EasyChair Preprint

№ 13959

Shilla Gyeongju Tourism AI-Bus Using XR Realistic Content Technology

Jin Ho Park, Sang Gyu Park, Ho Sung Park, Jae Byung Park and Amrapali P.Tribhuvan

July 13, 2024

9th International XR-Metaverse Conference 2024 (XRM 2024)
Busan, South Korea, May 20-22, 2024

Shilla Gyeongju Tourism AI-Bus using XR Realistic Content Technology

Jin ho Park[a], Jae Byung Park[b], Sang Kye Park[c] , Amrapali P.Tribhuvan[d]

[a] Sejong Campus Virtual Smart City Visualization System Convergence Education and Research Cluster, Korea University, Republic of Korea
arkology@naver.com

[b] Department of Display and Semiconductor Physics, Korea University, Republic of Korea
jaebyungpark@Korea.ac.kr

[c] AI-Media, Republic of Korea
greatpark1017@hanmail.net

[d] Research Scholar, Dr. Babasaheb Ambedkar Marathwada University, India
amrapaliprakash512@gmail.com

Abstract

This paper aims to present an XR-Bus digital tour of cultural heritage sites scattered throughout Gyeongju through a vehicle called Bus targeting Gyeongju's Shilla cultural heritage. A total of three technologies were applied. The first is a semi-transparent display technology. The second is an xr content implementation technology. The third is an XR-Bus with artificial intelligence (AI) technology. AI digital human technology is applied. After restoring representative figures of the Shilla Dynasty with digital human technology, they are used as guest tour guides. Ultimately, we want to produce 'Artificial Fusion' contents based on XR and establish it as a single XR-Bus platform. Based on this, we will expand it not only to Gyeongju but also to other cultural and tourism Main Cities scattered throughout Korea. This can be defined as AI-Bus Hallyu(Korean Wave).

Keywords: Shilla Dynasty, XR content, XR-Bus, AI-Bus, Digital Human

1. Introduction

In the future Mobility Industry, the use of media is increasing. At CES held in the United States in January 2024, "Artificial Intelligence" was the biggest issue. It showed the vision of the future car. The future car is no longer a means of transportation, but an entertainment space in evolution. This is due to autonomous vehicles by artificial intelligence technology. Various devices, contents, and ICT technologies are converging to create new market industries.

In particular, the field that can be applied first and foremost is the smart tourism sector. This includes tourist guidance, information delivery, movement, and smart experiences using New media. To explain more technically, it is the development of car contents using extended content technologies such as AR/VR/MR.

Buses have long served as a means of transportation for humans. However, in the age of artificial intelligence, buses will no longer focus solely on transportation. Currently, XR contents are being developed into a media bus that can be operated inside the bus. Furthermore, if the AI technology is combined with autonomous driving and content implementation technologies, it will bring a revolution to the mobility industry.

For the past few hundred years since buses first appeared in the civilized world, they can be transformed from simple means of transportation into media buses where content is implemented. This paper examines the development status of the world's first MR-Bus and XR-Bus in Korea. First, we explain the case of the Zoo MR-Bus(Mixed Reality Bus) developed in 2019. In addition, we identify the case of the Suwon City Hwaseong XR-Bus (eXtended Reality Bus) service in 2022.

Furthermore, we aim to further enhance the XR functionality of the conventional City-Tour Bus. Through this, we propose an "AI-Bus" that has been upgraded to include artificial intelligence functions. First, we propose the operation of an AI-Bus in Gyeongju, designated as a UNESCO World Heritage Site. This "AI-Bus" with added artificial intelligence functions can also be developed into a "Digital Tourism Mobility Platform" that effectively introduces major cultural heritage sites in Korea and Abroad.

2. Suwon Hwaseong XR-Bus

2.1 From the Zoo MR-Bus to the Suwon XR-Bus

A bus is a large vehicle that carries passengers on roads and has a history of about 200 years since its introduction in the late 1800s. It is generally the best means of transportation for transporting a large number of people on a single trip. Recently, there have been attempts to convert these ordinary buses into Augmented Reality Buses. This happened in Daejeon City Zoo in Daejeon, South Korea in 2019. An African Safari MR-Bus was developed for the zoo, which ran for about four years from 2019 to 2023. Like this In 2019, an MR-Bus was operated for the Daejeon O World African Safari program, but only limited technology was applied. In 2022, an XR-Bus was operated in Suwon City. However, this XR-Bus also remained in the form of playing videos on the bus windows without any interaction. Therefore, we propose a fundamental New XR-Bus that goes beyond the limited media technology of the past.

2.2 The System Architecture of the XR-Bus

The Suwon City Hwaseong XR-Bus is an XR tour bus designed to showcase the natural, historical, and cultural sites of the UNESCO World Heritage Site, Suwon Hwaseong Fortress. This bus is equipped with transparent OLED media windows, allowing general visitors to vividly experience Suwon Hwaseong Fortress as it was 230 years ago during the Joseon Dynasty. Additionally, each seat is outfitted with a Galaxy Tab AR device that uses AI Face Recognition technology. This feature enables visitors to virtually try on period costumes (such as those worn by kings, queens, crown princes, generals, and other historical figures). The virtual fittings can be saved as image files, which visitors can download to their smartphones. This one-person augmented reality (AR) system provides an immersive and personalized experience.

Fig.1. View of Suwon City XR-Bus

3. Proposal for the Shilla Gyeongju XR-Bus Model

3.1 Proposal for the Gyeongju XR Tour Bus

VR (Virtual Reality), AR (Augmented Reality), and XR (Extended Reality) are no longer confined to static spaces like museums and experience centers; they are now accessible through mobility experiences such as cars. This development has been made possible by groundbreaking advancements in automotive in-vehicle display technology, enabling a 'time travel to the past' experience while on the move.

Forty years ago, when the science fiction movie "Back to the Future" was released in Hollywood, traveling back in time was purely an imaginative concept seen only in movies. However, with the integration of media display technology in cars, digital technology now allows for journeys into the past. In the near future, we will witness the application of digital media environments in Urban Air Mobility (UAM) vehicles. The goal has shifted from simple video viewing to developing platforms that fulfill the growing demand for digital tourism through interactive data collection. Currently, the XR-Bus provides general information and visuals through 'tourism.' It aims to offer time and space-based content that allows passengers to experience both the past and present in the digital virtual space between cultural heritage sites and the XR-Bus. In response to the increased demand for digital content post-pandemic and the evolving expectations of visitors, we have developed an engaging, experiential content suitable for foreign tourists visiting Korea, children, multicultural families, and groups of middle and high school students. Ultimately, the Gyeongju XR-Bus proposes an edutainment content model that stimulates curiosity and has high cultural and educational value by applying an interactive system for two-way communication with tourists interested in cultural heritage.

3-2. Hardware Display System Architecture of the Gyeongju XR-Bus

We propose a mobility content bus that allows passengers to enjoy XR-tour buses through natural, historical, and cultural destinations in Gyeongju, where UNESCO World Heritage sites are scattered. This is an XR-Bus equipped with bus automation technology, content interaction, and synchronization with stops. It is a different level from the MR-Bus and VR-Bus that were previously operated. It is based on full 3D video content inside transparent OLED. It would be much more effective if LG Electronics' semi-transparent display technology, which was exhibited at the US CES in 2024, is applied. Gyeongju XR-Bus plans to install tablets in each seat to maximize passenger interaction. We aim to overcome the limitations of the previously produced Media-Bus. Through the tablet PC installed in each seat, it is possible to implement a two-way service that allows passengers to participate. In conclusion, Gyeongju XR-BUS can enhance communication with travelers by applying interactive realistic contents.

Fig.2. View of Gyeongju XR-Bus

3-3. Hwangnyongsa Temple Site Area of the Gyeongju XR-Bus

This proposal aims to provide tourists with a digital experience of cultural heritage sites, going beyond the conventional city tour buses. It greatly aids in the visual understanding of cultural heritage and history. Similar to the currently operating Suwon Hwaseong XR-Bus, the existing XR-Bus provides general information and visuals. While there are some limited interactions through partial AR device operations, these are insufficient. There is a need for improved content services through the enhancement of the substantive and technical aspects of traditional interactive services. This will help overcome the gap between the actual heritage site and the visitors, offering an experiential mobility content.

Figure.3. The ruins of Hwangnyongsa Temple, the digitally restored image of Hwangnyongsa Temple, and the XR-Bus touring the Hwangnyongsa site.

Hwangnyongsa Temple was a prominent temple in Gyeongju, Gyeongsangbuk-do, during the Silla Dynasty until it was destroyed by Mongol invasions in the Goryeo period. The site has been in ruins for the past 800 years since the Mongol invasion. Various attempts have been made to digitally restore Hwangnyongsa, allowing users to experience the site in virtual reality (VR). In 2021, the National Research Institute of Cultural Heritage provided a service using augmented reality (AR) technology, enabling users to see the image of Hwangnyongsa at the heritage site through AR devices like smartphones or tablets. However, VR and AR have limitations in showing the past image of the ruined site. By touring the ruins in the XR-Bus, visitors can effectively view both the current ruins and the digitally restored past image through the windows on either side of the bus.

3-4. Underwater Tomb of King Munmu of the Gyeongju XR-Bus

The Underwater Tomb of King Munmu is Historic Site No. 158 in South Korea. It is currently located off the coast of Bonggil-ri, Munmu Daewang-myeon, Gyeongju, Gyeongsangbuk-do, South Korea. The site is a small rock island split into four parts and is historically known as the tomb of King Munmu, the 30th king of Silla who achieved the unification of the Three Kingdoms. It is also known as "Daewangam" (Great King's Rock) and is situated 200 meters offshore. King Munmu left a will stating that if his body were cremated and buried in the East Sea, he would become a dragon to protect the country. His ashes were reportedly buried on a rock in the East Sea according to this wish. Due to its location 200 meters from the shore, actual tourists cannot approach the underwater tomb of King Munmu and can only view the distant sea from the beach. However, by boarding the XR-Bus, which transforms into an amphibious vehicle, visitors can visually experience being above the underwater tomb of King Munmu through the bus windows, even though they cannot physically reach it. The XR-Bus offers a visual storytelling experience related to Gameunsa Temple and the legend of King Munmu turning into a dragon. Although physical access to the actual site is impossible, the XR-Bus windows can display full CG animations, recreating the past appearance of the tomb.

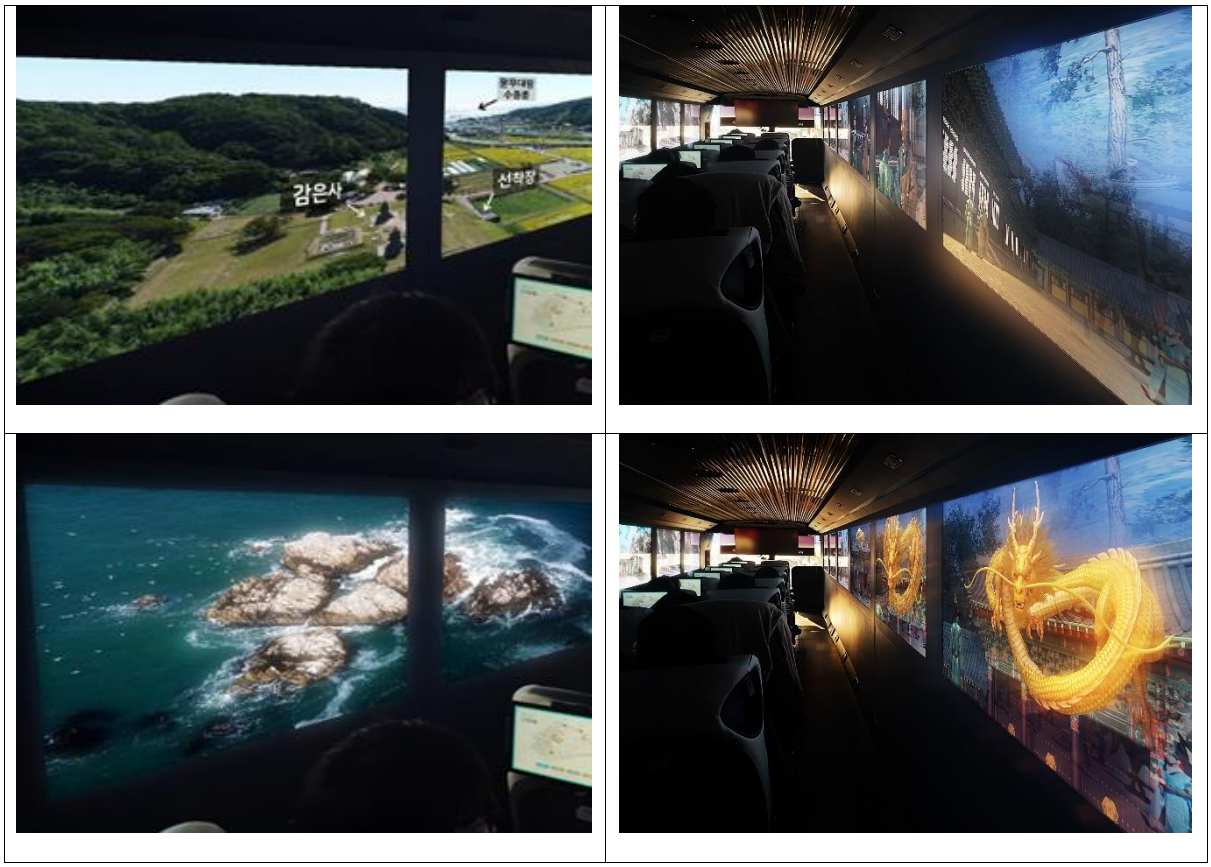

Figure.4. King Munmu Underwater Tomb XR-Bus

This allows for the planning of content that considers the archaeological, documentary, historical, and cultural value of the underwater tomb of King Munmu, to be provided on the XR-Bus. While overcoming the limitation of physical access, the XR-Bus enables digital restoration based on the historical site through its mobile display.

4. Gyeongju XR-Bus for Digital Tourism

4-1. Silla Capital (王京) XR-Bus Tour

The Silla Capital (新羅王京) refers to the area of present-day Gyeongju, which was the capital of the Silla Kingdom. The ancient capital, known as 'Seorabeol,' was a meticulously planned city with a grid layout of 360 squares. Silla Wang Gyeong, with its orderly grid structure, was centered around Wolseong (月城), where the royal palace was located. During the peak of Unified Silla in the 8th century AD, it was one of the world's four major cities.

Figure. 5. Experience the Major Landmarks of Seorabeol, the Capital of Shilla, 1300 Years Ago with the Silla XR-Bus

With the XR-Bus, you can tour Shilla Capital . Gyeongju, where Shilla Capital was located, is rich in cultural heritage sites such as Hwangnyongsa, Bunhwangsa, Cheongwansa, Woljeonggyo, Bulguksa, and Gameunsa. These relics, representing Silla's Buddhist culture, are already listed as UNESCO World Heritage Sites. Additionally, major destinations of the XR-Tour, as shown in Figure 10, include Cheomseongdae, Daereungwon (the tomb complex of Silla kings), and Wolji (Anapji), the site of the Shilla royal palace. These sites play a crucial role in understanding the history and culture of Silla and are key routes for the Silla Wang Gyeong XR-Bus, attracting many tourists. The Gyeongju XR-Bus route, designed for virtual tours of Silla Wang Gyeong, has been planned for some time. It begins at Singyeongju KTX Station, which is currently a KTX route. Passengers board the XR-Bus at Singyeongju KTX Station and depart for the Gyeongju heritage sites where Silla Wang Gyeong was located. The tour, starting from Singyeongju KTX Station, includes a 3-hour course visiting Hwangnyongsa, the underwater tomb of King Munmu of Silla, and more, offering a new media bus content experience. Transparent OLED displays can be installed on the left, right, and front sides of the bus. Passengers can enjoy the beautiful natural scenery and historical sites of Gyeongju through these displays inside the bus. Additionally, each seat in the XR-Bus can be equipped with a tablet PC for interactive engagement between passengers and media. This allows passengers to interact and easily find necessary information through the tablets installed at each seat. Furthermore, autonomous driving technology can be applied, enabling the Gyeongju XR-Bus to offer a more spacious and relaxed environment for experiencing digital tourism.

.

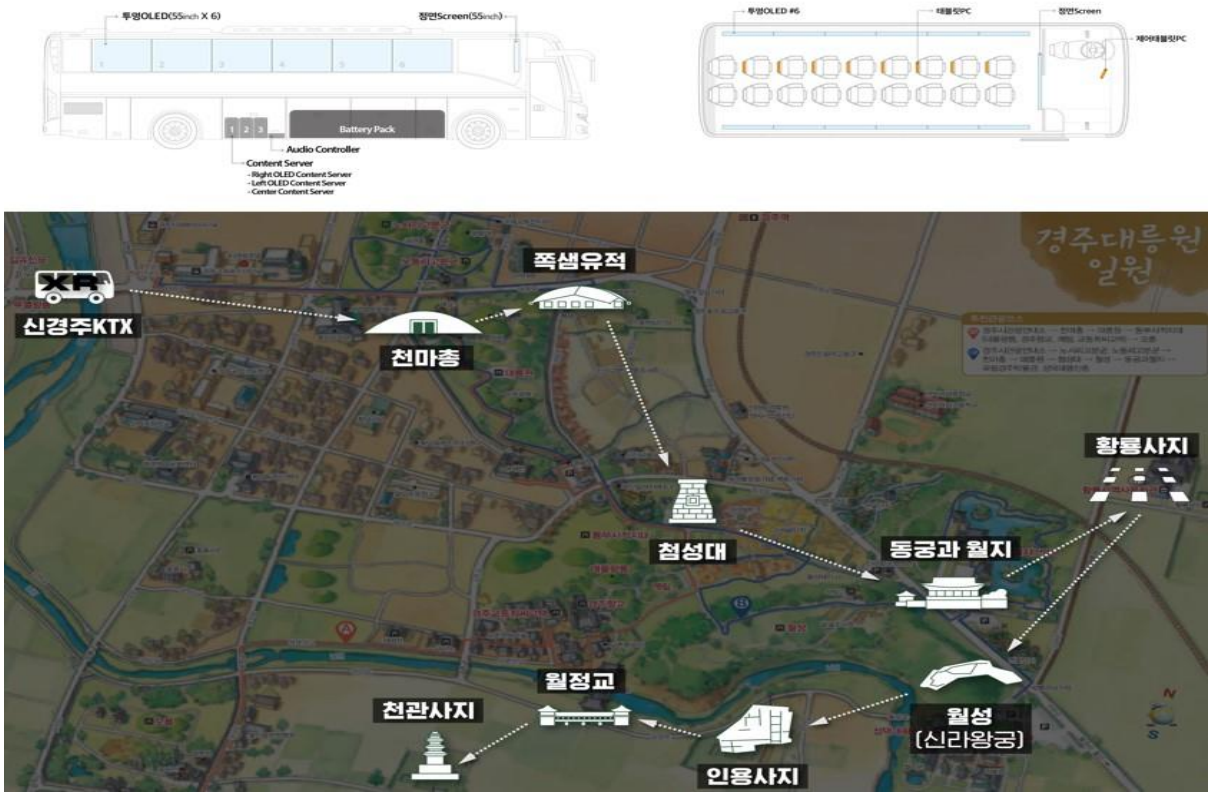

Fig. 6. The Hardware Structure of Gyeongju XR-Bus and the Map of the Gyeongju historic site tour, a UNESCO World Heritage site

.

4-2. Gyeongju AI-Bus

The applied XR technology is as follows. First of all, it is differentiated from the existing Suwon XR Bus "Memory of 1795". The hardware technology applied to Gyeongju XR-Bus is as follows. Technical elements that go into "Gyeongju XR-Bus" include virtual augmentation content technology, network technology, platform technology, and device technology. In particular, the AI technology applied to achieve AI-Bus is "AI Digital Human" technology. It is a real-time play technology for playing virtualized content in real time. Here, a Virtual Character guide content is added. The virtual character is an AI Digital Human. Three-dimensional characters of traditional Silla heroes such as General Kim Yu-sin, Queen Seondeok, and King Munmu are introduced.
Finally, an Artificial Intelligence Digital Human from the Silla Dynasty will appear to explain the cultural heritage of the Shilla Dynasty through the XR bus driver. In the end, the Shilla XR bus can become a Silla AI-Bus

5. Conclusion

In the end, "Shilla Gyeongju AI-Bus" implements an interactive viewer experience service. It is breaking away from being a simple video viewing bus. Data collection is also possible through interaction with passengers. Although it starts as an AI-Bus in Gyeongju, South Korea, it will be digitalized into a tourism platform. It is planned to be applied to other South Korean tourist destinations other than Gyeongju. It will settle down as a bus platform that meets the demand for the spread of cultural and natural tourism.
In conclusion, in the future, buses will no longer be limited to just running. With autonomous driving technology, it will be transformed into a space similar to enjoying entertainment at home. The start will be an AI-Bus for historic site tourism.

6. References

[1] Park Jin ho, Kim Si-Jung, Yoo Tae sun, Kim Hyun, Syed Hamad Ullah Shah, “Design and Development of XR Mobility Towards K-XR Bus”, International Conference of the Korean Contents Association, 2022.

[2] Ahn Hyoung ki · Park Jin ho, “A study on the contents of the UNESCO World Heritage Troy Ruins layer-based Artificial Intelligence Metaverse”, Proceedings of the Korean Contents Association Comprehensive Conference, 55-56, 2021.

[3] Park Jin ho, Hologram Technology and the Future Prospect, Journal of Korea Culture and Contents Technology Association) (Journal of Korea Culture and Contents Technology Association, 2012.

[4] Wi Sang-hee & Ahn Hyung-ki, ‘A study on the case analysis of cultural heritage exhibitions using hologram technology’, “Global Cultural Contents” No. 54, Global Contents Association, 2023.

[5] Kim S. J., Hung Yu-Hsiu and Winchester Woodrow, “Environmental User Interface (EUI): The Initiative of Environment Coupled User Interface”, HCI International 2007, 580-584, 2007.

Acknowledgements

This paper was prepared with the support of the 4th Stage BK21 ARMR System and Content Convergence Research Group of Korea University Sejong Campus.