

Awang Laut:

Exploring storytelling in a mobile
augmented reality environment for
cultural heritage sites

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Everything not saved will be lost

- *Nintendo "Quit Screen" message*

Abstract

In the age of mobile technologies, tourists are using their hand-held devices at the same time they are living travelling experiences. Mobile technologies such as smartphones and tablets are not only essential for tourists, but are also frequently contributing to enrich their experiences. This study explores the development of a mobile app that combines storytelling and augmented reality to enhance the visitor experience at cultural heritage sites. Specifically, the study aims to explore an innovative way to incorporate storytelling in mobile augmented reality (mAR) environments.

The designed mobile app aims to engage visitors through fictional stories that are weaved into a walking tour. The narrative is crafted for a specific place by incorporating artefacts within and local stories. Imperative to this is an amalgamation of virtual and real worlds, which in this study is achieved through the use of marker and location-aware AR technologies. Langkawi, an island in Malaysia that is very familiar to the author, is the tourism destination chosen for this project. The island's history is rich in myths and legends, thus providing a great opportunity for leveraging storytelling in an “app”.

The design and development of the mobile app follow a research-informed approach where a framework is established to guide the process. This is then extended into a creative practice-based methodology to produce the minimum viable product (MVP) of an mAR app. The documentation of the experience with the design and development of this MVP throughout this exegesis provide valuable insights for other research efforts within the area of storytelling and mAR applied to tourism.

Table Of Contents

Abstract	2
Table Of Contents	3
List of Figures	6
Attestation Of Authorship	8
Acknowledgements	9
Introduction	10
Research background and motivation	11
Research question and aims	12
Exegesis structure	13
Literature review	14
Tourism	15
Cultural heritage site	17
Sense of place	18
Visitor experience	19
Mobile augmented reality	22
Mobile augmented reality in tourism	22
Review of relevant mAR apps within tourism	23
Storytelling	26
Characteristics of Storytelling	27
Storytelling in tourism	28
Retelling stories on mAR platforms	29
Conclusion	30
Approach	32
Methodology	32
Experiential framework	34
Minimum viable product (MVP)	35

Design phase	36
Story approach	36
Selected cultural heritage site: Langkawi Island	37
Tour-trail planning	39
Layout and wireframe	40
Look and feel	45
Development phase	46
Graphics	46
Interactivity	51
Animation	54
Code implementation	56
Testing phase	57
Reflections and future development	59
Challenges presented in the project	60
Future work	61
Conclusion	62
References	64

List of Figures

Figure 1. The research focus in relation to the three main areas of literature

Figure 2. The Four Realms of an Experience (Pine & Gilmore, 1998, p.102).

Figure 3. The proposed Experiential Framework (my elaboration based on Pine and Gilmore (1998), Kuflik et al. (2015) and Buonincontri and Marasco (2017))

Figure 4. Location of cultural heritage sites around the Langkawi Island

Figure 5. Tour trail planning

Figure 6. Design sketches of *AWAR* app

Figure 7. Wireframe for *AWAR* app

Figure 8. High-fidelity wireframes

Figure 9. Design iteration of the user interface

Figure 10. The app's user interface artwork

Figure 11. Moodboard use for character design

Figure 12. Illustration of Garuda

Figure 13. Illustration of Jentayu

Figure 14. Illustration of Mat Chincang

Figure 15. Illustration of Mat Raya

Figure 16. Development of *AWAR* app on Unity

Figure 17. Hub-and-Spokes dialogue method

Figure 18. UI format for character dialogue

Figure 19. Frame-by-frame animation created in Adobe Animate

Figure 20. Image sequence for animation created using bone tools in Adobe Animate

Figure 21. Interactivity on Unity using Playmaker add-on

Figure 22. Playtest on mobile device

Attestation Of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma from a university or other institution of higher learning.

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1. Introduction

This research investigates the potential of combining both storytelling and augmented reality in enhancing visitors experiences at cultural heritage sites. It explores compelling ways to engage visitors through fictional stories that are weaved into a walking tour, with a focus on the use of a mobile device as the delivery platform.

Subsection 1.1 of this introduction section starts by providing the background to this work, which leads to the motivation of this research. This is followed by the central question and aim of this research in Subsection 1.2. The structure for the rest of the exegesis is presented in Subsection 1.3.

1.1. Research background and motivation

As a rising industry, it is important for tourism to keep up with the changing needs of the visitors (Park, Nam, & Shi, 2006). According to Krippendorf (1986), people are more motivated to travel to seek new experience and knowledge rather than the need to leave their daily routine. Before technology made independent travelling easier, visitors commonly had to rely on tour operators and go on standardised tour packages. With travel becoming increasingly popular and affordable, visitors are now seeking for more customised tour experiences that are original and different (Costantini, Mostarda, Tocchio, & Tsintza, 2007).

Emerging technologies such as virtual and augmented reality have the capacity to provide visitors with such meaningful experience. Virtual heritage systems are especially favourable at cultural heritage sites as the technology affords the authenticity and integrity of these sites to be maintained (Jung & Han, 2014).

In order to further emotionally engage visitor, Lombardo and Damiano (2010) suggest to integrate storytelling into virtual heritage systems. Augmented Reality (AR) is one of the prevailing technology that has enormous potential to deliver stories and folklores within localised environments. With a visual AR system, virtual objects and information can be overlaid on top of the real-world camera view of devices such as a smartphone. AR technology, therefore, augments the visitor's surrounding by allowing virtual information to be viewed as co-existing with the real-world environment. The virtual information in the form of text, audio, graphics and animations can be leveraged to enhance the storytelling process of local folklores. AR also allows the visitor to interact with the

physical environment making storytelling more realistic, motivating, engaging and fun.

Further, with the proliferation of mobile devices and advances in mobile technology, mobile augmented reality (henceforth abbreviated as mAR) apps are now more accessible to the public. This makes the technology open to mainstream adoption, which in turn makes the technology ideal for this context.

In the light of this discussion, the motivation of this research project is to enhance the visitor experience by incorporating storytelling in mobile augmented reality (mAR) environments within the context of cultural heritage tourism. The specific research question and aims are outlined next.

1.2. Research question and aims

This creative practice-based research project addresses the following central question:

What are the characteristics of storytelling that can be incorporated in mAR environment for cultural heritage sites?

The information acquired in response to this question is crucial, especially when designing story-based experiences for mAR environments within the context of cultural heritage sites.

Therefore, this research aims to identify the best practices and to formulate a structure for designing such story-based experiences. It aims to explore an innovative way to incorporate storytelling in mAR environments. This includes the exploration of an integrative framework drawn from existing literature, which is then used to support the design

and development of a mAR app, produced as the minimum viable product (MVP) for this project.

1.3. Exegesis structure

This exegesis is organised into six sections.

In this first section, the background motivating the research work is provided, followed by the central research question and aims.

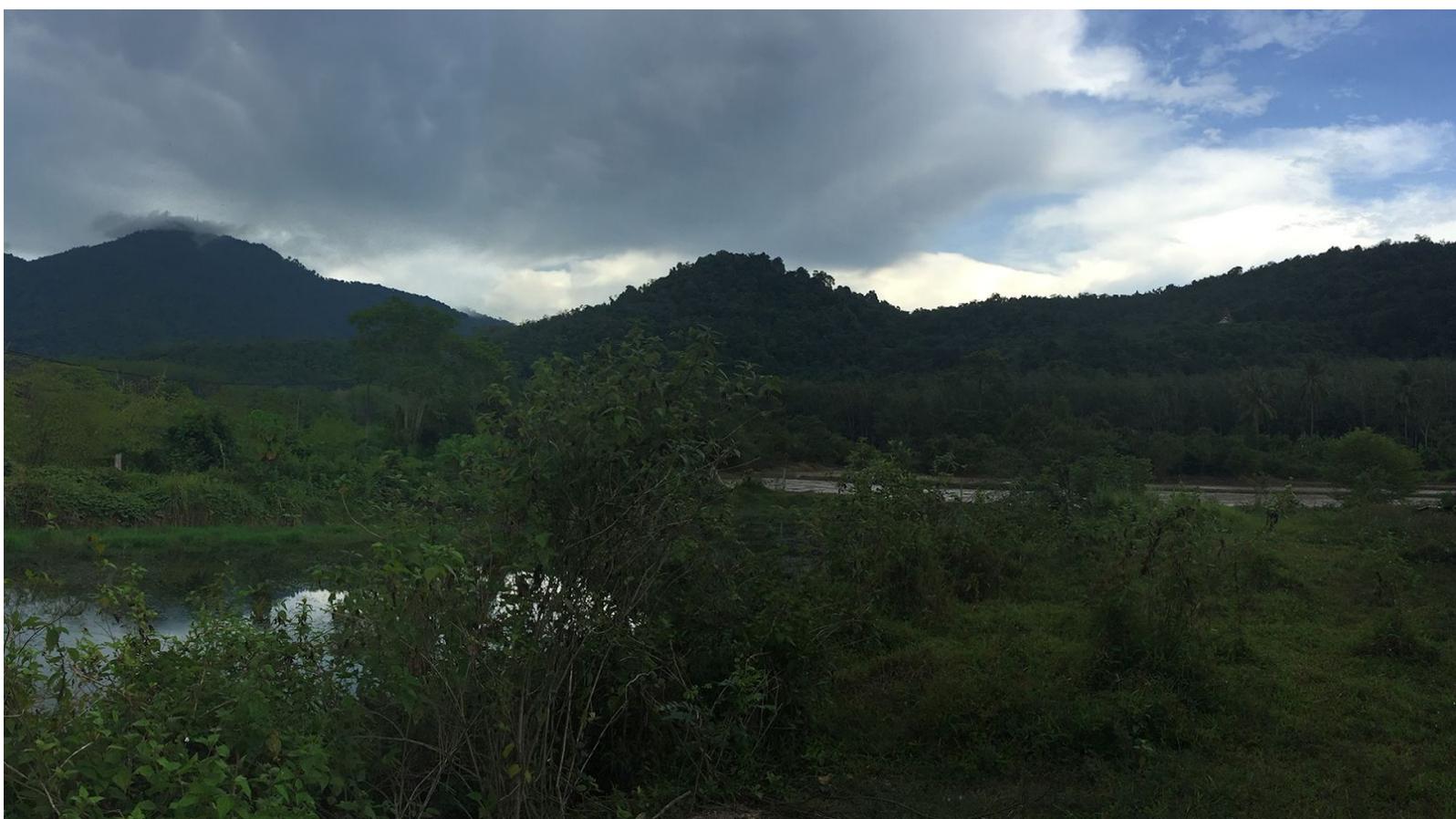
The second section reviews relevant literature within the three overlapping research areas in which the focus of this research is situated: tourism, mAR and storytelling.

The third section presents the research approach, where a framework which guides the design and development of this project's mAR app is established by elaborating on the existing theoretical frameworks and models reviewed in the earlier section.

The development process of the mAR app as the minimum viable product (MVP) is documented under the fourth section.

The fifth section covers the reflection as well as discussions on future developments.

Last but not least is the research conclusion, which is presented in section six.



2. Literature review

This section reviews the three areas of literature in which the focus of this research is situated between: tourism, mAR and storytelling (see figure 1). As per mentioned in the previous section, a framework for the design and development of a mAR application is established based on the analysis and synthesis of relevant literature. This section therefore covers theories and concepts within each of the three aforementioned areas that are considered as relevant guidelines to frame this research.



Figure 1. The research focus in relation to the three main areas of literature

Subsection 2.1 firstly covers relevant theories under the domain of tourism. This consists of unpacking what a cultural heritage site is, the notion of ‘sense of place’ and visitor experience. This is followed by reviews on the use of mAR within this domain under subsection 2.2. The review continues by examining story-based approaches in section 2.3, before finally concluding with the important insights gleaned from the reviews.

2.1. Tourism

The nature of travelling removes visitors from their home culture and place them temporarily in a new cultural environment. According to Marzuki (2009), “tourism in general has become one of the major cultural and economic forces in the world today and is regarded as an important means to benefit local communities” (p. 25).

The following is one of the widely accepted definition of tourism:

“Tourism comprises the activities of person travelling to and staying in places outside their usual environment for not more than consecutive one year for leisure, business and other purpose”
(Camilleri, 2018; Rodzi, Zaki, & Subli, 2013; “Tourism Definition,” 2002).

According to Theobald (2004), the origin of the word “tour” is derived from latin ‘tornare’ which means lathe or circle. When a morpheme ‘-ism’ is added at the end of the word, it gives a meaning of movement around the circle. He suggested that a *tour* therefore denotes a journey which starts and ends at the same point of origin and that a *tourist* is a person who takes this journey (Theobald, 2004).

It is notable that the terms ‘tourist’ and ‘visitor’ can sometimes be seen used interchangeably. As suggested by Camilleri (2018), travellers that engage in tourism can also be described as a visitor. During a regional workshop on tourism, Laimer (2010) provided a basic definition of a visitor as a person who is “taking a trip to a main destination outside his/her usual environment, for less than a year, for any main purpose (business, leisure or other personal purpose) other than to be employed by a resident entity in the country or place visited” (p. 2). He therefore regarded tourism as the *activity of visitors* (Laimer, 2010). For the sake of consistency, this exegesis accepts the definition by Laimer (2010) and will use the term ‘visitor’ here forth as an umbrella term that also includes ‘tourist’.

Theobald (2004) suggested viewing tourism as a social phenomenon, a process or an *experience*. The idea of viewing tourism as an experience resonates well with what mAR and storytelling are able to offer, and thus will be further unpacked later under subsection 2.1.2, which specifically looks at visitor experience.

2.1.1. Cultural heritage site

Cultural heritage can be defined as “the legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations” (UNESCO, 2017). It is to note that cultural heritage consists of those that are tangible and intangible. Artefacts that are movable, such as coins, as well as artefacts that are static, such as monuments, are considered as tangible cultural heritage. Examples of intangible cultural heritage are rituals and oral traditions. Vecco (2010) commented on how the extension to the immaterial - in which heritage is no longer defined on the basis of its material aspect - has enabled intangible cultural heritage to be recognised, protected and safeguarded.

‘Cultural heritage tourism’, which are also referred to by some as just ‘cultural tourism’, ‘heritage tourism’ or ‘ethnic tourism’, usually offers tourists the attraction of cultural traditions, places and values such as religious practice, folklore traditions and social custom of certain communities or ethnic (Rodzi et al., 2013).

According to Park, Nam and Shi (2006), the majority of cultural heritage sites continued to have outdated forms of tour that is static and information centred. Interpretive boards, booklets, maps, and books are among the types of information displays commonly provided at most cultural heritage sites (Zaibon, Pendit, & Abu Bakar, 2015). Tourists create experience via their own interpretation or through reading information displays when visiting a cultural heritage site (Pérez Aranda, Guerreiro & Mendes, 2015). However, these information displays, which typically contain brief descriptions and some pictures, are not enough to uncover the history of the sites (Zaibon et al., 2015).

Such negligence are a great loss to the tourism economy, with opportunities to engage visitors with the cultural value of the site -

enabling visitors to experience and learn more - going to waste. This further highlights the gap in this area in which this research has the potential to fill.

2.1.2. Sense of place

As individuals, we attach value to a place through our memories. A theory that can better explain this sense of attachment to a specific location is 'sense of place'. As described by Tuan (1974 cited by (Williams, Patterson, Roggenbuck, & Watson, 1992, p. 31), "sense of place is often associated with an emotional or affective bond between an individual and a particular place; this bond may vary in intensity from immediate sensory delight to long-lasting and deeply rooted attachment".

Malpas (2008) pointed out how places with cultural heritage significance usually have their own special character or unique identity that create their relevant 'sense of place'. As suggested by Smith (2015), identifying these special qualities will, therefore, enable place-based cultural tourism to further enhance its 'sense of place' for visitors. However, Shamai (1991) argued that relying on just the location itself is insufficient. Creating an attachment to a place necessitates a long and deep experience of the place. Shamai (1991) further highlighted that a place is part of a larger whole that is being felt through the "experience of meaningful events" (p.348).

In their study, Chang, Hou, Pan, Sung and Chang (2015) developed an mAR guidance system for a heritage site based on the three constructs of 'sense of place': (1) place attachment, (2) place dependent, and (3) place identity. They then tested the mAR system using a quasi-experimental design to compare between 3 visitor groups consisted of university students: those with AR-guidance, those with audio-guidance, and those with no guidance. Their results indicated that mAR enhances a visitor's

sense of place and learning motivation, as well as effectively improves learning achievements when applied in learning related to heritage sites.

Sense of place theory is therefore deemed relevant to this study and will be considered in the design of the MVP.

2.1.3. Visitor experience

If tourism is to be viewed as an ‘experience’, it is then important to further unpack this concept in order to determine the appropriate steps to be taken to enhance the visitor experience.

In a seminal work on what they called the ‘experience economy’, Pine and Gilmore (1998) described the experience as ‘a memorable event’. These ‘memorable events’ have their own distinct qualities and characteristics; and much like any services, goods or commodities, can be designed and sold by companies. From this perspective of the experience economy, experiences are to be viewed as across two dimensions: *customer participation* and *connection* (Pine & Gilmore, 1998). The *customer participation* dimension represents a spectrum between active and passive participation, whereas the *connection dimension* represents a spectrum between absorption and immersion. They then introduced “The Four Realms of an Experience” (see Figure 2) which further distinguishes experiences into four broad categories - Esthetic, Entertainment, Educational and Escapist - along with the spectra of the two dimensions.

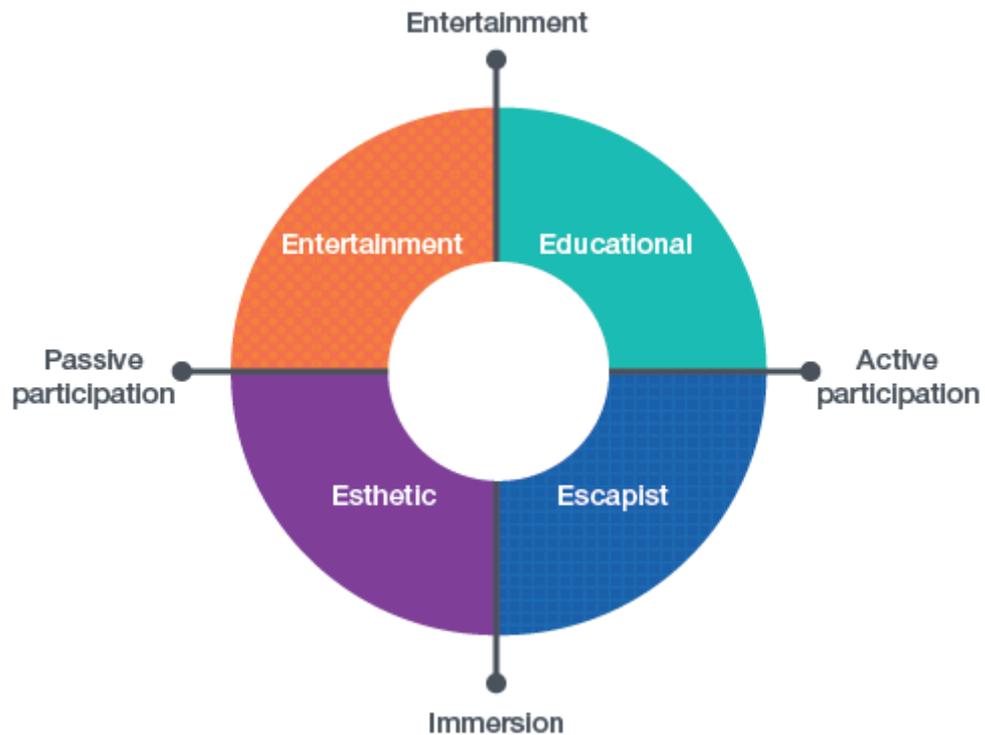


Figure 2. The Four Realms of an Experience (Pine & Gilmore, 1998, p.102).

Borrowing from an earlier work by Clawson and Knetsch (2013), a visitor¹ experience can be described as “an event which includes anticipation and planning, the actual travel to the destination, on-site activities, travel back to the point of origin, and then remembering and sharing with others.” This description suggests a more holistic view of the visitor experience where activities of the pre, as well as post site visit experiences, are included within the overall visitor experience. In other words, the visitor experience not only needs to be considered at the site location but should be extended before and after the visit.

Therefore, not all four realms of experience must necessarily be experienced on-site. However, as noted by (Buonincontri & Marasco, 2017), “most of the existing technological applications and related studies only focus on the on-site stage of the cultural heritage experience” (p.84).

In his work, Kuflik et al (2015) suggested and demonstrated the use of a generic framework that integrates all three visit phases (*pre, during* and

¹ Note that the original term used by Clawson and Knetsch (2013) was ‘tourist’

post) in order to extend the on-site visit boundaries. Buonincontri and Marasco (2017) further built on this work by combining the integrative framework by Kuflik et al (2015) with the four realms of experience identified by Pine and Gilmore (1998). In their framework for enhancing cultural heritage experience using smart technologies, Buonincontri and Marasco (2017) included three interrelated components: *off-site* (during the *pre-visit* stage), *on-site* (during the *visit* stage) and *online* (during *pre-* and *post-visit* stage). In their survey, it is apparent that mobile devices are the most used tools, especially in the on-site / visit stage (Buonincontri & Marasco, 2017).

These works became the key reference for the approach of this research project, which will later be elaborated further in section 3.

2.2. Mobile augmented reality

Augmented Reality (AR) is a technology that “enhances a user’s perception of and interaction with real world” (Azuma, 1997 p. 356). AR is different from virtual reality (VR) in which instead of immersing users in a digital environment, virtual objects are merely layered on top of users’ view of the real world (Azuma, 1997). Mobile augmented reality (mAR) is when this AR technology is delivered, e.g. as an app on mobile devices such as smartphones and tablets.

An mAR system typically uses the mobile device’s in-built camera to capture the view of the physical environment and then overlays the live camera view with virtual objects. A ‘tracker’ is then used to determine the position in which a virtual object is to be displayed. The mobile’s Global Positioning System (GPS) is one means of tracking (Azuma, 1997). Another way to track is to use a ‘marker’. A marker is typically a distinctive object or image (such as a logo) in the real world that the mAR system recognizes from the live camera view. The marker helps the mAR system to anchor a digital object to an exact location in the real world, such as on a specific page of a book.

The advancement of smartphones and wider mobile network have enabled visitors to access mobile apps anywhere and at anytime, and in turn making mAR a feasible option for delivering experiences at cultural heritage sites.

2.2.1. Mobile augmented reality in tourism

Research as well as actual implementations of AR systems under different areas of tourism have been growing in the recent years (e.g. Lombardo & Damiano, 2012; Chang et al., 2015; tom Dieck & Jung, 2017). Of interest is the build-up of significant research in virtual heritage systems within the

domain of mAR, particularly those that focuses on virtual restoration of historical site (Noh, Sunar, & Pan, 2009). This increasing trend perhaps indicate the positive impact of implementing mAR. For example, Adhani and Rambli (2012) found that by adopting mAR technology, visitors' learning experiences can be improved when visiting cultural heritage sites. They also highlighted that mAR can help virtually preserve the heritage sites through digital reconstructions of tangible cultural heritage.

Review of relevant mAR apps within tourism

“Carletto the spider”

In their work, Lombardo and Damiano (2012) presented their application which used storytelling techniques on mobile device for guiding visitors at a historical site. A fictional anthropomorphic spider character called “Carletto”, plays the main role as a guide to form the narration and deliver information. Their finding confirms the importance of the storytelling-based approach in engaging visitors emotionally. However, they warned about the tendency for such app to isolate visitors and recommended a flexible strategy that allows sharing of experience among visitors, at the same time provides privacy upon request.

“James Monroe’s Highland”

According to the Highland museum website (‘James Monroe’s Highland’, n.d.), the location in this project was a heritage site that used to be owned by the fifth United State President James Monroe and his wife. The museum gives an option of a tour experience using AR with Smart Glasses with a 40-minute duration. The visitor becomes an observer of the important historical event that occurred in 1819 at the location. The narrative is told through a dialogue between historical characters. Among the highlights of the AR tour is the digital reconstruction of the 1799 main house that was previously lost to fire after Monroe sold the property. The Executive Director at James Monroe’s Highland believes that the AR tour can engage new and younger audiences who use the technology as a new way to experience history (Epson Moverio, 2018).

“The Westwood Experience”

The Westwood experience is an experiment conducted between December 2009 and January 2010 to evaluate the Mixed Reality (MR) effects in enhancing walking tour at a prominent location around Westwood, California (Azuma, 2019). The tour used a linear story unique to the site. The experience started with an actor that acted as the Mayor of Westwood physically briefing participants before the start of the journey. Mobile phones and earphones were given to each participant to proceed with the walking tour on their own using an mAR. The same Mayor of Westwood continued as a virtual narrator in the mAR app. When the participants align their phone camera to the building at each site point, they can then see visual elements from the year 1949 superimposed on the live view of the location on their mobile screen. Along the way, participants

find clues that guided them to a mystery woman who was then revealed as a famous figure back in that time. At the end of the tour, an actress acting as the mystery woman/famous figure physically meets the participants to conclude the story.

“T.I.A - Ngāti Whātua Orākei”

In this storytelling application, Māori cultural stories are told by 3D-rendered characters representing Māori superheroes. The mAR app uses markers that users can download, print and place in the real-world to ‘conjure’ the Māori superheroes. The application was launched in December 2018.

“ARA Journeys”

“ARA Journeys” mAR app combines augmented reality (AR), mixed reality (MR) and gaming technologies to encourage and enhance cultural connection with indigenous knowledge and language. ARA Journeys are a series of applications, each with different stories based on the main character called Manu. The first of the series; “Journeys of Manu - Puhinui Stream”, which was launched in 2017, uses marker as its mAR tracking technology. However, its more recent series such as “Journeys of Manu - Maramataka” have started using the mobile’s GPS to anchor digital objects to an exact location in the real world.

2.3. Storytelling

Since the start of human history, storytelling has been used by mankind as a mean of expressing experiences, emotions and ideas. It is also used to communicate information from generations to another. As stated by Gershon and Page (2001), storytelling not only conveys information, but also deliver cultural values and experiences. Both McCloud (1994) and Azuma (2015) agreed that storytelling, as a method of instruction and education, is important. The knowledge and experiences, wisdom and understanding, all live on in stories and in words, inside those who heard them (McKenna, 2005, p. 20).

2.3.1. Characteristics of Storytelling

Miller (2014, pp. 17–18) suggested the following special characteristics of storytelling to be applied in interactive format:

- *types of narratives: they involve a series of connected dramatic events that serve to tell a story;*
- *works that contain characters, including types of characters found only in digital media: characters controlled by the user or by the computer, and synthetic characters with the appearance of artificial intelligence (AI);*
- *interactive: the user controls, or impacts, aspects of the story;*
- *nonlinear: events or scenes do not occur in a fixed order; characters are not encountered at fixed points;*
- *deeply immersive: they pull the user into the story;*
- *participatory: the user participates in the story;*
- *navigable: users can make their own path through the story or through a virtual environment.*
- *break the fourth wall: the user can communicate with the characters; the fictional characters behave as if they were real people;*
- *blur fiction and reality;*
- *include a system of rewards and penalties;*
- *use an enormous narrative canvas, tying together multiple media to tell a single story;*
- *may be multi-sensory;*
- *attempt to incorporate some form of artificial intelligence (AI);*
- *allow users to create and control avatars;*
- *offer a shared community experience;*
- *manipulate time and space (contracting or expanding time; allowing users to travel enormous virtual distances);*
- *put users through a series of challenges and tests (modeled on rites of passage and The Hero's Journey);*
- *offer opportunities to change points of view, either seeing the story from the vantage point of different characters or by changing the visual point of view;*
- *include overt and non-overt gaming elements;*
- *include elements of play.*

These storytelling characteristics are considered relevant and sufficient in

addressing the research question set out in section one, and will therefore be used in this research project.

2.3.2. Storytelling in tourism

Story and location are connected through folklores such as myths and legends. From an economic perspective, Pérez Aranda, Guerreiro, & Mendes find that myths and legends are important assets for a location to be a distinguishable destination to attract visitors. Myths and legends not only represent age-old collective memories, cultural ideas, spiritual concepts and values, but also embody ideas on modern history and localized environments. For example, according to Abidin and Razak (2003), a lot of traditional Malay rituals, events or functions are being told in a form of folklore. The stories were told in a simple manner; with the use of analogies, symbolisms, rhymes, idioms and proverbs in the narrative.

As discussed in earlier in this section, the desire is to provide cultural heritage sites visitors with experiences that are meaningful. It is important that the value of the site is made known and understood. As a source for tourism communication, myths and legends can have an important role in imparting visitors with meaningful and memorable experience (Pérez Aranda, Guerreiro, & Mendes, 2015). Further, the local myths and legends that are unique to each culture can be used as a narrative when providing visitors with an exclusive set of experiences, memories and emotions in connection to the site (Pérez-Aranda et al., 2015). This argument can be linked back to the 'sense of place' theory discussed earlier in section 2.1.2.

The stories in the forms of myths and legends are typically passed on verbally from one generation to another, some through songs and poetry. As pointed out by Miller (2014), digital storytelling has a similar function in the anthropological field, where it "is used as a way to preserve stories of

a culture or historic period that might otherwise be forgotten” (p. xviii). So from this perspective, having myths and legends retold in a digital form helps to better preserve them. However, visitors usually have to rely on the knowledge of a tour guide and/or information display to provide the narrative of a cultural site. Moreover, this is not enough for the tourists to interact with the current information display that are available at the cultural heritage sites (Park, Nam, & Shi, 2006).

Hence, the next section will look at how mobile augmented reality (mAR) as an emerging technology can be utilised to enhance the story-based experience.

2.3.3. Retelling stories on mAR platforms

In the past, medium of storytelling was limited to verbal delivery, namely oral, and later in the form of writings and pictures. When modern media such as radio, television and cinema were introduced, the form of storytelling evolved to include moving pictures and animations. With the advent of new media, these are converted to digital data, which allows for more exciting possibilities to expand the ways in which a story can be told. As aptly stated by Azuma (2015), “storytelling is fundamentally important, and any advancements in media technology that enable people to tell stories in new and potentially more compelling ways can have profound impact” (p.260).

Kourouthanassis et al. (2015), highlighted that a critical point to look at when designing an interaction for mAR app is to reduce user’s working memory needed to operate the application. He further suggested that it is also essential that the mAR app present “relevant-to-the-task content and cultivate semantic associations in users’ cognition, in order to minimise the necessary interaction steps” (Kourouthanassis et al., 2015, p. 84) as visitors frequently travel from one location to another. By minimising the

interaction and information, visitors can easily navigate the real world using the app without affecting their awareness of the physical surroundings. This makes storytelling a perfect match, seeing that a well-told story has the capacity to neatly compact large amounts of information (Gershon & Page, 2001).

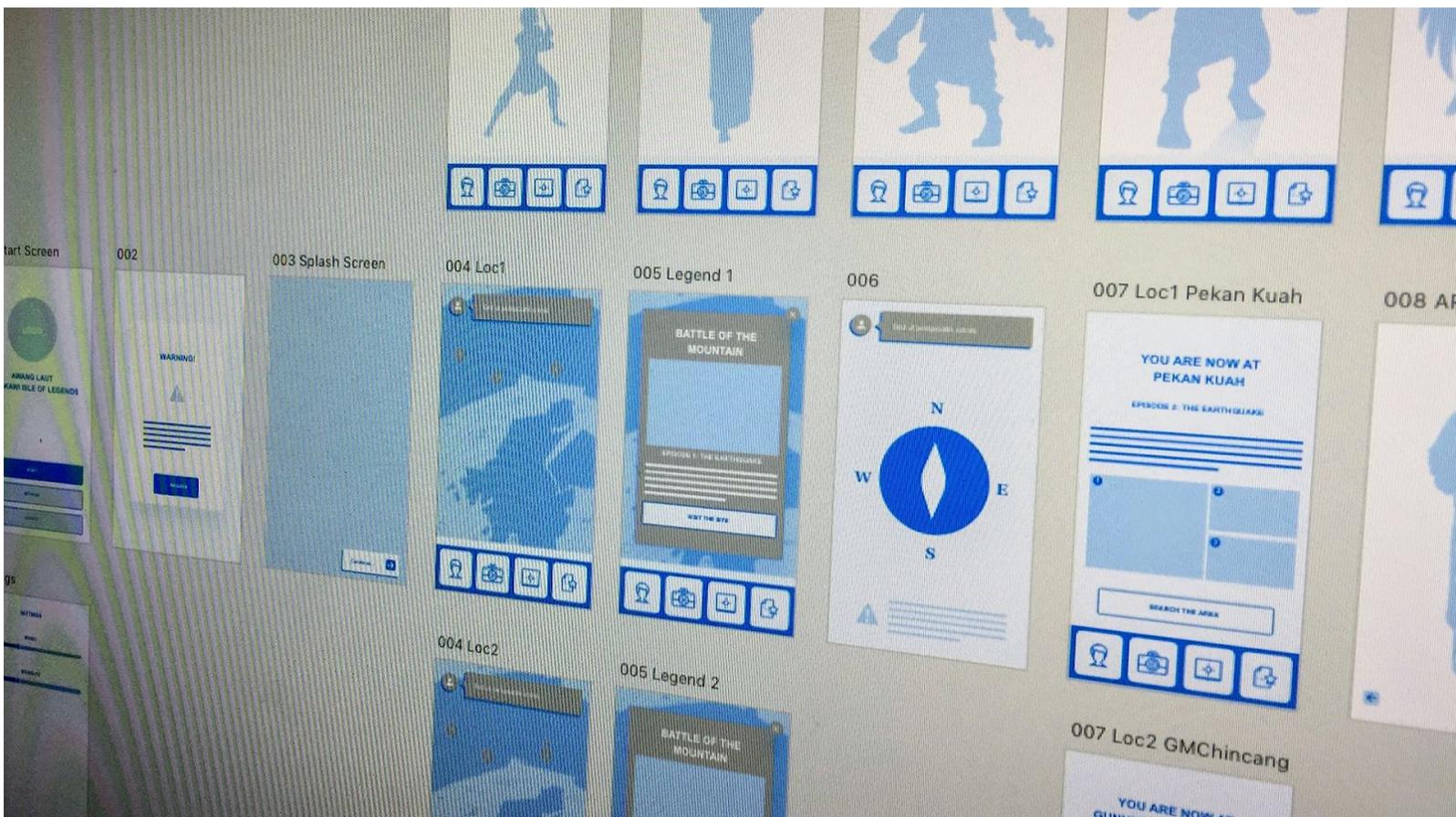
In his work, Azuma (2015) mentioned three approaches to make AR storytelling a powerful new form of media: Reinforcing, Reskinning and Remembering. The Reinforcing approach identified that an AR storytelling experience is more compelling when virtual content is applied at the actual physical site. The Reskinning approach is a strategy to make the physical site more attractive by adding interesting virtual content that suits the purpose of the story and location. The Remembering approach combines personal memories and story with the actual site. Even though the Remembering approach appears similar to the Reinforcing approach, the difference is that Remembering draw upon individual interpretations or perspectives when experiencing the story.

The convergence of technology has provided a lot of possibility and capability to connect real and virtual environment on mobile devices. As pointed out by Azuma (2015), “AR storytelling experiences will offer new ways to tell stories, in different ways than traditional media, with new advantages and disadvantages compared against established media”(p.260).

2.4. Conclusion

This review covered the three areas of literature in which the focus of this research is situated between: tourism, mAR and storytelling. The review has helped shed light on the use of storytelling in mAR viewed through the lens of enhancing visitor experience at cultural heritage sites. Several research projects indicated that mAR is able to enhance the overall

visitor's experience at cultural heritage sites. mAR systems is especially favourable when it comes to cultural heritage tours as not only smart mobile technologies are becoming increasingly accessible to each individual visitors, but also because visitors' on-site experiences can be enhanced without risking the integrity and authenticity of the cultural heritage site. Storytelling helps to further enhance the experience by providing visitors with unique memories and emotional connections to the particular site. The common theme identified is the emphasis on '(visitor) experience', which will therefore be used in this research project as the common ground to link all three domains - cultural heritage tourism, mAR and storytelling - together.



3. Approach

This section outlines the methodological step used in this research project. The steps involved identifying iterative phases of practical, technical and design development.

3.1. Methodology

This section introduces the approach used to address the research question that was mentioned earlier in section 1.2. Pragmatism is chosen as the underlying philosophy guiding this research. The research went through the following phases: **analysis**, **design**, **development** and **testing**. In the analysis phase, a deductive approach was used to establish the benefits and pinpoint the challenges of integrating

storytelling in mAR. The literature review in section 2 presents the bulk of the analysis phase, with the primary outcome being the experiential framework based on my analysis and synthesis of the relevant literature which will be presented in the following sub-section. The framework is then applied to the creative practice-based methodology to produce a minimum viable product (MVP). In the design phase, a tour-trail planning was used to identify the story approach. The visuals, narrative and interactivity were also crafted during this phase. Paper-prototyping were also used to understand and test the app's interaction workflow before it is finalized for development. During the development phase, the components of the MVP were built. The components were constructed separately before combined into one application. This allowed for each component's functionality to be tested on an actual mobile device during testing phase.

The study data are collected through the documentation and reflective practice covered in section 4 and 5 of this exegesis.

3.2. Experiential framework

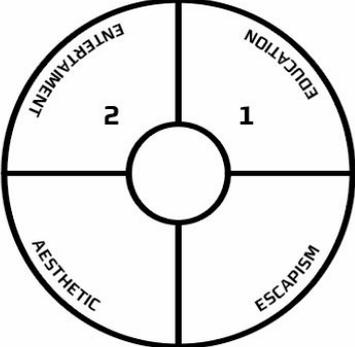
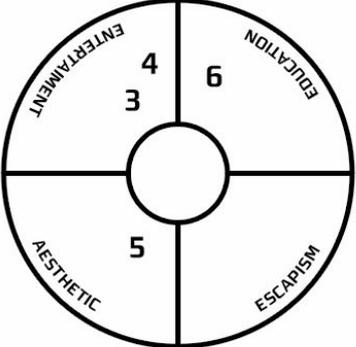
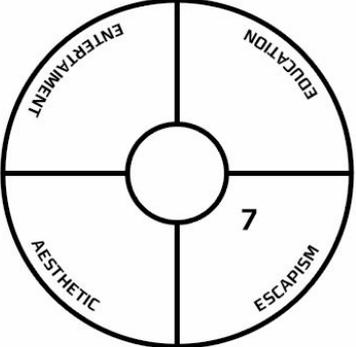
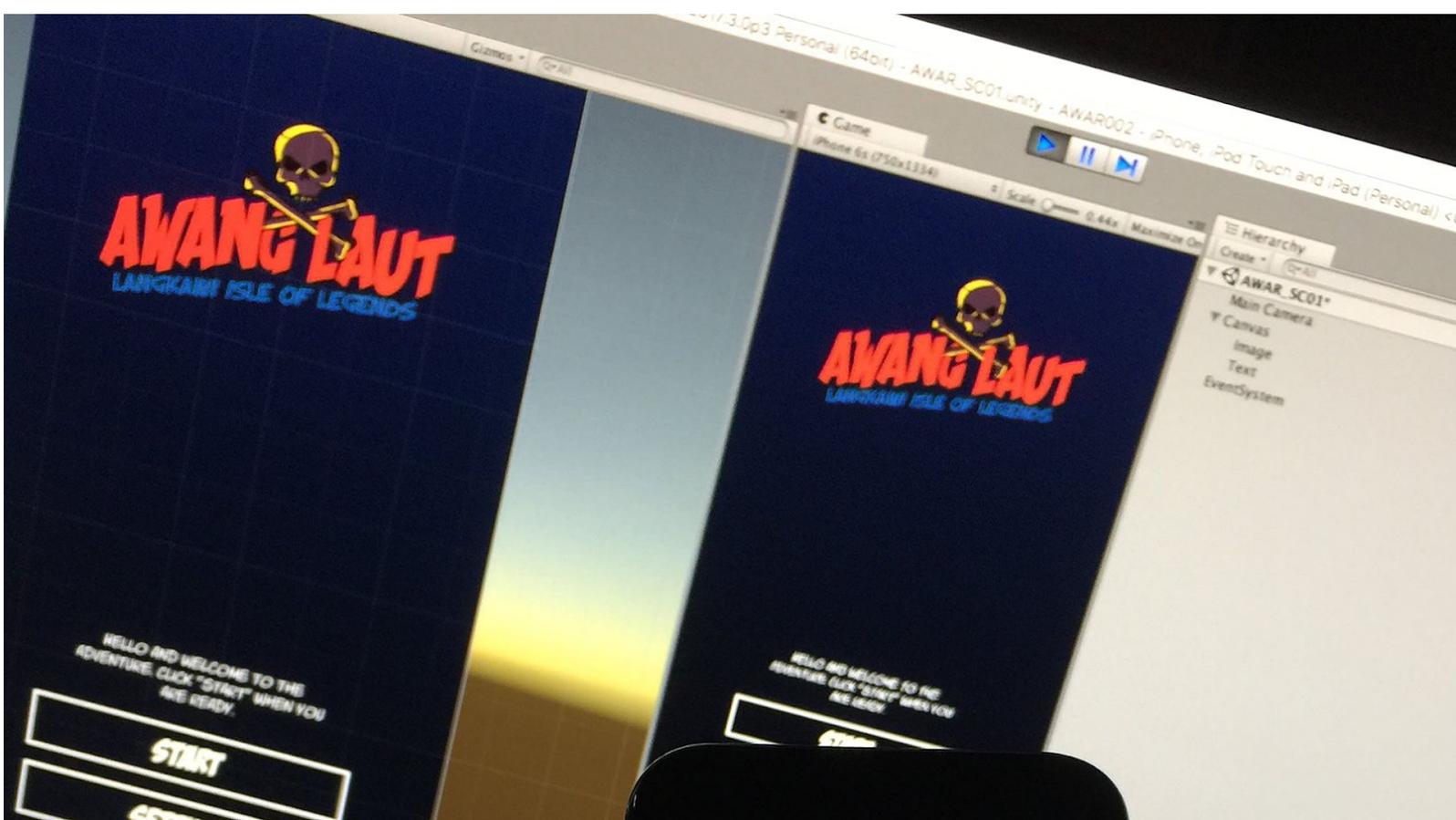
STAGES	PRE-VISIT	ON-SITE	POST-VISIT
REALMS OF EXPERIENCE			
CHARACTERISTIC OF STORYTELLING	<ol style="list-style-type: none"> 1. Break the four wall: the user can communicate with the characters; the fictional characters behave as if they were real people. 2. Allow user to travel enormous virtual distance. 	<ol style="list-style-type: none"> 3. Nonlinear events or scenes. 4. Interactive - The user controls can impacts the aspect of the story 5. Blur fiction and reality. 6. Put users through series of challenges and test (Hero's Journey) 	<ol style="list-style-type: none"> 7. Offer a shared community experience

Figure 3. The proposed Experiential Framework (my elaboration based on Pine and Gilmore (1998), Kuflik et al. (2015) and Buonincontri and Marasco (2017))

In order to identify the design needed for the app, I have established the above framework to guide my design process. The framework is elaborated based on the insights gained from the review of literature in the previous section. This enabled suitable storytelling characteristics extracted from the list suggested by Miller (2014) to be matched with the visitor experience in relation to the stages of the visit. By covering all four realms of experience, a richer and more holistic story-based experience for the visitor can be designed.



4. Minimum viable product (MVP)

The Awang Laut Augmented Reality (*AWAR*) app, which is the minimal viable product (MVP) for this research project, has been developed through several iterations; starting from the elaboration of the story approach, character concept and interactivity, to the exploration of the format of storytelling on the AR system, which included the combination of text, image, audio and animation. This section documents the process by describing the design, development and testing phases of the project.

4.1. Design phase

4.1.1. Story approach

The story behind *AWAR* app connects myths and legends with a physical cultural heritage location - which is the Langkawi Island, Malaysia. The story uses a main fictional character called *Awang Laut*, who is based on a real historical figure. The following is an excerpt of the script introducing the character:

Some called him Enrique,
Enrique of *Melaka* – which was where he originated from.

Some called him Henry,
Henry the *Black* – which was the colour of his dark sailor's skin.
But among the Malay locals he's fondly known as 'Awang', either
Awang the Black, Panglima (Commander) *Awang*, or, as how he's
referred to in this story, *Awang Laut*.

Laut, which in Malay means the sea. The sea upon which he travelled
around the world, onboard of Ferdinand Magellan's ship in the 19th
Century.

However, this story will not be about the sea travel that turned him into
a historical figure and the local hero. Rather, it's a story of his early
teenage life that was not recorded in any historical journals or writing*.

In this journey, you will be assisting the main character in finding a
magical weapon in the island. Throughout this quest, the visitor will
have chance to talk with other character figures from myth and legend
that lived on the island.

The excerpt above is how the fictional story in *AWAR* begins. As the early part of the real *Awang Laut*'s life was not in recorded history, the gap therefore affords the freedom in designing a fictional story for this project. Strands of the story is then interwoven with the rich local myths and legends that Langkawi Island is famous for. Note that in this project, the visitor assumes the role of Awang Laut as the main character of the story.

4.1.2. Selected cultural heritage site: Langkawi Island

The Langkawi Island was selected due to the island's history being rich in myths and legends, so much so that the island is also known as the “Island of Legends” (Razak & Ibrahim, 2017, p. 10). This thus provides another great opportunity for leveraging storytelling.

Among the largest island off the coast of northwestern Malaysia, Langkawi projects a breathtaking landscape that provides a foundation to the unique collection of myths and legends. Mythological stories were used to depict the shape or the origin of the physical location. This makes it ideal to connect the location with the story.

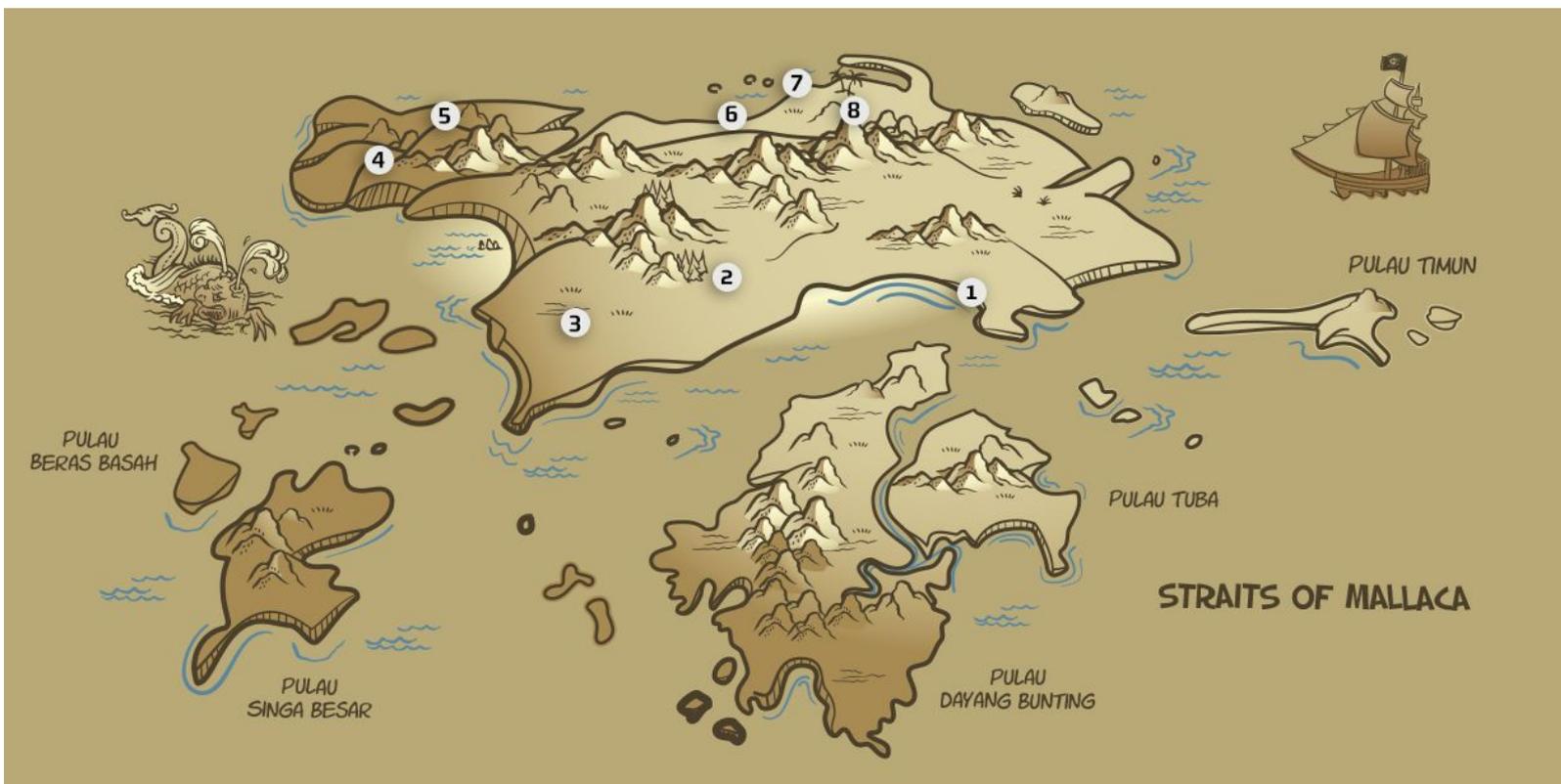


Figure 4. Location of cultural heritage sites around the Langkawi Island

In this project, eight different cultural heritage sites around the island were identified to be both significant to the story plot and suitable for visitors to explore using mAR. As *Awang Laut*, visitors get to ‘converse’ with other characters at each respective site. This is how the story is enfolded to the visitor, as well as how clue is provided for them to move through the story and onto the next physical site. Information regarding the on-site location is also weaved through the conversation. By completing the story, the visitor will have the additional satisfaction of having finished touring the cultural heritage sites of Langkawi.

4.1.3. Tour-trail planning

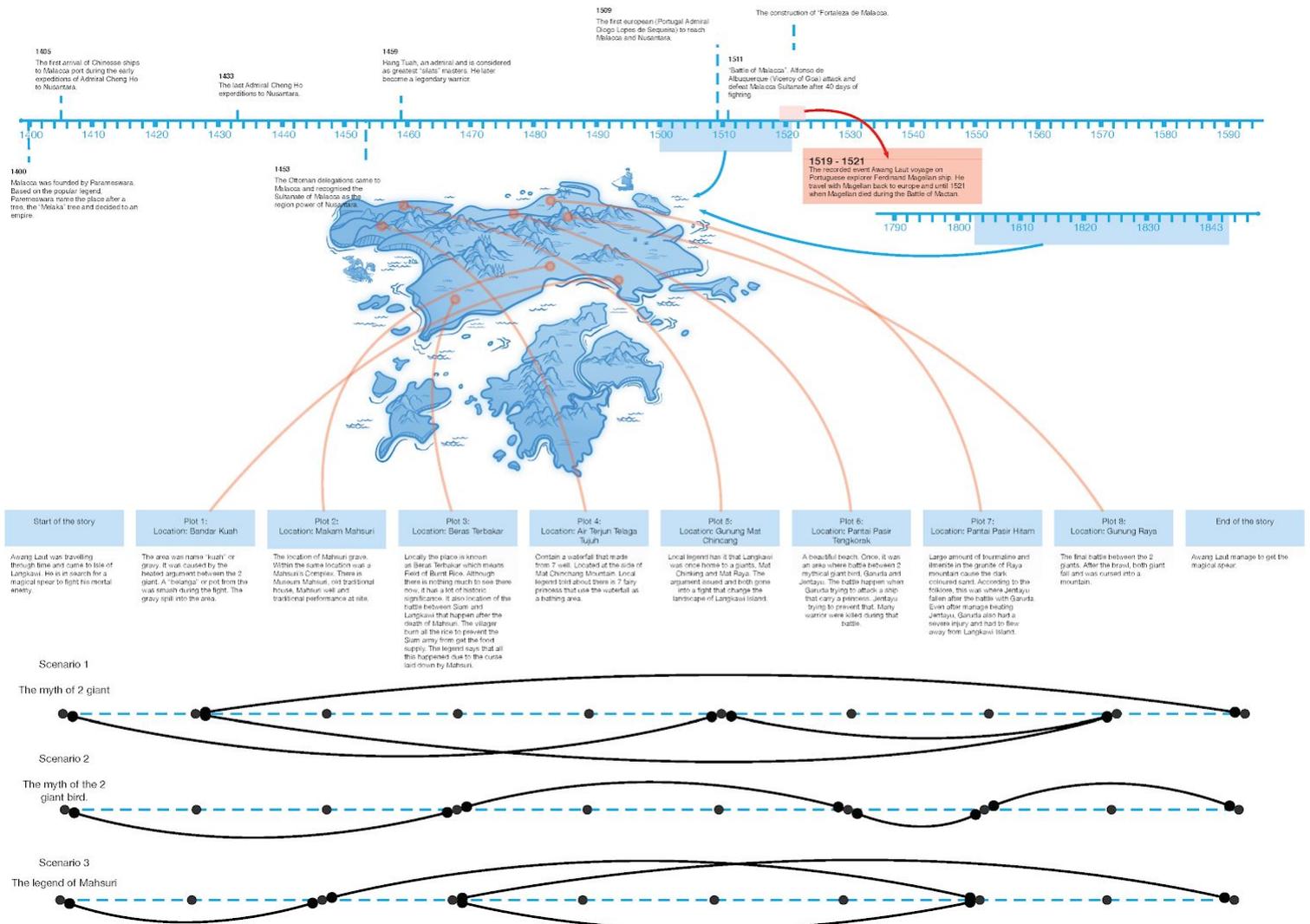


Figure 5. Tour trail planning

To create a story which takes the different cultural heritage sites into account, a 'tour trail planning' (Figure 5) was used to connect each story relative to the physical location. Considering that the story can be non-linear, scenarios were used to establish different user pathways in the story. This is also where the pre- and post- considerations are included. For example, the pre-visit story includes the explanation of the character and the place in the form of a prelude. The post-visit allows visitors to recap their experience and 'chat' with the story characters. Both of these

are accessible from the mobile app without the visitors having to be on-site.

4.1.4. Layout and wireframe

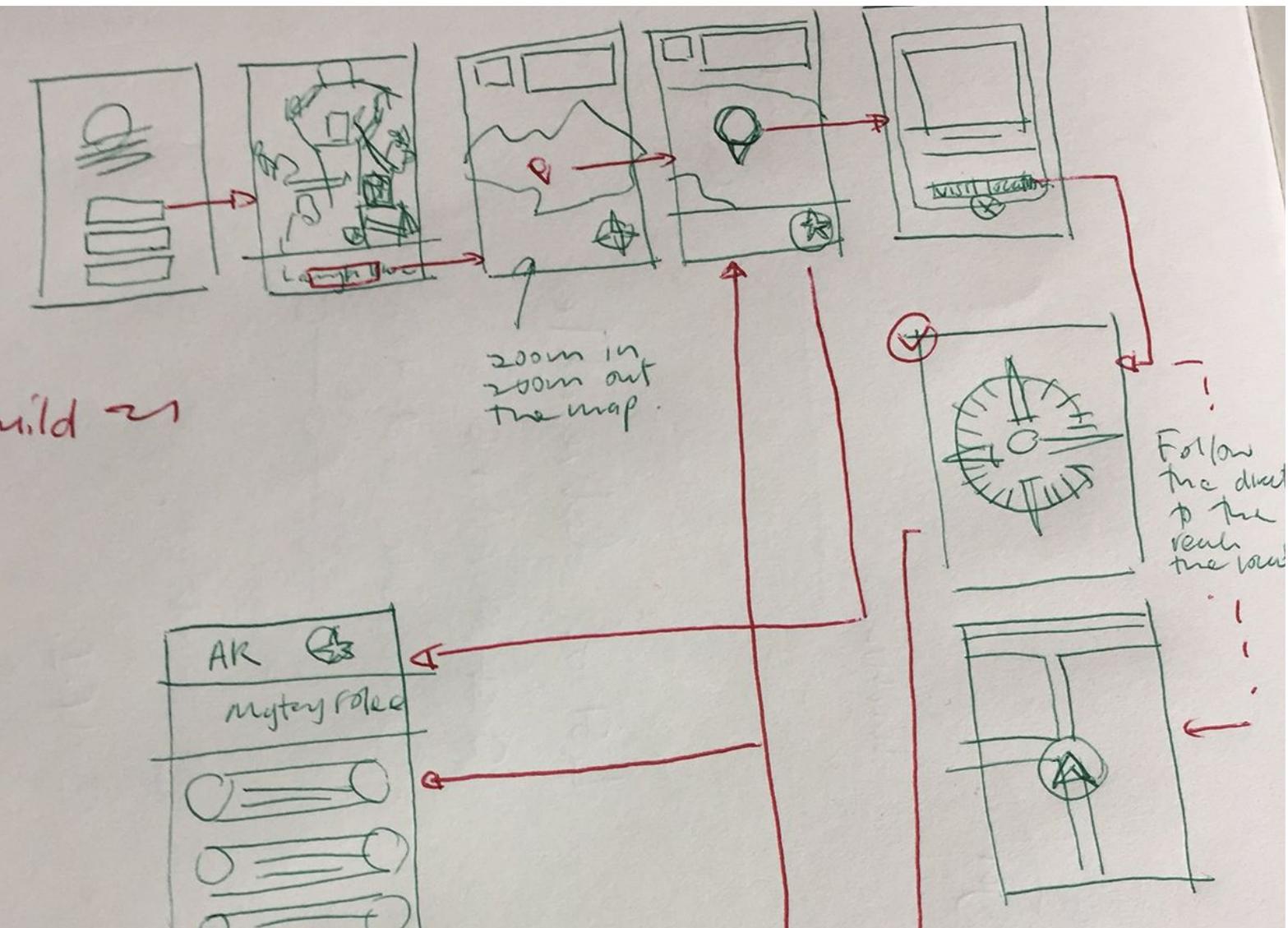


Figure 6. Design sketches of AWAR app

Rough sketches on paper (Figure 5) were first used to work out the layout and content placements in the mAR app, navigational issue and screen flow.

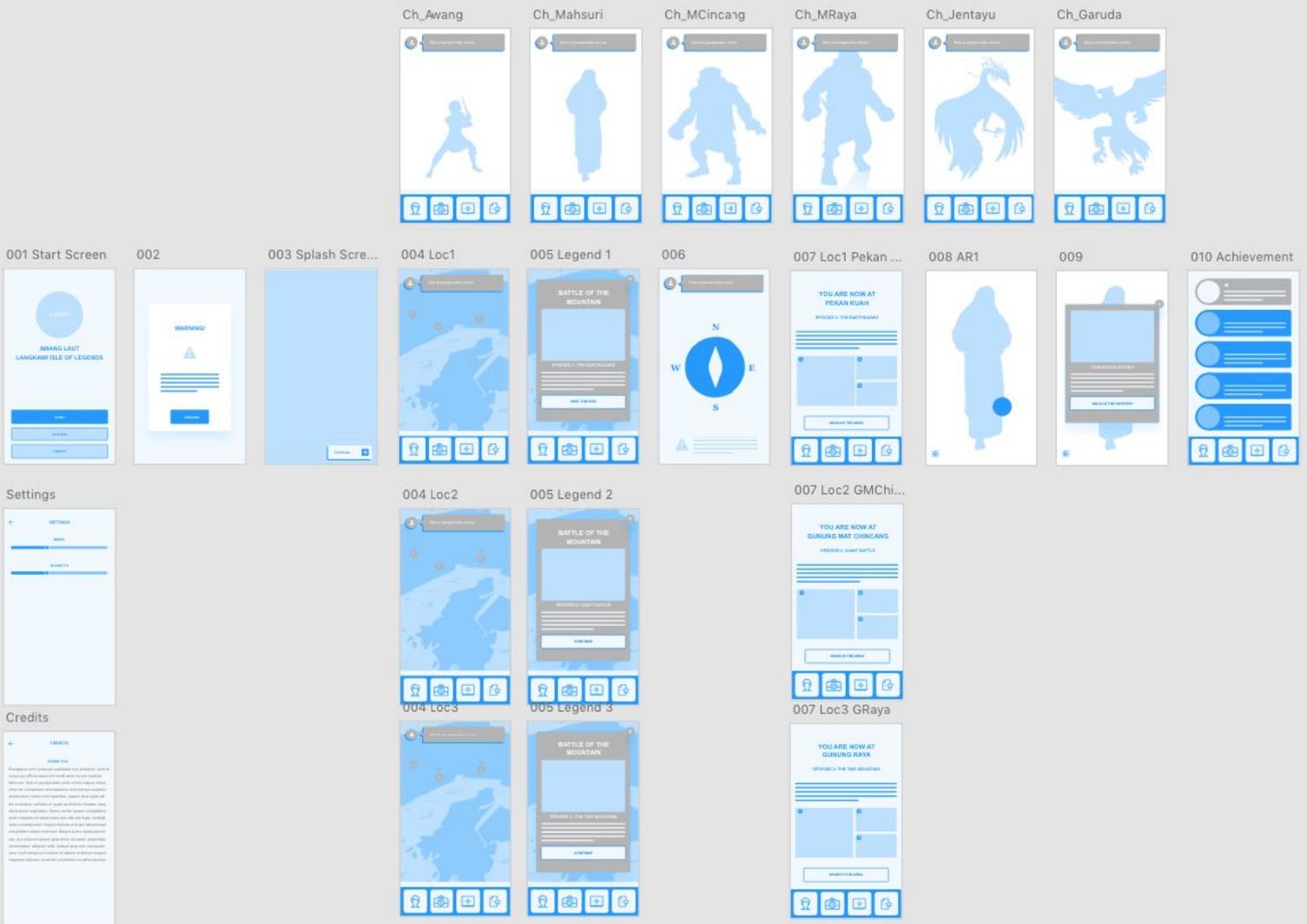


Figure 7. Wireframe for AWAR app

Adobe XD were used to replace paper prototyping and create interactive wireframes ²(Figure 6) in the early design phase of AWAR. Templates of key screens were made to present user interfaces and application functions. Basic user testing were then run using the interactive wireframes to determine user experience and interactions.

²A video recording of the interactive wireframes can be viewed on this link: <https://youtu.be/tJz81HKHrDs>.

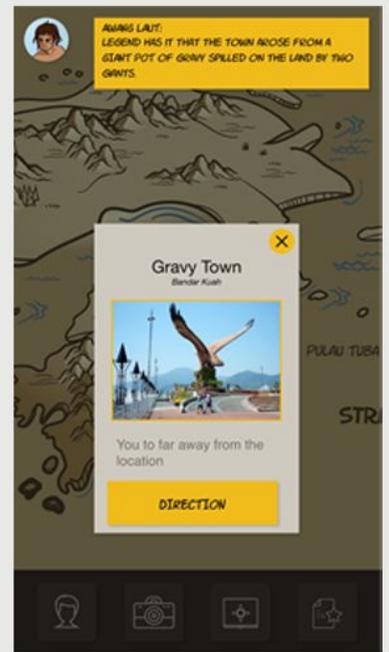
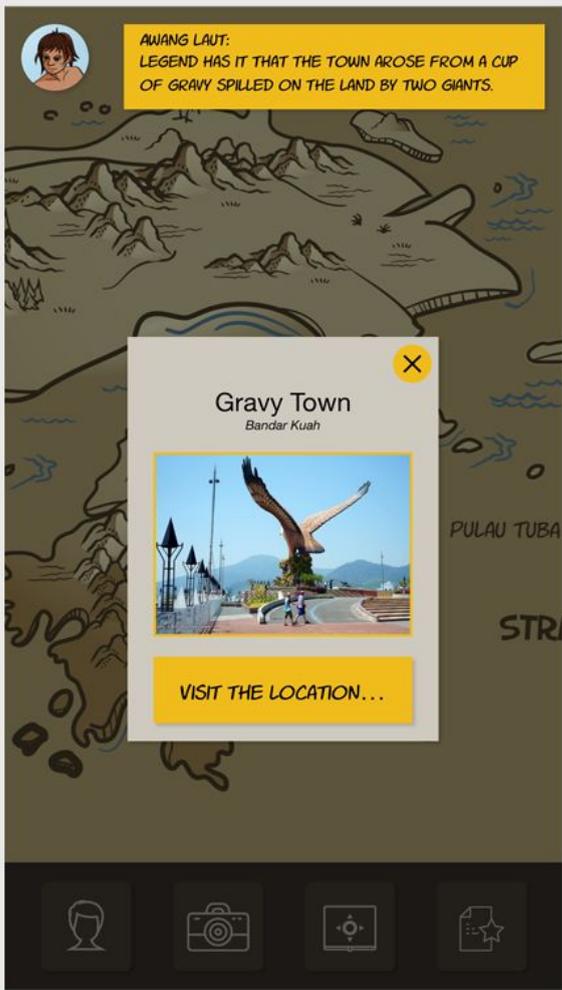


Figure 8. High-fidelity wireframes

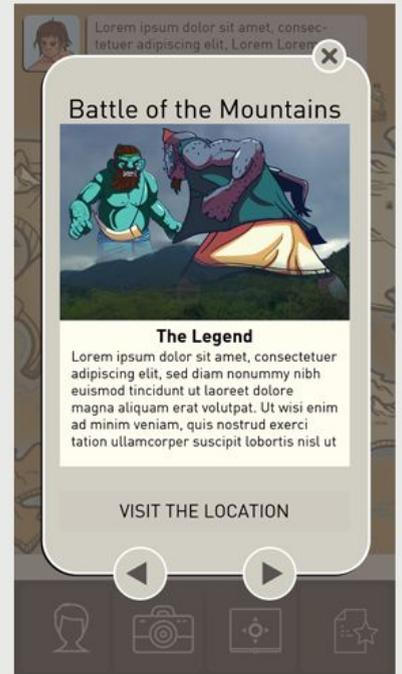
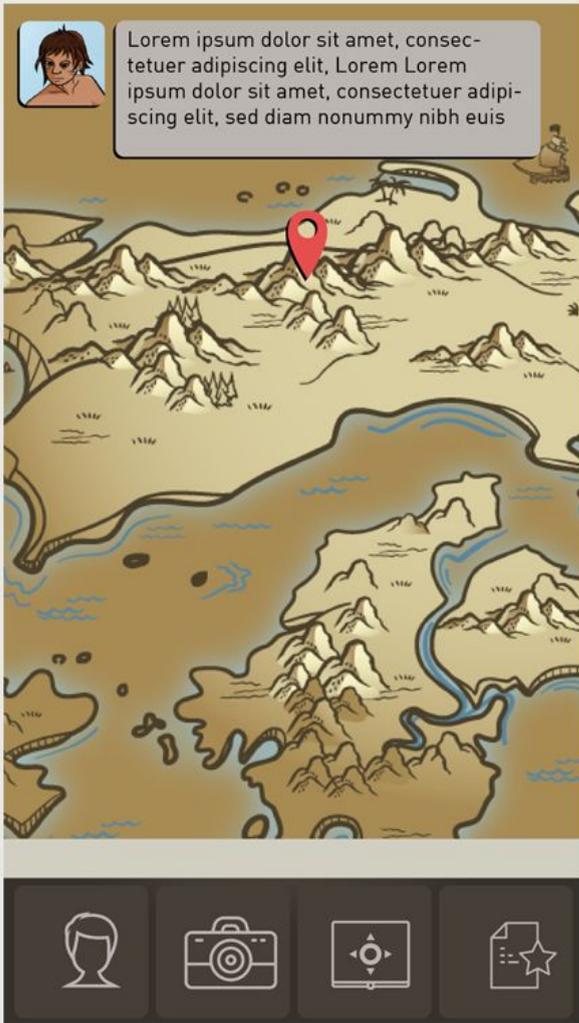


Figure 9. Design iteration of the user interface

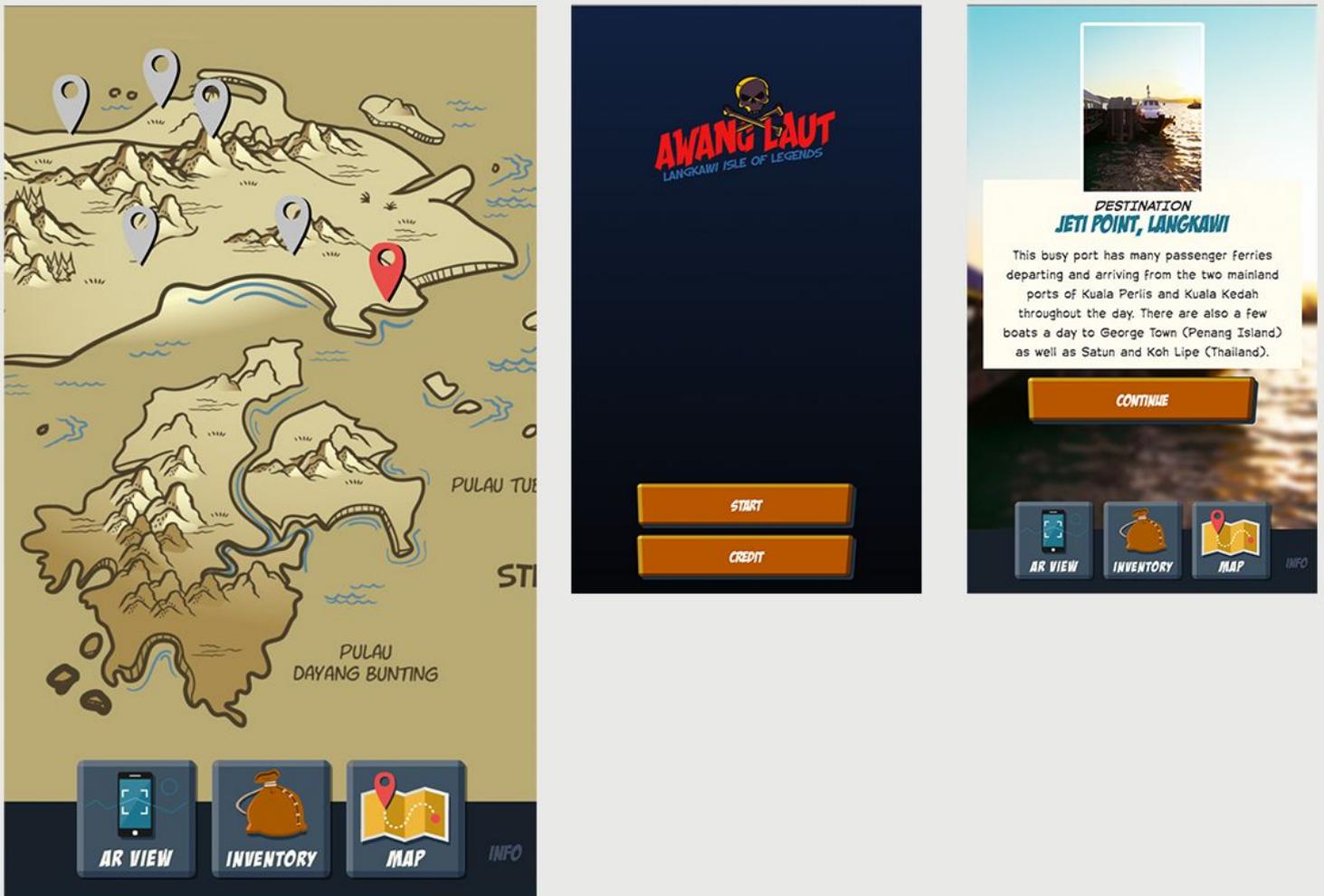


Figure 10. The app's user interface artwork

Several iterations of hi-fidelity interactive wireframes (Shown in Figure 8-10) were also developed using Adobe XD.

As per recommended by Kourouthanassis et al. (2015), the user interface design was kept simple to minimise visual and cognitive overload to the user. Other design considerations that was derived from the review of literature included 'reskinning' (Azuma, 2015), which was achieved by exploiting the content that visitors can connect with at the physical location.

4.1.5. Look and feel

In line with the story, theme is determined to represent old Malay archipelago. This section further discusses the visual style that influences the character design and the overall look and feel in *AWAR*.

The visual reference for characters in Malay myths and legends are rare or non-existent. This is mainly due to the religious censorship among Malays who majority are Muslims; whereby the religion prohibits drawings of characters, especially those that have the tendency to be adored and 'idolised'.

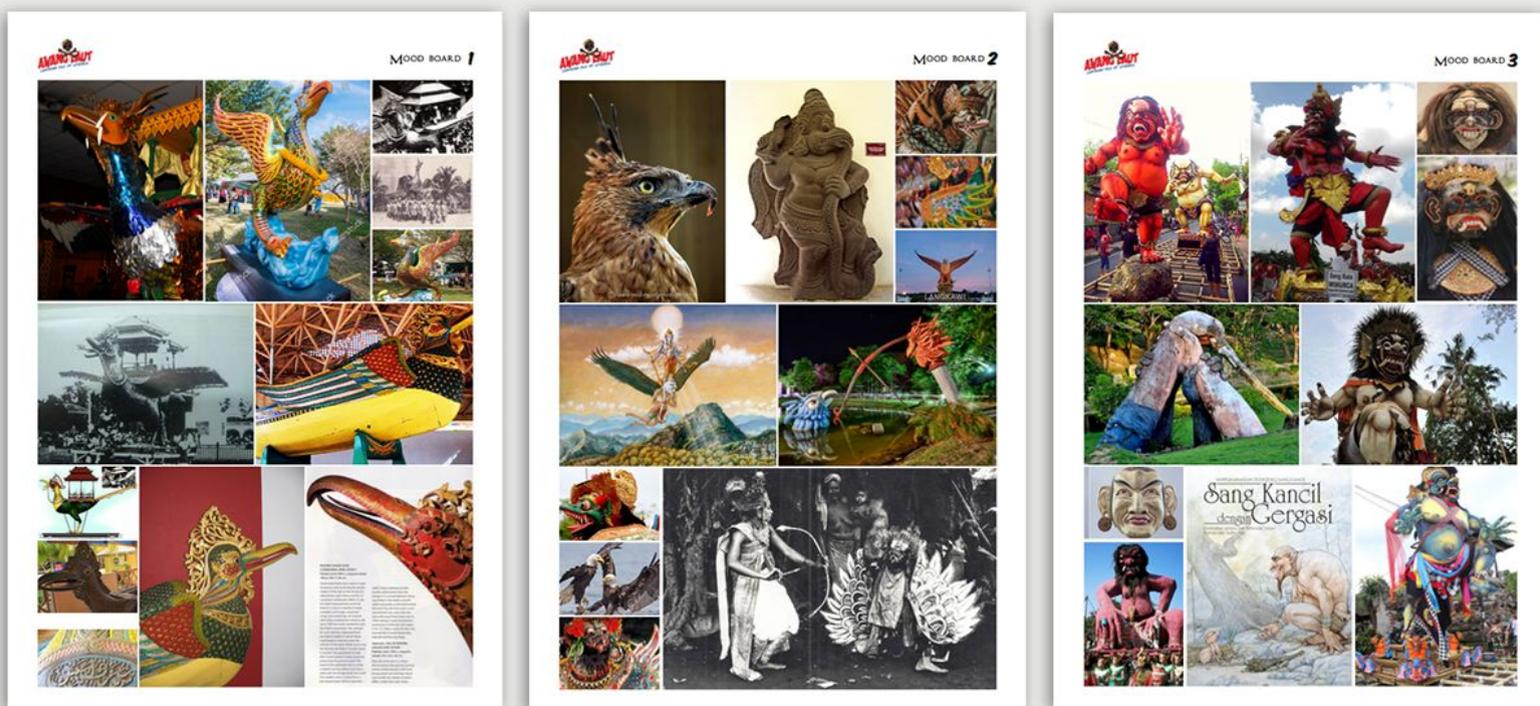


Figure 11. Moodboard use for character design

To illustrate the character, visual reference from neighbouring countries such as Thailand and Indonesia were used on the basis that these countries do share some cultural similarities with Malaysia. Some

alterations were then made to better match the aesthetics of local Malay heritage. This is vital in ensuring the *AWAR* app maintains the ‘sense of place’ in relation to the cultural site visited. The style choice for the characters are based on my own personal form of expression, where I decided to go for more ‘iconic’ forms that is easier for international visitors to relate to.

4.2. Development phase

4.2.1. Graphics

The final graphics for the user interface were made using Adobe Photoshop and Adobe Illustrator. As can be seen in figures 12-15, a deliberate decision was made to render the characters in 2D, and in the style of graphic novel, comic book or ‘cartoon’ illustrations. In the words of McCloud (1994), “Cartoons have historically held an advantage in breaking into world popular culture” (p. 42).



Figure 12. Illustration of Garuda



Figure 13. Illustration of Jentayu



Figure 14. Illustration of Mat Chincang



Figure 15. Illustration of Mat Raya

I would acknowledge that in a standard approach for rendering in AR, the character designs are produced in 3D graphics (Lombardo & Damiano, 2012; Vlahakis et al., 2002). However, Dow et al. (2006) argued on the concerns of losing much control of a character's expression when using a 3D model or video-based character in an interactive AR. In "AR Façade",

which is an AR version based on a PC-based interactive story application of the same name, Dow et al. (2006) give their reasoning to render the characters in a cartoon-style image layers as to have more control on creating the characters' facial expressions. McCloud (1994) also stated that something simple and as basic as a cartoon can be perceived much better than something which is too realistic. This is further supported by Gershon and Page (2001) who stated that the visualisation of information using a comic metaphor is able to overcome the limited capacity of human short-term memory to remember information.

4.2.2. Interactivity



Figure 16. Development of AWAR app on Unity

The final MVP was developed using Unity, with Vuforia AR as the augmented reality software platform.

The *AWAR* app is designed with two main interaction modes, one is via location-aware or marker-based input and the other is via mobile screen input. In the location-aware/marker-based mode, the story is generated whenever the visitor physically enters a certain radius around a local heritage site or when their mobile camera detects a physical image marker.

Once the story is generated, the visitor can use mobile screen input to select between choice nodes. This affords the visitor to make choices corresponding to the options that are provided at the location.

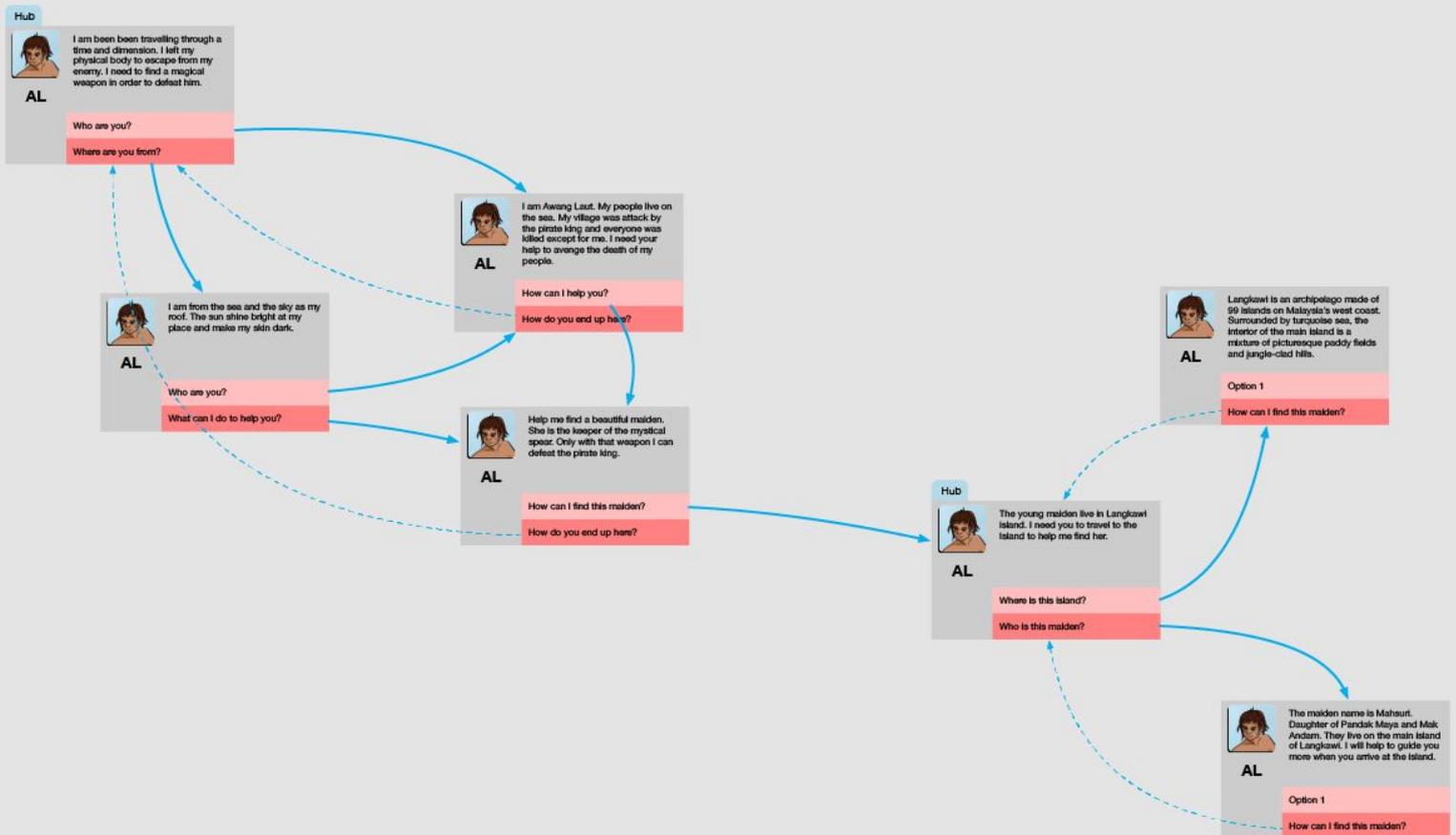


Figure 17. Hub-and-Spokes dialogue method

Using dialogues as a means of providing visitors with options, visitors are given the appearance of communicating with a character. In handling the

dialogue, the hub-and-spokes dialogue method was used to control the conversation. Different from the branching dialogue method, the hub-and-spokes method allows visitor to interrogate the character for further information or enter a new hub for more options (Ellison, 2008). The user can find a way back any hub by selecting their option. This method is particularly suitable for this project as it also allowed the control of the dialogue within the location of the site.



Figure 18. UI format for character dialogue

Selected storytelling characteristics as suggested by Miller (2014, pp. 17–18) were used throughout the three stages (pre-visit, on-site,

post-visit) of the app. Figure 3 (in Chapter 3) suggests the selection that was made for each stages accordingly. Note that not all of these storytelling characteristics was able to be displayed in the form of augmented reality. As exemplified in Figure 18, dialogues between the characters were displayed in a simple chat UI format which alternately shows an image of the character and his/her dialogue in text format. The visitor then converses with the other characters by choosing their response from the available options. This affords visitor control over the progress of the story at the location via the choices they make.

4.2.3. Animation

The MVP also contains animated sequences that are used in the augmented scenes. For example, there is one scene where an animation is used to visualise the scene of spilled gravy flowing through the town centre. Another scene shows Mat Chincang, an angry giant, which was then turned into a stone. Most of the animations in the MVP, such as of the spilled gravy, were made to loop throughout the scene. However, the scene with an animation loop of Mat Chincang being angry contains a button, which visitors can then tap to start the second sequence of animation that shows the giant turning into a stone.

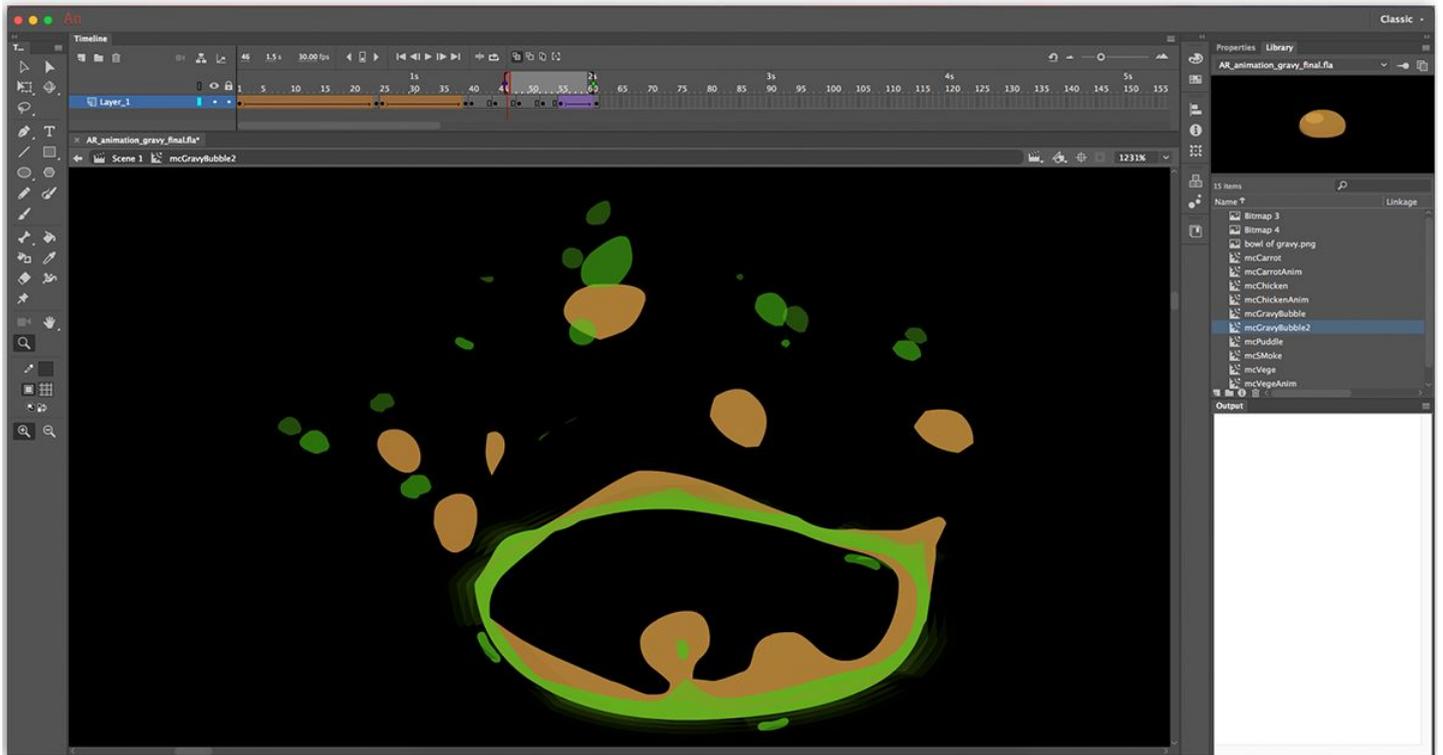


Figure 19. Frame-by-frame animation created in Adobe Animate

The sequence of images for the animation were done using Adobe Animate. Different animation techniques were used to create the sequence. A frame-by-frame animation technique was used to create the bubbles popping animation from the gravy sauce (Figure 19). The process was indeed time-consuming as each frame have to be hand drawn one by one. In contrast, the animation for Mat Chincang was created using the bone tool in Adobe Animate (Figure 20). Here, artwork that is made of multiples shapes were rigged using a skeletal joint-type connection. It is a less time-intensive process compared to the frame-by-frame technique. However, the frame-by-frame animation is required for complex animations, such as the popping bubbles where the bubble's shape needs to change in every frame instead of simply moving across the screen like the giant's arms.

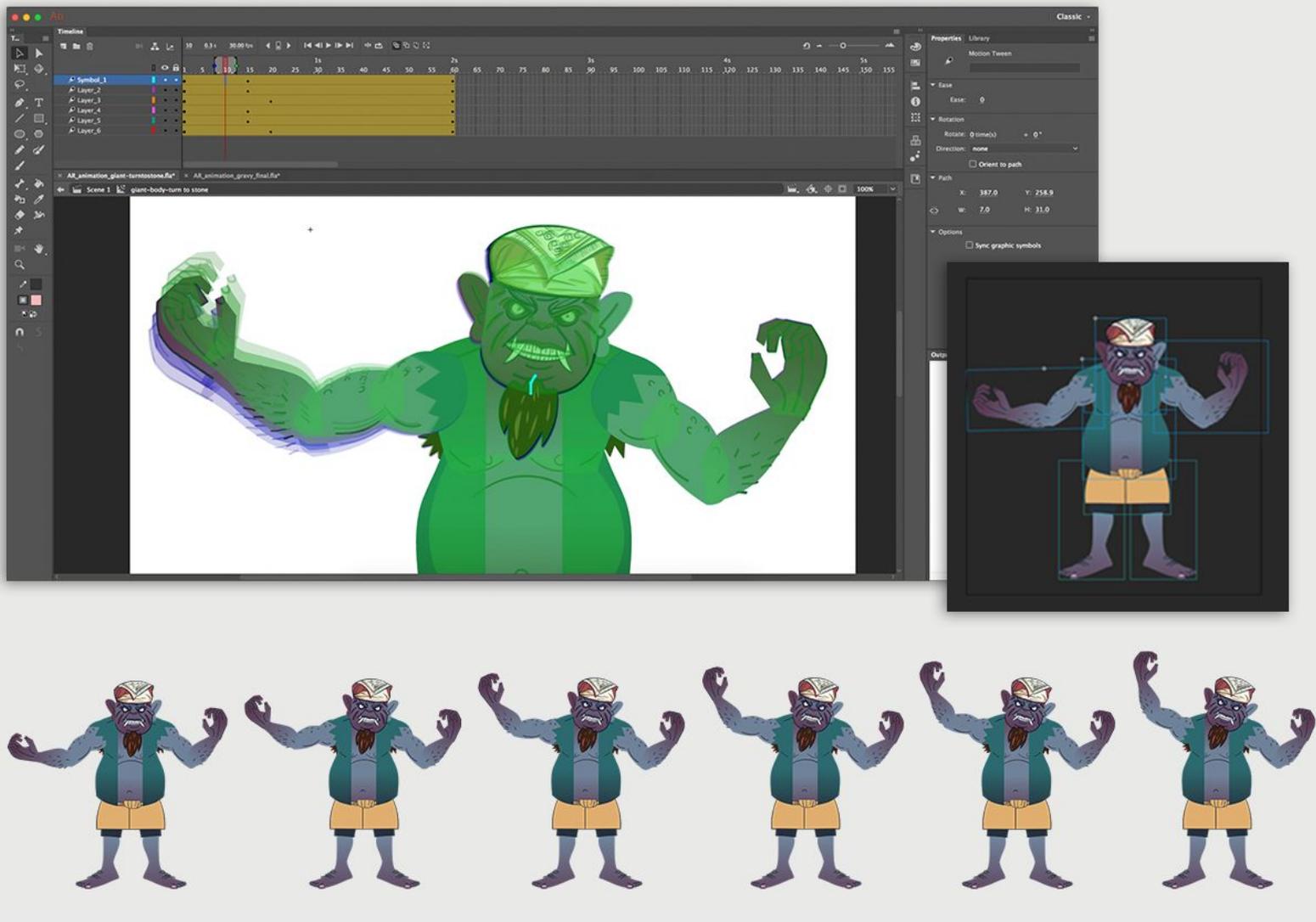


Figure 20. Image sequence for animation created using bone tools in Adobe Animate

These animations were then rendered into an image sequence before placed on an object inside Unity.

4.2.4. Code implementation

To implement the interaction, an add-on for Unity called Playmaker was purchased for the development of the app. This add-on allows non-programmer such as myself to create interactions with little to no code writing via visual scripting. The code is implemented by creating

scenes in Unity, with the structure following the wireframe previously shown in Figure 6. Basic placeholders are then added to each scene. The interactivity is then added to these placeholders e.g. to link the scenes (Figure 21).

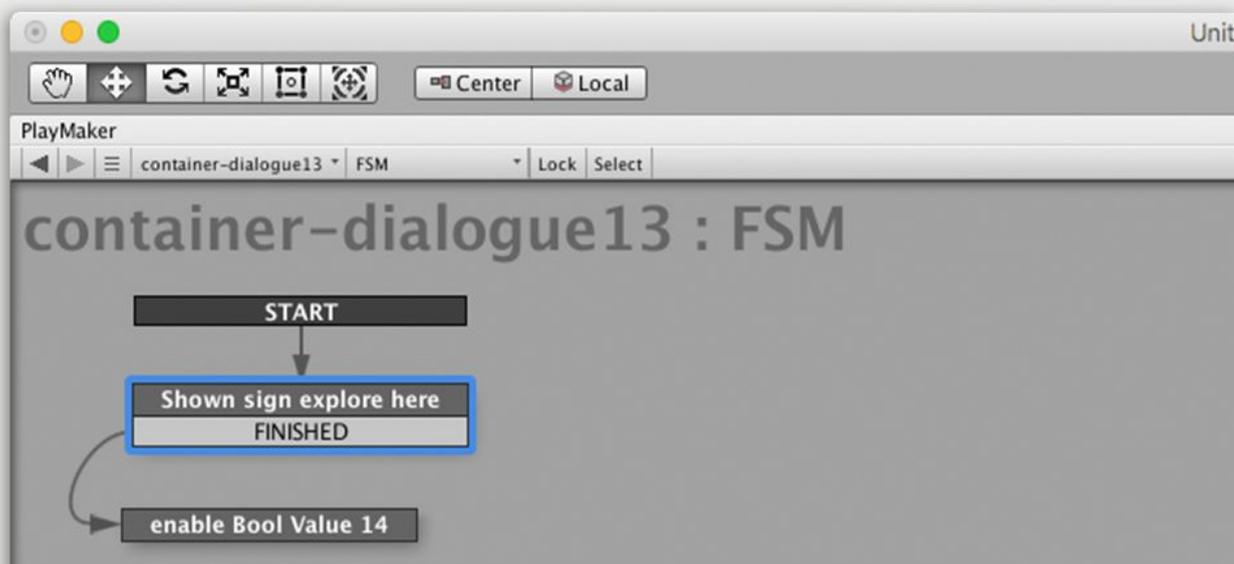


Figure 21. Interactivity on Unity using Playmaker add-on

4.3. Testing phase

A playtest³ was conducted to identify any bugs and design flaws in the *AWAR* app during the development. The initial playtests were conducted both on a laptop and on a mobile device. Samsung S4 was used as the targeted mobile device. This ensures the mobile app is viable to operate for the demonstration. Observations made during the playtest inform the changes required to the design and development of the application. Once finalized, an Android Package (APK) file is exported from the project so that the app can be installed on a mobile device.

³ The recorded video of the playtest on mobile device can be viewed on this link <https://youtu.be/ZOnTjkhZLE>.



Figure 22. Playtest on mobile device



5. Reflections and future development

This practice-based research project addresses its central research question; i.e. “What are the characteristics of storytelling that can be incorporated in mAR environment for cultural heritage sites?” by not only inspecting the key characteristics of storytelling, but also the context in which it will be incorporated.

I started by looking into how I can effectively incorporate storytelling into an mAR app for tourism. Figuratively speaking, the topic of inquiry ended up being ‘flipped on its head’, where the viewpoint is taken from figuring out how a story can be built around the context, to first understanding

what it all means to the ‘visitor experience’. The ‘visitor experience’ is used as the common ground to link all three domains - *cultural heritage tourism*, *mAR* and *storytelling* - together. This enabled a more holistic approach in designing story-based experiences for mAR environments within the context of cultural heritage sites.

5.1. Challenges presented in the project

Not being a programmer, I lack knowledge of C# programming language that is required to code in Unity 3D and Vuforia. Programming languages such as C# was not being taught during this study. Although I managed to find workarounds and put an effort to learn C# informally through online courses, suffice to say the project would have benefited more from proper C# programming commands, especially by an experienced programmer. While I feel the AWAR app lacks in interactive functions, I view the overall experience it creates in a positive light as I feel the app has served its purpose in demonstrating the key ideas of this explorative project. I believe the design and approach demonstrated in this research will help provide better insights and encourage future storytellers and content creators in using mAR as a platform for storytelling within the context of cultural heritage tourism.

Creating a complete interactive story experience can be overwhelming, even more so when the whole process is done individually. As stated by Gershon and Page (2001), “*effective presentations using the storytelling approach require skills like those familiar to movie directors, beyond a technical expert's knowledge of computer engineering and science.*” (p.

36). With a team of specialised skills, the MVP could definitely be polished into a higher standard as per how I originally envisioned it.

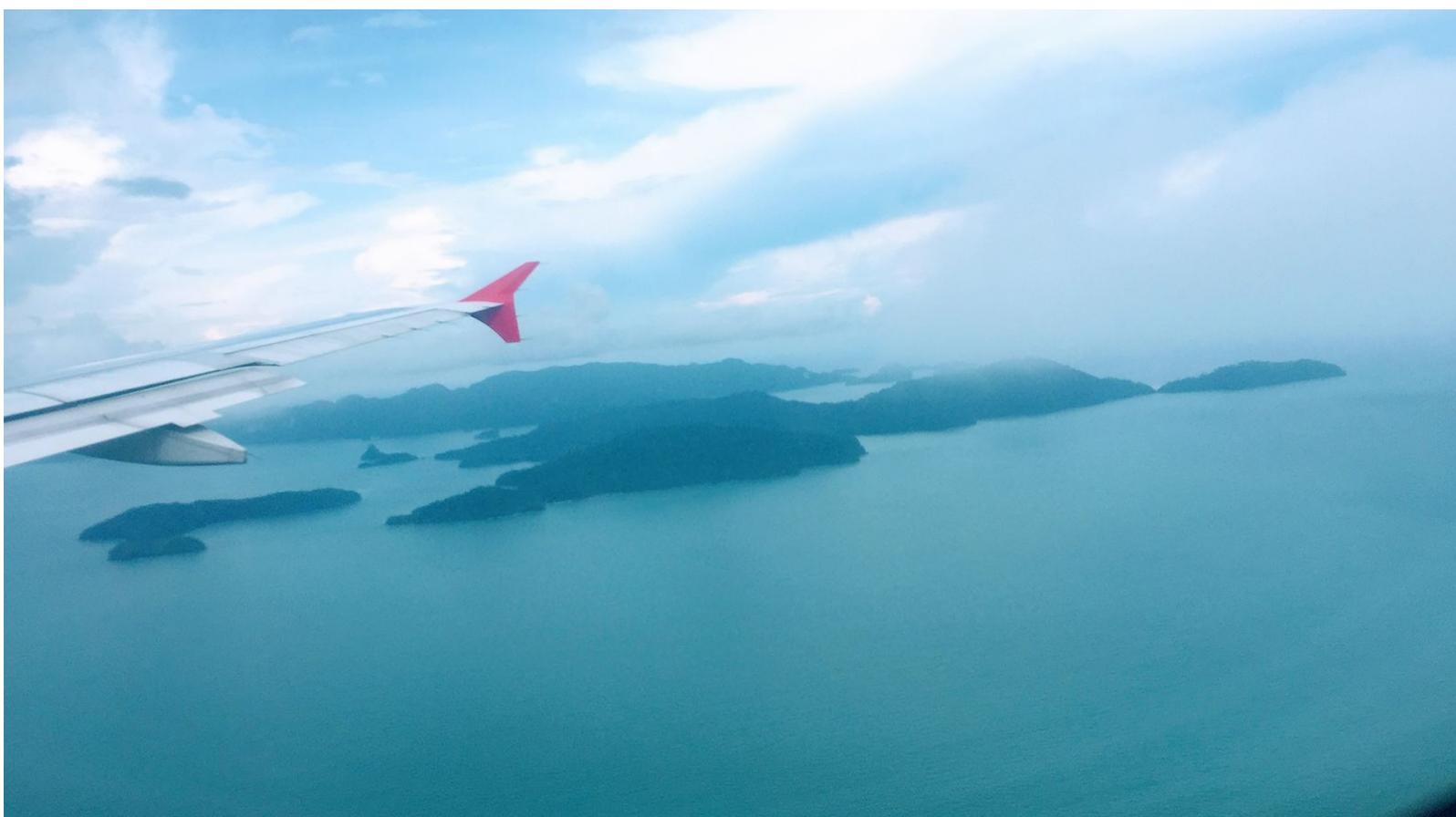
5.2. Future work

One aspect of the experience economy that was deliberately left out from the design was the ‘five key experience design principles’ proposed by Pine and Gilmore (1998). It was felt that the principles - especially ‘Mix in memorabilia’ and ‘Engage all five senses’ - are a better fit for ‘Transmedia storytelling’. According to Jenkins (2010), who first popularized transmedia,

“Transmedia storytelling represents a process where integral elements of a fiction get dispersed systematically across multiple delivery channels for the purpose of creating a unified and coordinated entertainment experience. Ideally, each medium makes its own unique contribution to the unfolding of the story” (p. 944).

As this project focuses only on the mAR environment, the principles are therefore considered beyond the scope of this project.

However, as the *AWAR* project has a story-centric experience as the core of its design, there is a high prospect for its storyworld to be expanded and systematically dispersed across other platforms and in different formats e.g. an animated series, feature film, website, VR experience and game. Thus, expanding the visitor experience of Awang Laut’s storyworld by converting it into a Transmedia project would be the next logical step. And if this next step is to be taken on, then it is recommended that the ‘five key experience design principles’ proposed by Pine and Gilmore (1998) be included in its design considerations.



6. Conclusion

This exegesis presents the documentation of the steps taken to design and develop an mAR app called *Awang Laut Augmented Reality (AWAR)*, and most importantly, the research that goes behind it. *AWAR* serves as the minimal viable product for this research, which explores the incorporation of storytelling within an mAR app targeted to visitors of a cultural heritage site.

It is important that the design not only satisfy the research question but provide meaningful and engaging experience to the visitors. To conclude, the key concept derived from the research was to view the design approach through the lens of *visitor experience*. Imperative to this concept is the inclusion of the visitor's pre- and post-visit experience in the design consideration. The proposed experiential framework has provided the

researcher of this project with a structure that scaffolds the crafting of a story, which results to a more holistic experience for the visitor of a cultural heritage site. While this project looks specifically at cultural heritage sites, the experiential framework proposed can easily be deployed by other content creators looking to integrate storytelling into their tour systems within other areas of tourism.

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