



**ASHESI UNIVERSITY**

**AUGMENTED REALITY AS A TOOL TO PROMOTE TOURISM IN GHANA**

**Undergraduate Thesis**

B.Sc. Management Information Systems

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**ASHESI UNIVERSITY**

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**Undergraduate Thesis**

Undergraduate thesis submitted to the Department of Computer Science, Ashesi University, in partial fulfilment of the requirements for the award of Bachelor of Science in Management Information Systems.

Marian-Bernice Haligah

April 2021

## DECLARATION

I hereby declare that this undergraduate thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Signature:



.....

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.....

Date:

13<sup>th</sup> May 2021

.....

I hereby declare that preparation and presentation of this undergraduate thesis were supervised in accordance with the guidelines on supervision of undergraduate thesis laid down by Ashesi University.

Supervisor's Signature:



.....

Supervisor's Name:

Mr. David Sampah

.....

Date:

13<sup>th</sup> May 2021

.....

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## **Abstract**

This thesis seeks to find out if using Augmented Reality (AR) in Ghana's tourism industry is feasible in promoting its tourism activities. As developed countries have been well versed in the use of technology trends like Augmented Reality in their tourism sector, the researcher wants to determine if such integration in Ghana's tourism sites will be well patronized.

In this paper, the researcher designed and built an Augmented Reality Tourism website to give users an interactive graphic experience of a tourist site through their devices. Volunteers from social media, both Ghanaians and foreigners, who wish to participate in the research process were the participants of the study. The study took place in this order: the link to the AR Tourism website was posted on social media, the participants clicked on the link to the website to interact with it. After, they were required to fill a questionnaire that aimed to get insights into the participants experience using the AR Tourism website, how effective the system was and if it informed a possible tourist's decision to take a tour. Microsoft Excel was used to analyze the data received from the data collection process.

The results from analyzing the data gathered from the questionnaires showed that Augmented Reality would be suitable for the Ghanaian setting. The majority of the possible tourists who responded to the questionnaire are willing to take a tour in Ghana after experiencing a tourist site through Ghana's Augmented Reality application, once implemented, hence boosting its tourism sector due to increased local and international patronage.

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# **Chapter 1: Title and Introduction**

## **1.1 Introduction**

Tourism is a business that is comprised of persons travelling to and staying in places outside their usual environment for a while, usually not more than one consecutive year, for leisure, business and other purposes [10]. Tourism delivers a travel experience comprising transportation, accommodation, eating and drinking establishments, retail shops, entertainment and lessons on cultural and historical background. The tourist experience differs for many people. Some people take tours to explore the beauty of a tourist site, learn about a place's historical and cultural background, for relaxation purposes, for the food and/or for adventures. The tourist experience is crucial in academic tourism research as it is pivotal to understanding what tourists are searching for.

For Ghana, the country has a beautiful natural scenic, history and diverse cultures. Mensah and Amissah [12] suggested that parts of West Africa, Ghana included, constitute one of the best destinations for African-Americans who want to return to their ancestral homeland since most of their ancestors were born in these African countries but sent out as slaves to a foreign land. Ghanaians and other international tourists may also want to experience Ghana's tourism destination. In 2019, Ghana's Year of Return, saw about 737,000 Africans in the diaspora return to Ghana for the numerous tourism activities [23]. Their patronage benefited the economy as it contributed to the country's GDP and increased revenue for these tourist sites [9]. For most tourists, if their experience at a tourist destination in Ghana were memorable, they could return or even tell other people to visit.

## **1.2 Background**

Tourism generates foreign exchange earnings, creates jobs and stimulates other sectors of the Ghana's economy. In 2016, the Tourism and Travel Competitiveness Report (TTCR) [18] stated that tourism is the fourth-highest forex earner in Ghana. Tourism contributes GHC 4.97bn to Ghana's GDP, making up approximately 3% of the GDP. Tourism in Ghana also provides 2.6% of total employment in the country. In 2016, the TTCR also reported \$818.8m in international inbound receipts, placing Ghana above other African tourist destinations like Kenya and Namibia. Despite this progress, the tourism sector requires ongoing attention to position itself strategically on the African tourism landscape as Ghana ranks 120th out of 136th global tourist destinations [18]. In west Africa, Ghana is below Côte d'Ivoire (109th), Senegal (111th) and Gambia (112th); however, Ghana remains above Nigeria (129th), Mali (130th) and Sierra Leone (131st) because of its infrastructure, openness, tourist services and price competitiveness [18].

## **1.3 Problem Statement**

According to Catherine Afeku, Ghana's minister of tourism, as of 2019, in all the sixteen regions of Ghana, one can count at least one tourist site that can be visited for recreational or cultural purposes, but one of the problems the country faces in this industry is the lack of awareness of these destinations [14]. How well tourist sites are advertised determines how many tourists crave to tour the site. Some Ghanaians are unaware of the tourist sites in the regions farthest from them, or even if they are aware, they have little to no information about these places or how to get there. This makes it difficult for Ghanaians and foreigners who want to tour different parts of Ghana because they do not know how to get there or what to expect upon arrival.

It is with no doubt that technology is a factor that has helped the tourism industry around the world succeed for almost over a decade [15]. Prior to a tour, information can be obtained about the location to be visited via its online presence, which is intended to support tourists with any travel decisions. The incorporation of technology in tourism, such as social media, can also enable people to share their travel experiences and assist others in obtaining information about a site and virtually experience it from the comfort of their home.

According to Neuhofer-Buhalis [15], the advancement of technology in the tourism industry has empowered tourists to identify and patronize tourist destinations. For instance, a huge information source is the internet, where potential tourists can easily collect ideas, become inspired, plan their vacation and book online. In Ghana, common ways in which tourists get information about a tourist destination before travelling are by using pamphlets, simple websites and/or social media. All these have attempted to create awareness of tourist sites. According to Chang and Wu [11], newer technologies can be used to reach a larger market since they were created to suit the newer generations. Augmented Reality is one technology that has been innovated and continues to welcome newer iterations [3]; thus, it is being explored in many sectors of the world, tourism included. Augmented Reality enables the addition of virtual objects (mostly in the form of 3D) into environments to facilitate real-time interaction [5]. In the area of Augmented Reality, little research has been done as to how it creates an interactive graphic experience of Ghana's tourist destination electronically to attract more visits. The study focuses on filling this gap by investigating whether an Augmented Reality application can enhance the online experience of a possible tourist in Ghana's tourist location. My research aims to contribute to the tourism context and help any interested stakeholder focus on tools that can create more awareness of tourist sites in Ghana and thus promote tourism.

## **1.4 Significance of the Research**

Tourism is one of the GDP contributors in Ghana, providing about GHC 4.9 billion to the country. An increase in the patronage of tourists in the tourism sector can, in turn, increase the GDP of the country tremendously. Hence, there is a need to maximize the tourism sector of Ghana to its full potential. Researching to employ as many possible strategies such as Augmented Reality can determine whether tourists will engage in Ghana's tourism activity, contribute to the GDP, and socio-economically develop Ghana.

Augmented Reality is one of the technologies that is still in its infant but has a good prospect, so there is a need to experiment with it in many areas. Showing its capabilities by building on top of a mobile device, one used every day, can ease the application's penetration rate to reach more users. It can also encourage more developers to leap to experiment and build functional applications using AR, not necessarily in the same tourism sector.

## **1.5 Research Questions**

To address the problems identified, the research seeks to answer the following questions:

- What is the current state of tourism in Ghana?
- How is technology currently being implemented in Ghana's tourism industry?
- Can the implementation of Augmented Reality boost tourist experience and tourism in Ghana?

## **1.6 Aims/ Purpose of Research**

- Provide an overview of Ghana's current state of tourism
- Identify the current state of Ghana's tourism industry with regard to the implementation of technology.
- Analyze the responsiveness of tourists to the application of Augmented Reality in tourism in Ghana.

## **1.7 Hypothesis**

Possible tourists are likely to visit a tourist destination in Ghana due to an experience with an Augmented Reality application.

## **1.8 Organization of thesis**

This research document entails five chapters outlined as follows:

### **1.8.1 Chapter 1 – Title and Introduction**

This chapter introduces the research by providing a background to the problem being investigated. In this chapter, the research questions, aims, hypothesis and the significance of the study are outlined.

### **1.8.2 Chapter 2 – Literature Review**

In this chapter, existing literature on the research area is reviewed. The Tourist Experience, Tourism and Technology, and Augmented Reality in Tourism are explored. Related works are also stated.

### **1.8.3 Chapter 3 – Research Methodology**

In this chapter, the research process is described. It makes mention of the tools and technologies, and the functional and non-functional requirements. This chapter also highlights on the research design, the data collection process and means of dissemination.

### **1.8.4 Chapter 4 – Implementation, Findings and Analysis**

The beginning of this chapter explains the procedures during the implementation phase. It also analyzes the data received from the data collection tool – questionnaires. It presents the findings in the form of graphs and discusses them in light of the research objectives and hypothesis to show approval or disapproval.

### **1.8.5 Chapter 5 – Conclusion and Recommendations**

In this chapter, the researcher highlights the application of the results found in the research. Some limitations discovered during the study are also pointed out with some recommendations for future works.

## **Chapter 2: Literature Review**

### **2.1 Tourist Experience**

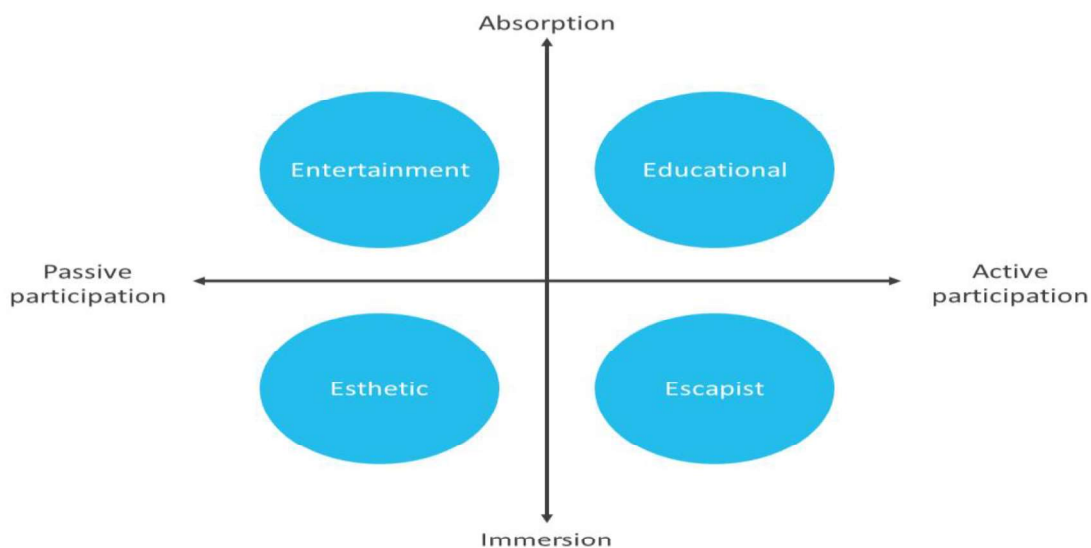
Creating a memorable experience for tourists has become the primary importance of tourism as tourists are increasingly empowered to co-create their own experiences by immersing themselves in the activities of a tourist environment and the experiential contexts they offer [1,2]. Tourist experiences cover various subjective reactions, moods and feelings when the tourists interact with a tourist product [2].

A tourist's feeling and attitude towards a tour determines the levels of experience that the tourist acquires, and this depends mainly on the combination of Pine and Gilmore's experience realm. Pine and Gilmore [13] asserted that the richest experience should cover aspects of the four different realms of consumption experience:

- **Entertainment:** Occurs when there is a passive absorption of a tourist experience through the senses of the tourist (see Figure 2-1). This realm is when a tourist mainly takes a tour for the purpose of being entertained. It includes festivals and other special events that the tourist can go for, to have fun and relax. For instance, in Ghana's "Year of Return" in 2019, many international tourists came for the Afrochella festival – a big concert and carnival [23].
- **Education:** Occurs when the tourist absorbs the destination by actively participating in the activities (see Figure 2-1). With the educational realm, it appeals to the thinking of the tourist. The tourists are expected to absorb themselves in the environment and actively use their minds throughout the tour. It includes tourism activities where the tourist will have to think a lot about what they are experiencing, for instance, taking horse riding lessons at Ghana's Polo Club.

- **Escape:** Occurs when the tourist actively participates in a tour by immersing him/herself in the environment (see Figure 2-1). The escapist realm deals with acting. Typically, a tourist destination offers escapist experiences by providing specific resources to aid the user in fully participating in the activities. It includes mountain hiking, golfing, swimming and any other actively engaging activity during a tour. In Ghana, escapist tourist activity is going hiking at Shai Hills in the Volta Region to enjoy the beautiful view.
- **Estheticism:** Occurs when the tourists immerse themselves into the whole tourist experience but still manage to remain passive (see Figure 2-1). With the esthetic realm, it appeals more to the senses of the tourist. The activities that constitute estheticism include visiting cultural or historic sites. With such activities, the tourists can enjoy being at the tourist destination without doing anything that affects the nature of the environment. The experiences appeal to how they feel and their senses. For instance, in 2019, many African-Americans returned to learn about their history during the Year of Return activities. They visited the Cape Coast Castle and Elmina Castle to learn about slavery and colonization [23].

The figure below explains the four realms explained above [9].



***Figure 2- 1: Diagram showing the Experience Realm [9]***



The tourist experience is all that happens during a tourist event, commencing with anticipation through the period before the tour, to the on-site activity, the return from tour then the recollection phase. Before touring, tourists have different reasons and motives, of which having a great experience, knowledge and self-identity are included [12]. Thus, tourist sites must ensure that their products and services are of adequate quality and are essential to the tourists as it could determine their experience. That is because tourists, both domestic and international, who partake in tourist activities contribute to the sustainable development of the tourism industry. In Ghana, tourists regenerate the economy through increased foreign exchange earnings and increased growth, reducing poverty [12]. So, the tourism industry must be well planned to cater to tourists and what they consider a good experience to optimize socio-economic benefits for the country. These days, the tourist's social construction of a destination is influenced by the media, which results in their expectation of that destination [13]. Hence, tourist sites need to ensure that what the media publicizes beats the tourist's expectations by considering the tourist's factor in designing their offerings.

## **2.2 Tourism and Technology**

Researchers have explored different innovative ways of promoting tourism. Pine and Gilmore termed the world economy as an experience economy and made reference to technology as a push factor in creating so many experiences [13]. The internet today is an information source that tourists use as a channel to communicate and perform transactions within the tourism industry. The internet is seen to be a better mediator in the tourism industry as compared to other media since it has provided a much more interactive opportunity for tourists and tourist destinations, as well as in the creation of tourism products and forming the tourist experience [5]. With the

integration of technology in tourism, tourists can experience the real physical environment of a destination and at the same time stay connected in the online world [15]. Thus, integrating technology will help to transform our perception of the formation process of the tourist experience. Technologies support the tourists at the very beginning when they search for information, to the planning, decision making, online reservation, retrieval of information, as well as the post-sharing of experiences stage. Hence, ICTs such as interactive websites, recommender systems, virtual communities in the form of Virtual and Augmented Reality, social media networks as well as mobile technologies are utilized to support the tourist experience in all the stages of tourism [2].

For Ghana, the dominant technology used in gathering information about a tourist site are simple websites, for example, the official Ghana tourism website – [www.ghana.travel.com](http://www.ghana.travel.com) and social media pages such as @gtdc\_gh, @tourismgh on IG and individual tourist site pages such as @kakumpark. In [11], Chang and Wu emphasized social media as being a dominant tool for travel and tourism agencies to promote their services and reach their potential customers, who mostly tend to inform themselves about a tourist destination and exciting things to do before a tour. It buttresses the idea that the presence of a tourist site online is a determinant of tourist visitations. However, the authors conclude by suggesting that newer technologies should be further researched and explored to reach a much larger market. In countries like India, France, US, amongst others, who are doing so well in the tourism sector, they use Interactive and Cross-Platform Websites, Mobile Applications, Virtual and Augmented Reality and Recommender Systems, which are newer and more advanced technologies, to find information about a tourist destination. However, in [20], the author states that millennials are the key advocates for these technologies, unlike the older generation. The authors still recommend that such technologies are incorporated so that

tourist providers remain competitive and attract more tourists because should more tourists patronize tourist sites, there would be an increase in the revenue of the tourist sites and the country.

### **2.3 Augmented Reality in Tourism**

Augmented Reality (AR) technologies have been effectively utilized in the tourism industry. Kounavis, Kasimati, & Zamani [5] described AR as a visualization technique that enhances and transforms an actual environment as well as the users' perception of the real world by projecting computer-generated content on top of it. Computer-generated content refers to multimedia tools like videos, images, texts and graphical illustrations. In other words, Augmented Reality is the incorporation of real objects in a real environment, run interactively in real-time. The information is added to the user's field of view, usually to enrich their experience exploring the world by using a graphic to show relevant information in a compact space. The Augmented Reality aims to duplicate the world's environment in a computer. For online interactions with AR, the technology creates a view, which constitutes the user's real scene and a virtual location or object that augments the scene with additional information. For instance, when any camera-enabled device scans an object, a 3D image with further descriptions of that object appears.

The integration and use of Augmented Reality for tourism purposes is to exploit a tourist's immediate surrounding [9]. The application of AR is enabled and facilitated through the use of camera-featured computing devices such as smartphones [4]. The availability of these ICT tools has increased the tangibility and transparency of tourism products, in terms of enabling tourists to connect and interact with a respective destination before the actual commencement of the tour [16]. AR applications, be it a mobile application or website, foster interaction with the immediate surrounding, sometimes facilitated through the provision of location-based information (via GPS

navigation). This form of AR works for on-site interactions with the tool. As mobile AR applications and devices have the trait of being portable, they can be deployed as highly personalized tourist guides [16]. There are several benefits for tourists using such a service, including [7]:

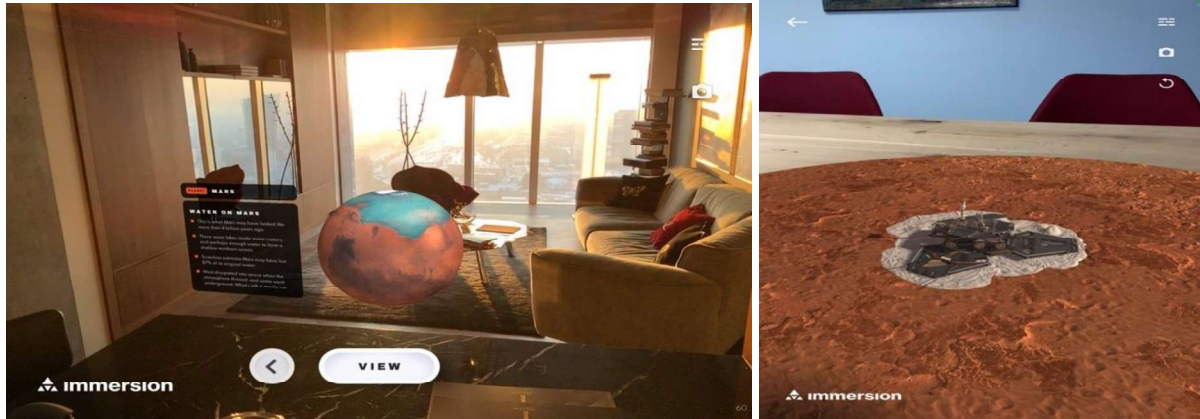
- The delivery of and access to tailored information on demand
- The minimization of irrelevant details and an excess of information
- The improvement of knowledge concerning various offers within a destination

Moreover, the integration of AR into the tourist experience illustrates a noteworthy entertainment factor for tourists, positively influencing and increasing the educational effect at the same time [17].

Most prominent players in the tourism industry now use AR-based tourism apps to catch tourist's attention in a sea of widely varying travel applications. AR-based tourism applications offer a robust solution with high-end features and a unique competitive advantage. Chuoyin [3] presents the use of Augmented Reality in a virtual tourism website in Taichung city and describes it as a provider of the necessary information for the destination. His research concluded that a website with a high level of interactivity and rich multimedia is more likely to persuade consumers than a fully text-based website. With research methodology, Chuoyin [3] explained the concept of Augmented Reality and how its implementation in a tourism website could be used for advertising and navigating a tourist site, adding that it is a feasible tool for enhancing the tourism experience, both online and on-site.

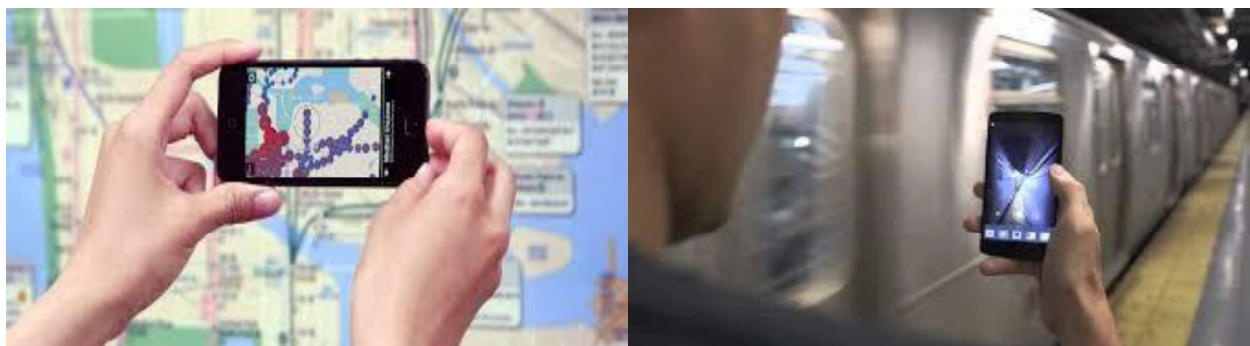
## 2.4 Related Augmented Reality Tourism Works

Mission to Mars AR [22] is an Augmented Reality application that allows users to superimpose images and videos of Mars into their living room (as seen in Figure 2-2 below) so they can navigate around it and experience it like they were there. This app is used by tourists who want an online experience of Mars.



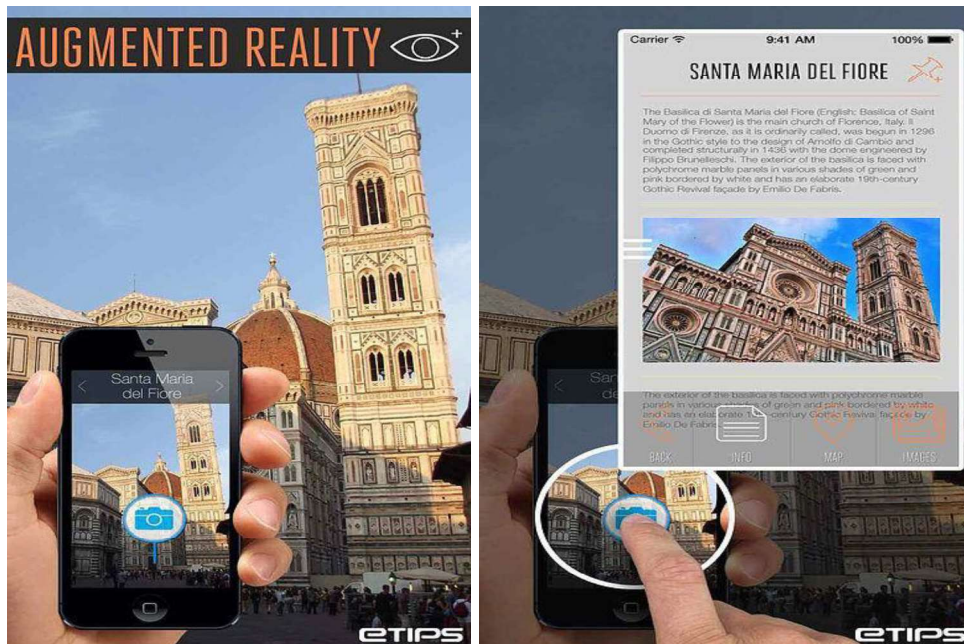
*Figure 2- 2: Mission to Mars AR [22]*

In New York City, an Augmented Reality tourism application named TunnelVision [19] helps travelers at the subway station understand a map easier. This application provides transport information and some information about New York City. The user will first use their phone against a map, and after it has picked up the information, it can help the user easily navigate through the city. This application is used by tourists that are on-site (seen in Figure 2-3 below).



*Figure 2- 3: NYC TunnelVision app [19]*

Aside from the TunnelVision app, there is the Florence Travel guide app [21] used in Italy. It has on-site Augmented Reality features that allow tourists to use their iPhone camera to scan their surroundings. As they do so, they get to know what is near them as icons pop up on the screen with information of the location detected in their surrounding (seen in Figure 2-4 below).



***Figure 2- 4: Italy's Florence travel guide app [21]***

## **2.5 Gap in Knowledge**

Research has been done as to how Augmented Reality can be used in the tourism sector; however, it would seem that no research has been done that is tailored to how feasible it would be in Ghanaian context and experience. In trying to bridge this gap, this study aimed to discover whether or not Augmented Reality can enhance the online tourist experience and boost tourism in Ghana if used in its industry.

## **Chapter 3: Research Methodology**

### **3.1 Introduction**

To answer the research questions, the implementation-driven method was used. The implementation-driven research is a scientific inquiry into questions concerning carrying an intention into effect by creating new software or making adaptations and improvements to a currently existing system [6]. The implementation-driven approach was included because the study involved developing a piece of software that would answer the research question of whether an Augmented Reality system can boost the tourist experience and tourism in Ghana.

After the implementation-driven research, the link to the AR Tourism website was posted on social media. The users were to click on that link to be redirected to the AR tourism website. A questionnaire was also attached to the website. After interacting with the AR tourism website, the research participants were required to answer the questions: share their experience using the AR system and provide insights into the effectiveness of the Augmented Reality system.

### **3.2 Implementation - Driven Research**

#### **3.2.1 Architecture Design**

##### **3.2.1.1 Tool**

A website with an Augmented Reality feature was designed to create an immersive and interactive tourist experience. Augmented Reality works when any camera-enabled device scans an object or a QR code and a 3D model of that object appears. The website is the medium to enable the Augmented Reality technology, meaning the AR website is accessed directly from a web browser. This tool allowed the respondents to digitally experience the reality of a tourist site, see the surrounding of the place and know the things to expect on the actual tour.

### **3.2.1.2 Intended Users**

Tourists, within and outside Ghana, who want to visit a tourist destination in Ghana were the target users of the Augmented Reality tourism website.

## **3.2.2 Software Development Life Cycle of the Augmented Reality Tourism Website**

### **3.2.2.1 Requirements specification**

The system contains basic features that are essential for an Augmented Reality tourism website. Through findings from literature reviews, the functional and non-functional requirements of the system were defined.

### **Functional Requirements**

For the Augmented Reality tourism website, the functional requirements describe what was implemented in order for a tourist to experience the real-life environment of a tourist destination through their digital devices such as laptops, phones and tablets. The functional requirements are:

1. Browse – The system allows users to browse through the catalog or the tourist sites available on the website for selection and exploration.
2. Routing and Navigation – The system allows users to explore the visible surroundings of a tourist site via the AR feature of the website, on their camera-enabled, AR-supported mobile devices such as phones and tablets.
3. Image recognition – The system identifies surroundings that can be overlaid with the 3D objects for AR.
4. 3D object tracking – The system has 3D models from engineering CAD drawings and accept some 3D object input formats.



5. Geometry Rotation – The system allows users to rotate the 3D content.

### **Non-Functional Requirements**

1. Immersive User Interface. The system emulates a physical world through a digital device (smartphones and tablets), creating a sense of immersion for the user.
2. Relevant and Updated Information on Surrounding
3. Accessibility – Just like other websites, the AR Tourism website should be accessible 24/7 with all features active. Also, there should be no barriers so that all types of users can interact with the AR feature.
4. Ease of Use - The system has a simple user interface that non-tech savvy people can use.

### **3.2.2.2 Analysis and Design**

In this section, the procedure for designing the application was discussed. The use case scenarios and diagram show the connections within the Augmented Reality application.

#### **Use Case Scenarios**

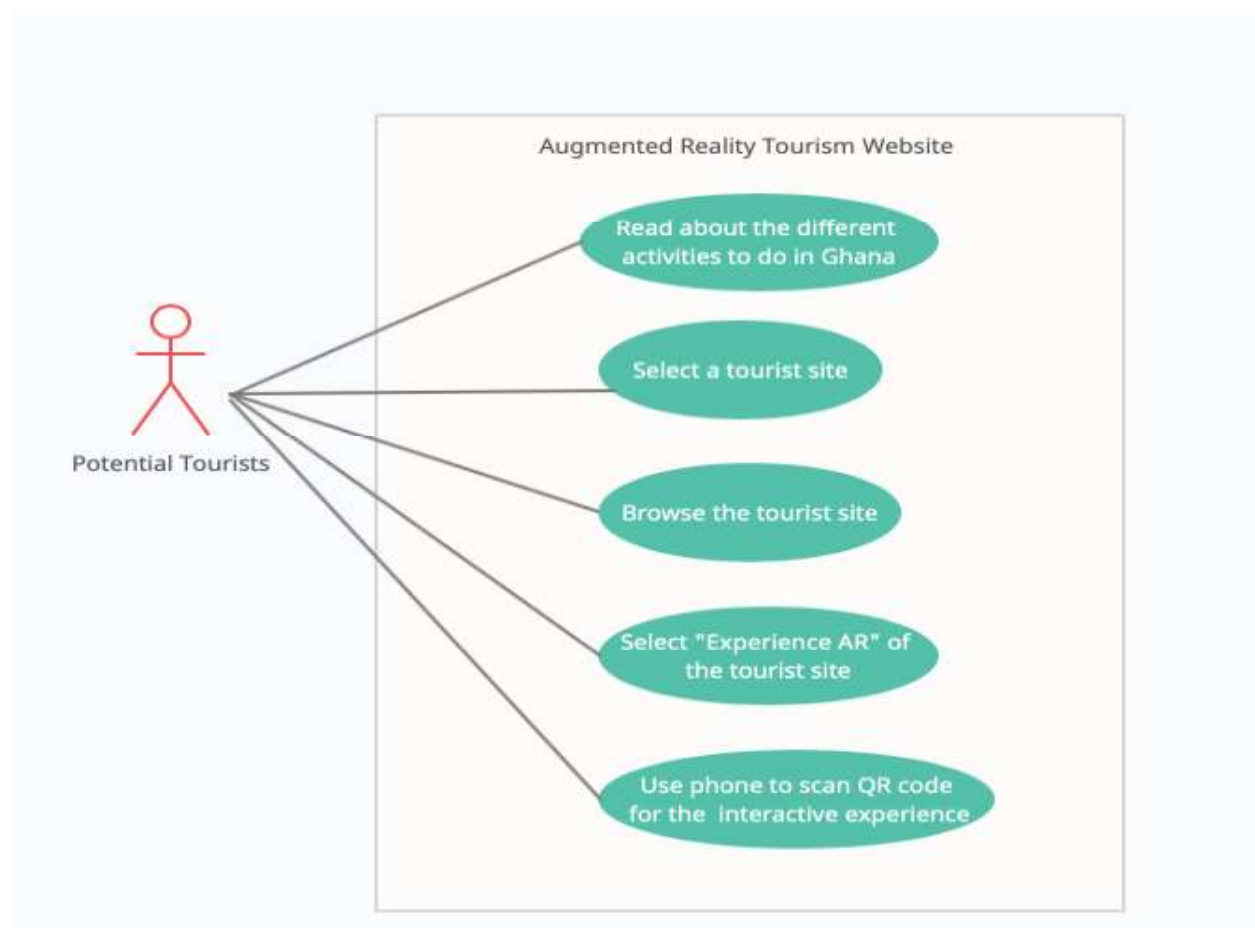
Example 1: Kafui just finished her National Service and saved up money to tour her motherland, Ghana. She has lived in Ghana her whole life but has never visited any of its tourist sites. She is to travel to the United Kingdom for her master's degree, but she wants to tour a few locations in Ghana before that. She needs a tool to help her select a tourist site to explore in Ghana. She believes Google would help.

Example 2: Jadon is an American who loves touring. For Christmas, he wants to come to Ghana, and he has started making an itinerary. Besides Kakum National Park and the Black Star Square, the popular tourist sites in Ghana, he does not know any other place to visit. Jadon believes googling Ghanaian tourist sites would help him get places to see.

## Use Case Diagram

This diagram models the functionality of the system using actors and the set of actions they can perform. Here, it shows the main actions a tourist performs when interacting with the system.

Below is *Figure 3-1: Use case diagram for AR tourism website*.



***Figure 3- 1: Use case diagram for AR tourism website***

From the above, a potential tourist who wants to visit a tourist site in Ghana can interact with the system prior to a tour. They can simply select a tourist site among the lists. After selecting the tourist site, they can browse through its catalog and find all the information about the place. Through this, they will come across the AR feature on the website, where they can have an interactive experience by being immersed into that environment in their surroundings. This includes scanning a QR code with their phones to see the tourist site in AR.

### **3.2.2.3 Technologies to be Used**

1. Vectary: It is an accessible 3D and Augmented Reality design platform. This software was chosen to implement the AR feature of the website because it supports numerous 3D models such as fbx, glTF and obj. Also, Vectary is cloud-based, so all Augmented Reality designs can be brought to life on your website by just embedding a code.
2. Sketchfab.com: This is a website with unlicensed 3D models. This was used to get the 3D models of the tourist locations.
3. Programming language: HTML, CSS and JavaScript was used to create the website. It works together to provide an easy way for programmers to build web and desktop applications. A tool called Mobirise was used. It is a free offline application used to easily design the virtually pleasing front-end of websites with rich content.
4. GitHub repository: This is a version control system used to track changes made in the code. It was useful in recovering lost code and keeping track of changes made in the overall system.
5. Microsoft Azure: This was used to host the website for external users to view.

### **3.3 Research Approach/ Methodology**

#### **3.3.1 Target Population**

The population consists of social media users. Such a population is suitable for the study because everyone can go on a tour. Social media is an open place to find people with different demographics: the young and old, and Ghanaians and foreigners [12]. Among this population, the researcher got responses from both citizens of Ghana and foreigners. The researcher expects these two categories to consist of students, especially those in university, workers amongst others.

#### **3.3.2 Research Method**

The mixed research method was used. This method sequentially analyzes data quantitatively and qualitatively for theoretical and practical results. The mixed-method research is best suited to understanding the numeric measurement of respondents' insight through quantitative coding of results and the in-depth understanding of the participants' views.

#### **3.3.3 Data Collection**

The data collection process was conducted from February 2021 to April 2021. After the Augmented Reality tourism website was completed, the link to the website was posted on social media, specifically Twitter and WhatsApp. The research participants were to click on the link and be redirected to the AR tourism website to interact with it. After interacting with the system, there was a questionnaire for the participants to answer. The questionnaire was the tool used to gather insights about the effectiveness of the system. The questionnaire contains;

- Open-ended questions – This answered the qualitative design of the mixed method research as it aided the researcher in gathering descriptive information. This set of questions dealt

with answers in the form of sentences. They were much lengthier, giving more detail of the user's experience using the AR website.

- Close-ended questions – This answered the quantitative design of the mixed method research. These questions helped the researcher to analyze data quickly as it deals with numbers to get a fair view of the participants' stance.

The data collection tool – questionnaire (as seen in the appendix) –aided in collecting feedback that helped to prove the hypothesis of whether a tourist is likely to visit a tourist destination in Ghana after experiencing the Augmented Reality of this project.

#### **3.3.4 Sampling Methods**

Convenience sampling was considered as the sampling method. The questionnaires were included on the website and published on social media for volunteers or opt-in persons who wished to participate. After 131 responses, the data was analyzed. With the convenience sampling method, the researcher intended to reach different sets of people on social media who can access the website by scrolling through their timeline or by receiving the link from a friend or a colleague.

#### **3.3.5 Data Analysis**

Microsoft Excel was used to analyze the quantitative and qualitative data collected from the questionnaire. The information was analyzed through coding in excel to show whether or not the hypothesis was proven.

## Chapter 4: Implementation, Findings and Analysis

### 4.1 Introduction

This paper has been concerned with answering the research question: Can the implementation of Augmented Reality boost tourist experience and tourism in Ghana? To answer this research question posed, the researcher developed an Augmented Reality tourism website. After research participants interacted with the tool, the researcher obtained responses from questionnaires issued via social media to identify any patterns, and check if the Augmented Reality tourism website made tourists interested in visiting a particular tourist site.

In this chapter, the implementation process and the data obtained from the questionnaires are outlined and evaluated, respectively. The chapter summarizes Ghanaians and foreigners' responsiveness to the application of Augmented Reality in tourism sites.

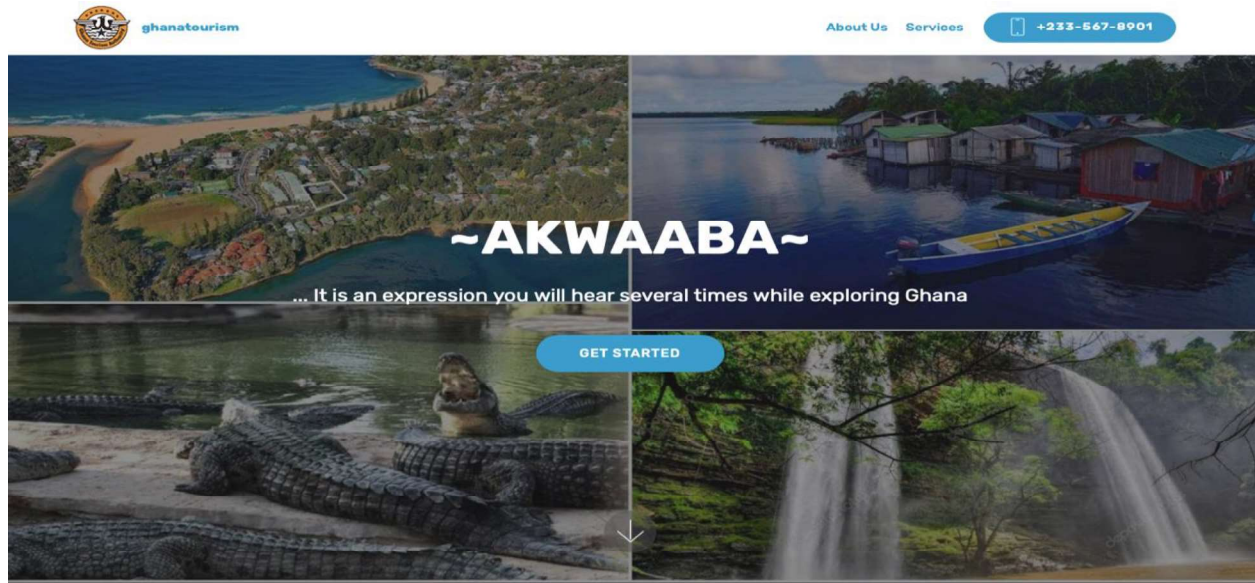
### 4.2 Implementation

#### 4.2.1 Augmented Reality Tourism Website

Here, some parts of the Augmented Reality Tourism website are shown and discussed. Some screenshots of the website are also included below.

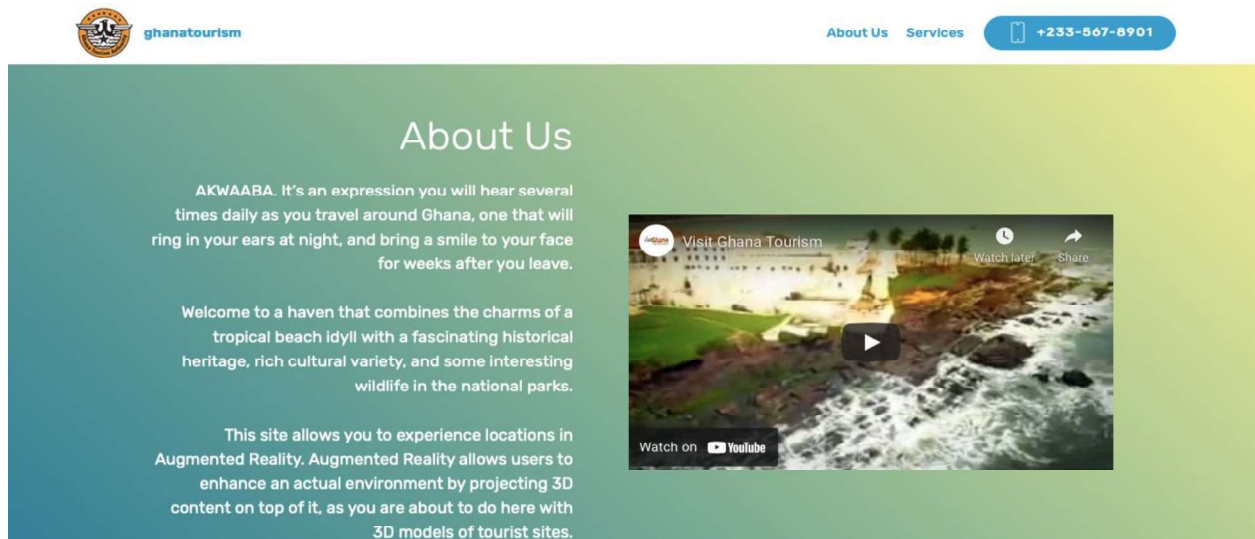
##### 4.2.1.1 The Website feature

Figure 4-1: *Index page of the AR tourism website* below is the Augmented Reality Tourism website's landing page - <https://alloteip3.sg-host.com/ghanatourism/> There are links to the About page, Services page, and a contact number on this landing page's header. Clicking on *Services* on the header or the *Get Started* button at the centre of this page directs the user to the part of the website where they can begin their Augmented Reality experience.



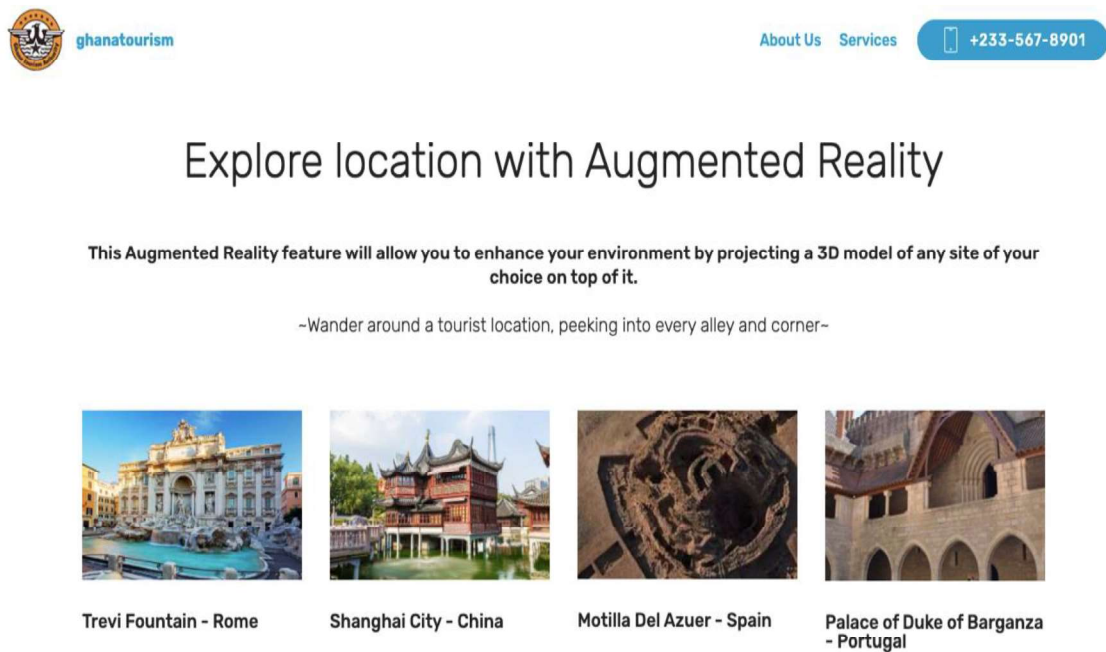
**Figure 4- 1: Index page of the AR tourism website**

Figure 4-2: *About Us* page of the AR tourism website below summarizes what to expect in Ghana's tourism industry. On the right side of the page is a YouTube video that further summarizes Ghana's tourism sector. This page also explains what the users are meant to do on this site: to have an Augmented Reality experience of a tourism location.



**Figure 4- 2: About Us page of the AR tourism website**

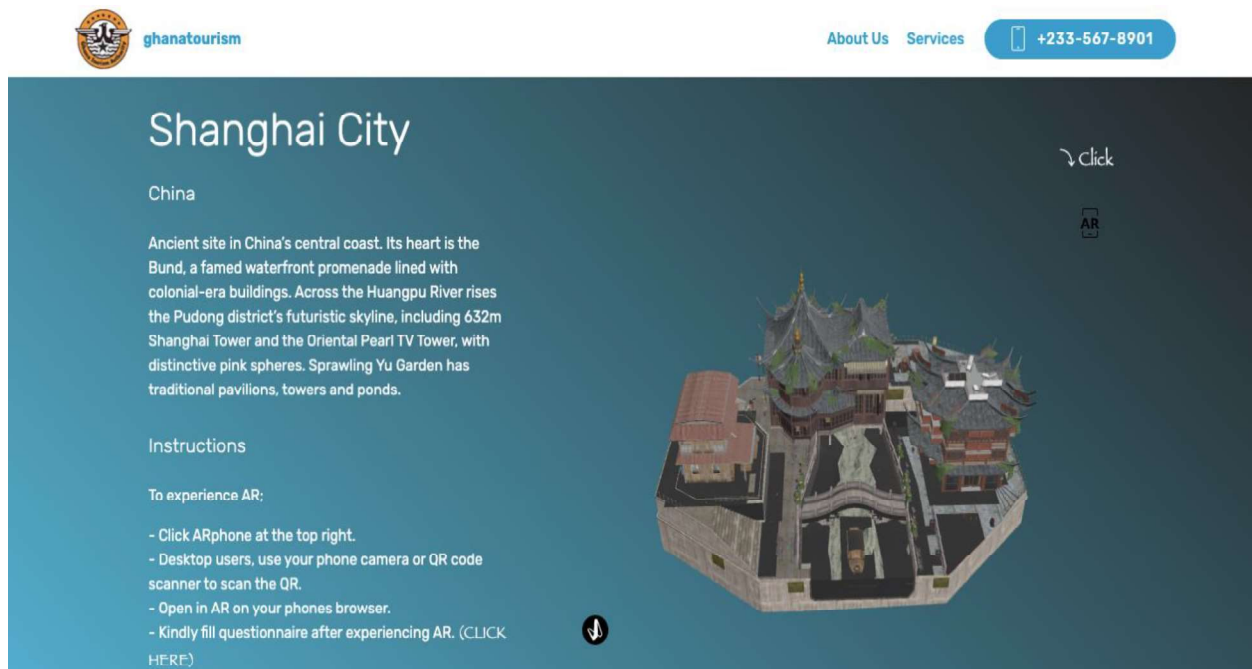
Figure 4-3: *Service page of the AR tourism website* below contains a few tourist sites – Trevi Fountain of Rome, Shanghai City of China, Motilla Del Azuer of Spain and the Ruins of Palace of Duke of Barganza in Portugal. For proof of concept as to how Augmented Reality works, the Augmented Reality feature for this website used 3D models of these tourist sites because of the lack of 3D models of Ghanaian tourist sites. Clicking on any of the images will direct the user to the page where they can have an Augmented Reality experience of the tourist site.



***Figure 4- 3: Service page of the AR tourism website***

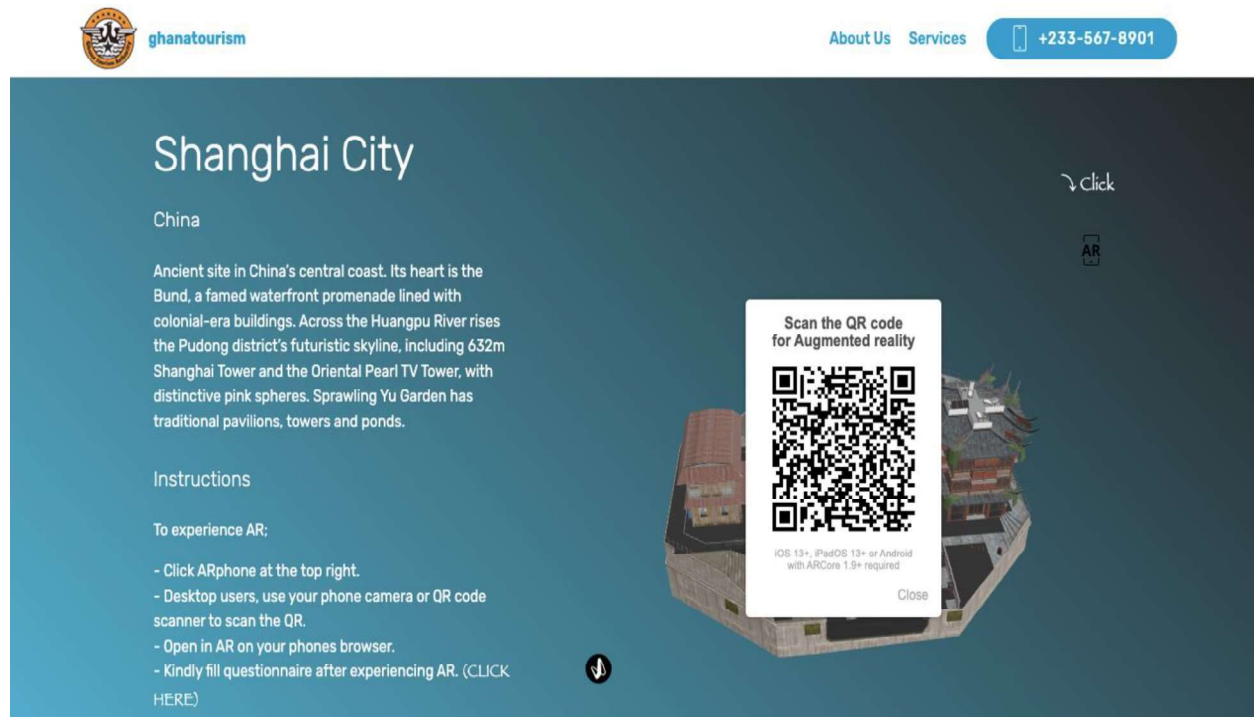


On the left side of Figure 4-4: *AR experience page of the AR tourism website* is some information about the selected tourist site and instructions on how to use the Augmented Reality feature. It also includes the link to the questionnaire; for users to answer after using the AR tourism website. In Figure 4-4 below, the selected tourist site is Shanghai City in China, and on the right side of the page is a 3D model of that tourist site. The research participants can down press on the 3D model and manually rotate the location. On the top right part of the 3D model is a sticker to click an AR phone.



***Figure 4- 4: AR experience page of the AR tourism website***

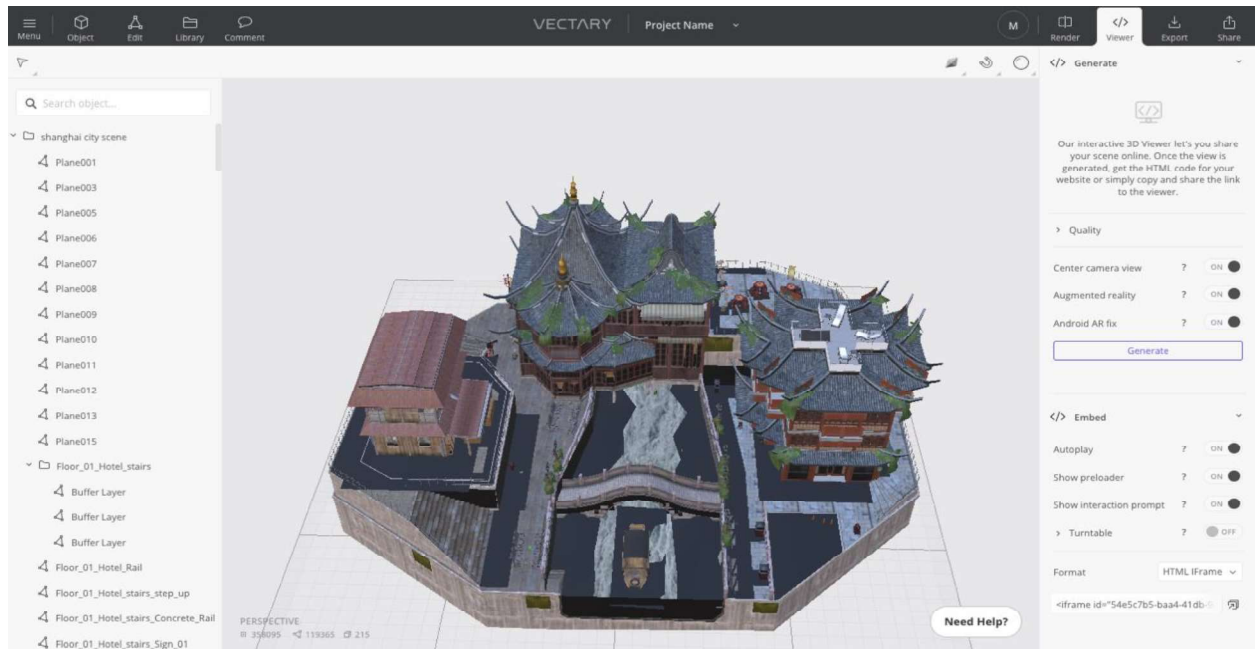
Upon clicking on the AR phone at the top right side of the 3D model, a QR code appears, as seen in Figure 4-5: *QR code for experiencing AR* below. The user is expected to use their phones, either an Apple phone or an Android phone, to scan the QR code with its camera app or QR code scanner app for Augmented Reality.



**Figure 4- 5: QR code for experiencing AR**

#### **4.2.1.2 The Augmented Reality feature**

The Augmented Reality feature was implemented using software named Vectary. The researcher imported a 3D model of a tourist site unto Vectary by clicking import at the top left corner in Figure 4-6: *How Vectary works*, below. The researcher resized the 3D model and geometrically rotated it in an attempt to fulfil the functional requirements. After doing this, the researcher generated the Augmented Reality zipped file that changes the 3D model to USDz. The researcher did so by clicking generate at the right side of Figure 4-6, after which the HTML code was gotten at the bottom right, beneath "Format", and embedded it into the website.



**Figure 4- 6: How Vectary works**

In Figure 4-7: *Snippet of Augmented Reality USDZ embed on the website* below, the researcher copied the USDZ code from Vectary (from Figure 4-6, bottom right) and pasted it into an iFrame tag as seen in Figure 4-7 below, line 80. With this action, the researcher embedded the AR viewer on the AR Tourism website, and Apple and Android automatically overlaid the image with the AR button in the user's web browser.

```

73 <div class="container">
74 <div class="media-container-row">
75 <div class="mbr-figure" style="width: 155%;>
76 <p style="font-size:18px; text-align: right; font-family: fantasy; color: white;"><span>6#10549;</span>
77 Click</p>
78
79 <!-- AR Embed -->
80 <iframe id="d58fe31b-24f5-445c-a961-8c2d0f73d048" src="https://www.vectary.com/viewer/
v1/?model=d58fe31b-24f5-445c-a961-8c2d0f73d048&env=" frameborder="0" width="100%" height="480"></iframe>
81 </div>
82
83 <div class="media-content">
84 <h1 class="mbr-section-title mbr-white pb-3 mbr-fonts-style display-1">La Motilla del Azuer</h1>
85 <h3 class="mbr-section-subtitle align-left mbr-white mbr-light pb-3 mbr-fonts-style display-2">Daimiel,
Spain</h3>
86 <div class="mbr-section-text mbr-white pb-3 ">
87 <p class="mbr-text mbr-fonts-style display-5">
88 The motillas were the early settlements of La Mancha (Spain) belonging to the Middle Bronze Age,
and connected to the Bronze of Levante culture. These were human-made hills atop of which are
placed fortified settlements. Their height is usually between four and five meters and the
motillas are separated from each other by a distance of four to five kilometers. Their
construction started c. 2200 BCE and they were used for about 1000 years.
89 </p>
90 </div>
91 <div class="mbr-section-text mbr-white pb-3 ">
92 <h3 class="mbr-section-subtitle align-left mbr-white mbr-light pb-3 mbr-fonts-style display-2">
Instructions</h3>
93 <p class="mbr-text mbr-fonts-style display-5">
94 To experience AR;
95 <p class="mbr-text mbr-fonts-style display-5">
96 - Click ARphone at the top right.<br>
97 - Desktop users, use your phone camera or QR code scanner to scan the QR.<br>
98 - Open in AR on your phones browser.<br>
99 - Kindly fill questionnaire after experiencing AR.<a style='color: white; font-family: fantasy;'
target="_blank" href="https://forms.gle/R2eKrqaVg4qBwzKM6"> (CLICK HERE)</a>
100 </p>
101 </div>
102 </p>
103 </div>

```

**Figure 4- 7: Snippet of Augmented Reality USDZ embed on the website**

## 4.2.2 Testing and Evaluation

The system was tested using different levels of testing: unit testing, component testing and system testing. Unit testing involves testing individual functions and classes in the code to ensure they work well. Component testing is ensuring that different individual classes interact correctly. For instance, there are proper transitions when buttons are clicked. From this, the researcher discovered that the 3D model took a long time to load. Finally, system testing involves confirming that the entire system performs well and meets functional and non-functional requirements. From this, the non-functional requirement for the AR tourism website to be accessible was not met. This is because only iOS and Android OS phones can support AR.

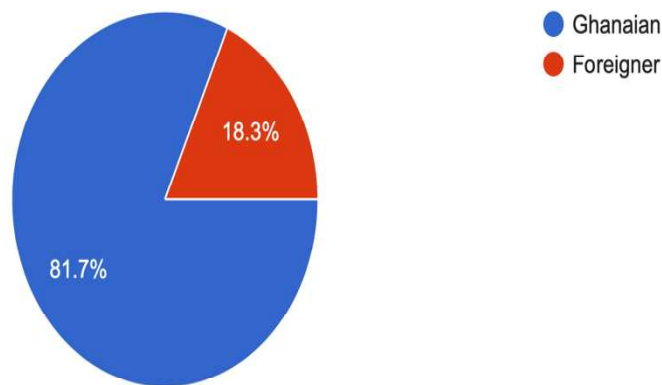
### 4.3 Research Findings - Questionnaires

The questionnaire designed was sent out as an accompaniment to the website and sent out over social media platforms to the target population – Ghanaians and foreigners. The research participants were required to interact with the Augmented Reality Tourism website. After, they filled the questionnaire by clicking on the google form link on the website. At the deadline for filling, there were 131 responses in total. Below are the responses to the questionnaires.

The feedback from the questionnaires showed that 81.7% of the students were Ghanaians, while 18.3% were foreigners, as indicated below in Figure 4-8: *The category of respondents*.

Which of the following categories do you identify with?

131 responses

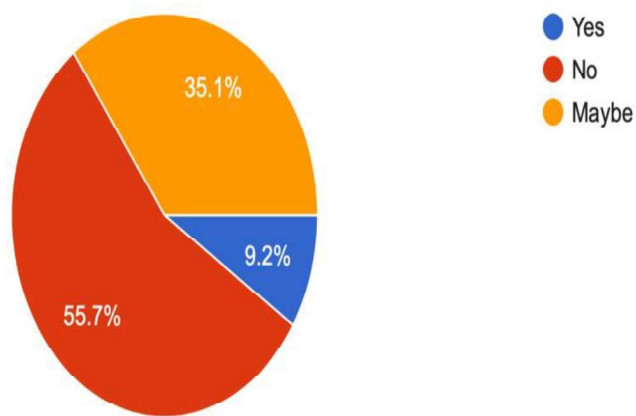


***Figure 4- 8: The category of respondents***

The chart in Figure 4-9: *Respondents who will visit a place with/without prior knowledge* below shows the percentages of research participants who will visit a tourist site without knowing the place looks. 9.2% of the respondents said yes, 35.1% said maybe, and the bulk with a percentage of 55.7% said no.

Will you visit a place without any information on how the place looks?

131 responses

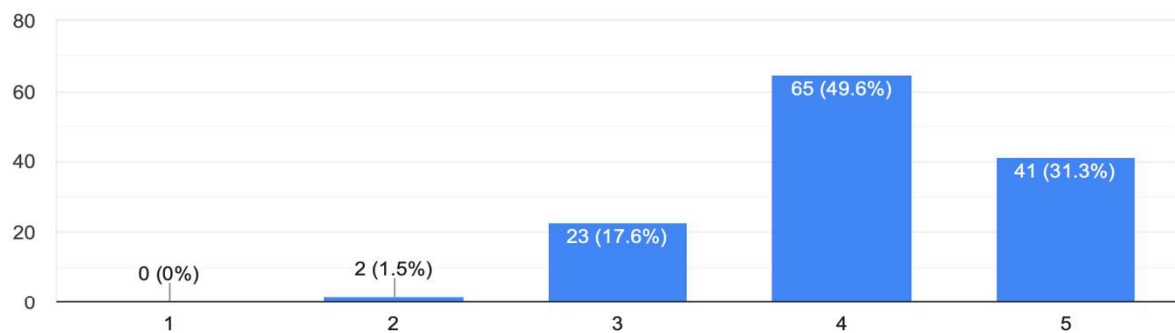


***Figure 4- 9: Respondents who will visit a place with/without prior knowledge***

Figure 4-10: *Responses to the effectiveness of AR tourism website* below; on average, none of the respondents found the Augmented Reality tourism website not very helpful. However, 1.5% found it not helpful, 17.6% indifferent, 49.6% helpful, and 31.3% very helpful.

On a scale of 1 to 5, how effective was the Augmented Reality tourism website in helping you gain knowledge of a tourism site?

131 responses

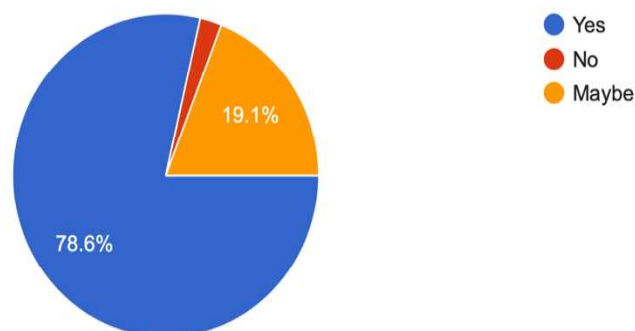


**Figure 4- 10: Responses to the effectiveness of the AR tourism website**

Respondents were asked whether they thought the Augmented Reality tool would be suitable for the Ghanaian setting. As seen in Figure 4-11: *Responses on the suitability of the AR tourism Website in Ghana*, 78.6% said yes, 19.1% said maybe, and 2.3% said no.

Do you think such a system will be suitable for the Ghanaian setting?

131 responses



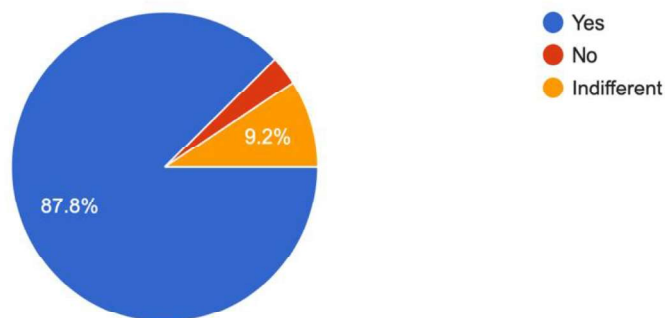
**Figure 4- 11: Responses on the suitability of the AR tourism website in Ghana**



In Figure 4-12: *Respondents' likelihood to visit a tourist site after using the AR tourism website*, the respondents were asked whether it was likely for them to visit a tourist site after experiencing it on the AR website. 3.1% said no, 9.2% were indifferent, and 87.8% said yes.

Are you likely to visit any of the tourist sites you just experienced through the Augmented Reality tourism website?

131 responses

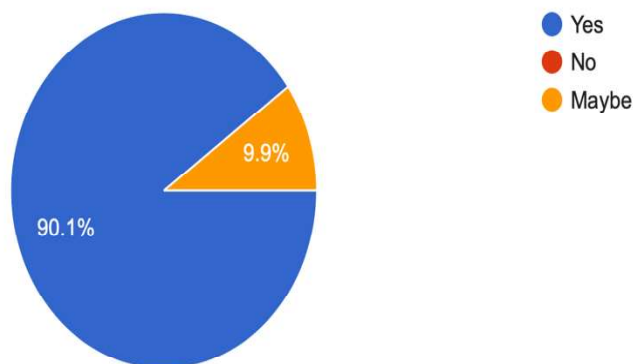


**Figure 4- 12: Respondents' likelihood to visit a tourist site after using the AR tourism website**

In asking the respondents whether they would recommend this website to others, 9.9% said maybe, and 90.1% said yes, as seen in Figure 4-13: *Responses to whether respondents would recommend this system*.

Would you recommend this Augmented Reality tourism website to other people?

131 responses



**Figure 4- 13: Responses to whether respondents would recommend this system**



#### 4.4 Discussion of Findings

The results from the questionnaire gave insights into how the respondents felt about the Augmented Reality tourism website. Here, the findings from the questionnaires are analyzed in light of the research objectives, questions and hypothesis and aim to confirm or disconfirm them.

A research objective was to analyze the responsiveness of Ghanaians and foreigners to the application of Augmented Reality in Ghana's tourism location. From the questionnaire, the category of respondents were Ghanaians and foreigners. In analyzing their responsiveness, the researcher considered the adoption and usability of possible tourists to an AR tourism website. With this in mind, the researcher evaluated the likelihood of the respondents to use the AR tourism website based on how useful they found it. Therefore, these respondents were asked how effective the website was in helping them gain knowledge of the tourist site they selected. The results showed that most respondents perceived the Augmented Reality tourism website to be helpful in providing useful information about each location. In contrast, 17.6% of the respondents were undecided about how helpful they found the tool, and 1.5% did not find the tool helpful, as seen in Figure 4-10.

To further fulfil the aforementioned research objective, the researcher asked the respondents – Ghanaians and foreigners – whether the system will be suitable for the Ghanaian setting and why their answer. 2.3% of the 131 responses came out with no, as seen in Figure 4-11. They felt the system would not be ideal in Ghana because they struggled to use the AR feature, even though the researcher included instructions on the website. As one of the respondents put it – "Some Ghanaians are not technologically literate, so before such a tool is very effective for them, they will need to be educated." On the other hand, a large ratio of respondents said yes. A popular reason given was that pictures do not provide an accurate depiction of tourist sites, so incorporating

AR into Ghana's tourism industry would be an intriguing way to give them a glimpse of what the tourist site looks like. These responses also confirmed the hypothesis that possible tourists are likely to visit a tourist destination in Ghana due to an experience with an Augmented Reality application since most of the respondents would be receptive to the Augmented Reality tourism website once implemented in Ghana.

Another reason why the respondents found the AR tourism website helpful was that it would inform their decision before a tour. In the questionnaire, the researcher asked the possible tourists whether they would visit a tourist site without any information on how it looks; few agreed, whereas the majority either disagreed or were undecided, as seen in Figure 4-9. The majority of the respondents saying yes is a clear depiction that most tourists will patronize tourist site if they have some knowledge about the place. This confirms Chang and Wu's [11] emphasis on tourists mostly informing themselves about a tourist destination before deciding to tour. Thus, Neuhofer's statement that "tourism service providers must seek to enhance tourist experiences in all the stages of tourism, most especially during the planning stage because it informs the tourist's decision" [15] should not be taken lightly.

Furthermore, the researcher asked the respondents whether they would recommend the system to others, and none disagreed. Except for approximately 10% who were unsure whether they would recommend the tool to others, the rest of the responses showed that the respondent found the system effective and viable to be recommended to others (see Figure 4-13). The researcher further asked the respondents qualitative questions based on their answers. Although the results geared positively to the system being recommended to others, a respondent suggested that an improvement to the Augmented Reality feature of the website, where they can see the inside of the tourist sites, would make the tool more attractive.

From analyzing the data from questionnaires, it is safe to say that a solution linked to Augmented Reality can help boost Ghana's tourism culture due to the increased patronage of locals and internationals.

## **Chapter 5: Conclusion and Recommendations**

### **5.1 Introduction**

This chapter highlights some application of the findings from the research conducted. Appropriate recommendations for the key limitations identified during the research and design phase and the implementation phase would be outlined to suggest how they can be enhanced to meet future systems and demands.

### **5.2 Application of results**

The results shown in this study can be used to inform interested stakeholders in Ghana on a technology such as Augmented Reality that can draw more people to visit a tourist site in Ghana. From the analysis done in this research, people find the Augmented Reality tourism website as helpful in gaining knowledge about a tourist site and also believe that it will be suitable for the Ghanaian setting; thus, this tool should be considered. The Augmented Reality feature was appealing to the respondents due to its interactive nature and the ability to have a 3D glimpse of what the location looks like.

Approximately 55.7% of respondents said they would not travel without any knowledge of how the tourist site looks, which is more than half of those who responded. This shows that tools such as the Augmented Reality website are very relevant and instrumental in showcasing the surrounding of a location, especially prior to a tour. This Augmented Reality system helped respondents see the outside surrounding of tourist sites. Since this was done, other researchers can explore the possibility of doing an Augmented Reality tool where users can see the inside of the tourist site, as suggested by some respondents.

### **5.3 Limitations of the study**

The results answer the research question “Can the implementation of Augmented Reality boost tourist experience and tourism in Ghana?”. It is clear that Augmented Reality, when implemented in Ghana’s tourism industry, will boost tourism in Ghana since tourists are likely to visit. However, there are some possible threats to the validity of the research, as listed below.

1. Time was a big factor that was against the research of this paper. Most of the time went into finding 3D models of Ghanaian tourist sites for the AR feature of the tourism website, which resulted negatively. After, there was little time left to create 3D models of the tourist sites and carry out the data collection process.
2. The lack of 3D models for the Ghanaian tourist sites may have limited the respondents’ understanding. They were not given an Augmented Reality experience tailored to Ghanaian tourist sites.
3. There were fewer respondents for the research. In addition to this, there was a skewed representation of Ghanaians over foreigners in the sample. This might have skewed the results and not represented the views of most foreigners.

### **5.4 Future work**

1. Once a researcher begins searching for 3D models for Ghanaian tourist sites and does not find any, that researcher should devise ways to create it themselves, to avoid wasting time. Perhaps, they should consider partnering with any interested stakeholder since it will be capital intensive.

2. Further research can be done to enhance the Augmented Reality tourism website by creating high-definition 3D models of Ghanaian tourist sites for the AR feature. In that case, respondents will have a realistic understanding of how Augmented Reality works tailored to Ghana during the data collection.
3. In subsequent studies, the researcher should aim for a larger respondent base for less bias and a much more accurate view. An incentive could be provided to respondents who fully participate in order to obtain a wider sample. This sample should contain more foreigners to get a more accurate representation of their views on the AR tourism website for Ghana.

## **5.5 Conclusion**

After conducting research for this paper, it was proven that most of the possible tourists who filled the questionnaires are likely to visit a tourist destination in Ghana due to an experience with Augmented Reality. They believe the Augmented Reality website will be suitable for the Ghanaian setting, and they will even go ahead to recommend it to others looking to tour Ghana. Though newer technologies like Augmented Reality can contribute significantly to Ghana's tourism experience, the issue of inaccessibility was raised by a few of the non-iOs and non-Android phone.

This thesis project studied the topic of Augmented Reality in boosting Ghana's tourism sector. Even though it was carried out with a few respondents, it provides an overview for any related stakeholder interested in examining the tourism businesses in Ghana regarding the matter. That is because once Augmented Reality is adapted into Ghana's tourism location, it will earn the patronage of most tourists, both citizens and foreigners, who will pay to visit a tourist site, thus increasing the country's GDP and boosting tourism in Ghana.

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## Appendix

Questionnaires - <https://forms.gle/E1vJYsXdmH3ezhDK8>

### CS Thesis Capstone

#### Augmented Reality as a tool to promote tourism in Ghana

**Researcher: Marian-Bernice Haligah**

**Supervisor: Dr. David Sampah**

You have been invited to participate in this research study. This is a five-minute questionnaire. The purpose of this questionnaire is to receive your honest feedback after using the Augmented Reality tourism website. You will not suffer any consequences if you discontinue filling this survey. However, I urge you to complete this survey as your contribution is extremely valuable because it will contribute to discovering technologies that can boost tourism in Ghana. Information gathered through this survey will be treated as confidential.

For further clarifications concerning the study or the terms of participation, please contact the researcher at [marian.haligah@ashesi.edu.gh](mailto:marian.haligah@ashesi.edu.gh)

**Expected submission date:** 10th April 2021

Kindly use the link below to access the Augmented Reality tourism website. Please make sure you have gone through the website before filling this questionnaire.

<https://alloteip3.sg-host.com/ghanatourism/>

#### 1. Which of the following categories do you identify with?

- Ghanaian
- Foreigner

**2. Will you visit a place without any information of how the place looks?**

- Yes
- Maybe
- No

**3. On a scale of 1 to 5, how effective was the AR tourism website in helping you gain knowledge of a tourism site?**

*not very helpful 1 2 3 4 5 very helpful*

**4. Do you think such a system will be suitable for the Ghanaian setting?**

- Yes
- Maybe
- No

**5. Referring to the previous question. Why your answer?**

---

---

**6. Are you likely to visit any tourist site you experienced through the Augmented Reality tourism website?**

- Yes
- Maybe
- No

**7. Referring to the previous question. Why your answer?**

---

---

**8. Would you recommend this AR tourism website to other people?**

- Yes
- Maybe
- No

**9. Aside an AR system, what other tools will you recommend in creating awareness of a tourism site?**

---

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Thanks for your response.