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Implementation of Augmented Reality and 3D as a Media for Introducing the Fusena Evo.4 Electric Car

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ABSTRACT The Fusena Evo.4 electric vehicle developed by Politeknik Negeri Madiun has gained attention through various national competitions and exhibition events. However, its introduction still relies on printed media and direct explanations, which are inefficient when dealing with large numbers of visitors. This study proposes the implementation of Augmented Reality (AR) combined with QR Code technology as an interactive introduction medium [1]. AR enables virtual visualization of three-dimensional objects, providing an immersive and engaging user experience. The integration of AR and QR Codes allows fast and detailed access to electric vehicle information, enhancing public understanding and awareness of environmentally friendly transportation [2]. The system was developed using the Luther–Sutopo multimedia development method, consisting of six stages: concept, design, material collection, assembly, testing, and distribution. The resulting Android-based application visualizes the Fusena Evo.4 electric vehicle in 3D using Augmented Reality, allowing users to explore vehicle components in real-world environments. Unity and Vuforia were used as the development engine and AR database, while Blender was utilized for 3D modeling [3]. The results demonstrate that AR-based media effectively improves accessibility, interactivity, and educational value in electric vehicle introduction.

INDEX TERMS Fusena Evo.4, Augmented Reality, 3D Visualization, QR Code, Electric Vehicle.

I. INTRODUCTION

Electric vehicles represent clean transportation technology capable of reducing air pollution caused by carbon dioxide and sulfur dioxide emissions from internal combustion engines [4]. Recently, electric vehicles have gained increasing attention, particularly in academic and competition environments. Fusena Evo.4 is an electric racing vehicle developed by Politeknik Negeri Madiun, designed with characteristics similar to formula electric cars for competitive purposes [5].

Currently, the introduction of Fusena Evo.4 during exhibitions such as the Indonesian Electric Car Competition (KMLI) and vocational festivals relies on printed banners and direct verbal explanations by team members. This approach is inefficient due to limited human resources and the large number of visitors attending exhibitions. Consequently, visitors often experience difficulty obtaining detailed and comprehensive information about the vehicle.

Augmented Reality has been widely applied in transportation, automotive, and educational sectors due to its ability to present information in a more realistic and interactive manner [6]. Additionally, QR Code technology offers fast data access and ease of use, making it suitable as an entry point for AR-based applications [7]. Therefore, this research implements AR and 3D visualization supported by QR Codes as an innovative introduction medium for the Fusena Evo.4 electric vehicle. This approach is expected to enhance educational value, promotional effectiveness, and public awareness of sustainable transportation.

II. INCINERATION DESIGN

2.1. System Architecture

The proposed system architecture consists of QR Code detection, AR camera activation, 3D object rendering, and interactive information delivery **[8]**. When users scan the QR Code using the AR camera, the system retrieves the corresponding 3D model from the Vuforia database and displays it in a real-world environment through Unity.

2.2. Use Case Diagram

The functional behavior of the application is illustrated using a use case diagram, as shown in Figure 1.

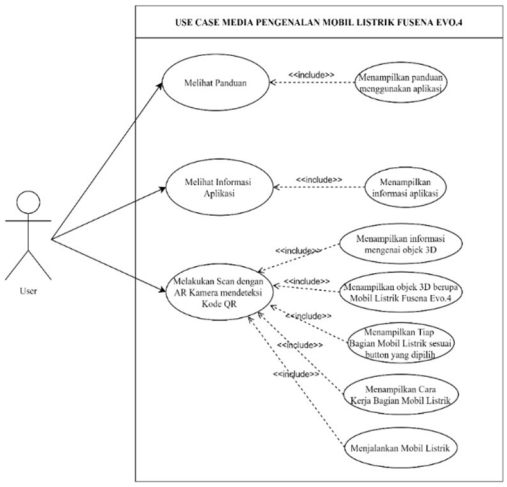

Figure 1. Use Case Diagram of Fusena Evo.4 Electric Vehicle Introduction Media

The user can access application guidance, application information, and the AR camera. Through the AR camera, users scan a QR Code to display the 3D electric vehicle model. Users can explore individual vehicle components such as the body, frame, motor, suspension, and braking system, view animated operational explanations, and simulate running the electric vehicle.

2.3. Application Wireframe Design

The application interface design is represented using wireframes to illustrate navigation flow and user interaction, as shown in Figure 2.

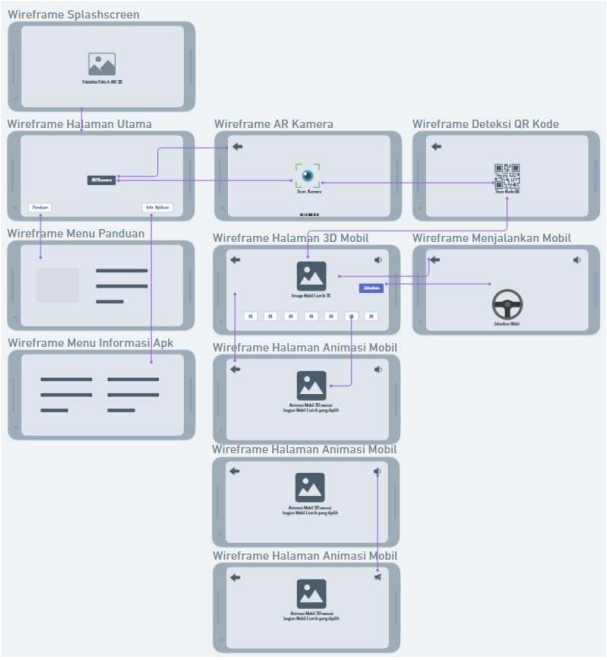

Figure 2. Wireframe of Fusena Evo.4 Electric Vehicle Introduction Application

The wireframe includes the splash screen, main menu, AR camera page, QR Code detection page, 3D visualization page, component animation page, application guide, and application information page. This design ensures intuitive navigation and clear user experience.

III. RESULTS AND ANALYSIS

3.1. Application Implementation Results

The implementation of the AR-based introduction application produces several main interfaces, as shown in Figures 3–5.

Figure 3. Application Splash Screen

The splash screen displays the Fusena Evo.4 logo as the initial interface when the application is launched.

Figure 4. Main Menu of the Application

The main menu provides access to the AR Camera, User Guide, and Application Information.

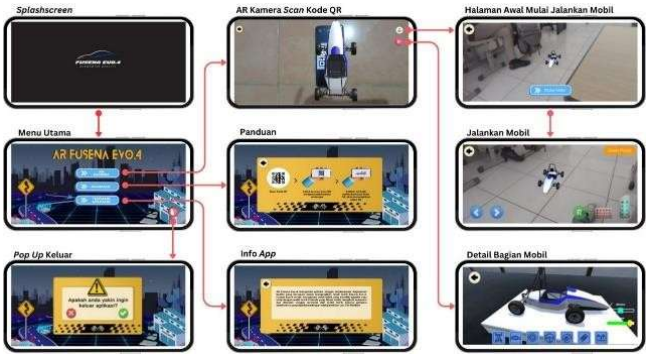

Figure 5. Overall Application Workflow

Figure 5 illustrates the complete workflow of the application, starting from splash screen display, main menu navigation,

QR Code scanning, 3D object visualization, vehicle operation simulation, and component detail exploration.
Through AR visualization, users can observe the electric vehicle in real scale, rotate objects, activate animations, and simulate vehicle movement, providing a realistic and immersive learning experience.

3.2. System Testing
Black-box testing was conducted to evaluate application functionality based on output behavior without considering internal code structure, as summarized in Table 1.

Table 1. Black Box Testing Results of the Fusena Evo.4 AR Application

Menu	Input	Expected Result	Actual Result	Conclusion
Main Menu	Press AR Camera button	The application displays the camera on Android 10 to scan a QR Code image used to display the 3D electric vehicle object	Aplikasi The application successfully displays the camera on Android 10 and scans the QR Code to show the 3D electric vehicle object	Accepted
	Press Guide button	The application displays a guide panel containing brief instructions on how to use the application	The guide panel with brief usage instructions is displayed correctly	*Accepted*
	Press Application Information button	The application displays an information panel explaining the Augmented Reality electric vehicle application Fusena Evo.4	The application information panel is displayed correctly	Accepted
	Press Exit button	The application displays a confirmation pop-up to exit the application	The exit confirmation pop-up is displayed correctly	Accepted

The functional testing results demonstrate that all core features of the Fusena Evo.4 Augmented Reality application operate reliably and in accordance with the system design. User interactions from the main menu consistently trigger the expected system responses, including AR camera activation, QR code detection, 3D electric vehicle visualization, and informational content display. The successful execution of these functions indicates that the integration between Augmented Reality, QR code scanning, and 3D visualization is stable and user-friendly. These findings confirm that the application effectively supports interactive introduction of electric vehicle technology and meets the usability and functionality requirements for educational and promotional AR media.

IV. CONCLUSION

Based on the implementation and testing results, the following conclusions can be drawn:

1. The AR-based introduction application successfully facilitates fast and interactive access to Fusena Evo.4 electric vehicle information using QR Codes.
2. The integration of Unity, Vuforia, and Blender enables realistic 3D visualization and real-world interaction through Augmented Reality.
3. The application enhances educational value, promotional effectiveness, and public awareness of environmentally friendly electric vehicles.

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REFERENCES

[1] A. (. Javornik, “The mainstreaming of augmented reality: A brief overview,” *Journal of Retailing and Consumer Services,* pp. 61, 102504, 2021.

[2] P. A. F. R. &. H. C. Rauschnabel, “Augmented reality marketing: How mobile AR-apps can improve brands through inspiration,” *Journal of Retailing and Consumer Services,* pp. 64, 102828, 2022.

[3] T. d. R. K. C. M. M. D. &. K. D. I. Hilken, “Augmenting the eye of the beholder: Exploring the strategic potential of augmented reality to enhance online service experiences,” *Journal of the Academy of Marketing Science,* vol. 50, no. 1, p. 1–21, 2022.

[4] E. Saefudin et al., “ Static Analysis of Tubular Space Frame Chassis of an Electric Racing Car,” *METAL: Jurnal Sistem Mekanik dan Termal,* vol. vol. 7, no. no. 1, 2023.

[5] M. PNM, “Proposal Kompetisi Mobil Listrik Indonesia,” Jawa Timur, 2023..

[6] F. B. e. al., “FiAAR: An Augmented Reality Firetruck Equipment Assembly Assistant,” dalam *IEEE CogInfoCom*, 2020.

[7] A. A. e. al., “QR Code-Based Asset Management System,” *Jurnal Nasional Teknologi dan Sistem Informasi,* vol. Vol. 6, no. No. 3, 2012.

[8] J. &. S. A. N. Scholz, “Augmented reality: Designing immersive experiences for consumer engagement,” *Business Horizons,* vol. 64, no. 1, p. 55–64, 2021.