robust authentication and authorization system, which helps to ensure that only authorized users have access to the system's resources.
- Input validation is a fundamental security practice that involves validating user input to prevent attacks like SQL injection. The Quiz Game system can prevent the introduction of malicious data into the system, which can compromise the security and privacy of the system.

- ASP.NET is a secure programming framework that provides built-in security features and best practices.

Overall, by implementing Auth0 into the system, following security by design principles like input validation, and choosing ASP.NET as a programming framework, the quiz game system can significantly improve its security and privacy. However, it is important to note that security is an ongoing process, and regular security testing and vulnerability assessments are necessary to ensure the continued security of the system.

Conclusion

In conclusion, building a software project with security by design principles in mind is crucial in today's world where cyber threats and data breaches are on the rise. It's important to conduct thorough research and engage in trials and errors to identify vulnerabilities and address them throughout the development life cycle. While the implementation of security by design can significantly improve the security and privacy of a software project, it's an ongoing process that requires regular security testing and vulnerability assessments to ensure the continued protection of the system.