Indigenous Bali on Augmented Reality as a Creative Solution in Industrial Revolution 4.0

Putu Wirayudi Aditama¹, I Nyoman Anom Fajaraditya Setiawan²

¹Informatics Department, STMIK STIKOM Indonesia, Denpasar, Indonesia
²Informatics Department, STMIK STIKOM Indonesia, Denpasar, Indonesia

Email: wirayudi.aditama@stiki-indonesia.ac.id¹, anomkojar@stiki-indonesia.ac.id²

Abstract. Packaging creative media in augmented reality technology has become a new media in the face of the industrial revolution 4.0. The rapid development of the latest technology has caused problems for traditional Balinese culture - the phenomenon of colliding traditional culture towards the industrial revolution 4.0, motivating the development of culture-based technology. Bali has a variety of storytelling cultures, one of which is the traditional story of Cupak and Grantang. Story designation based on traditional fairy tale literacy will collaborate with augmented reality technology to add value to local content. The use of technological developments in traditional stories increases opportunities for cultural preservation in the form of creative and commercial media, while at the same time providing design solutions for Balinese native folk media in the field of augmented reality technology with traditional stories so that they can exist in the industrial era based on the industrial revolution 4.0 with native Balinese elements.

1. Introduction

The industrial revolution 4.0 became a growing problem by combining automation technology with cyber technology that gave rise to the industrial era with the latest technology. This issue is a trend of automation and data exchange in manufacturing technologies, including cyber-physical systems, Internet of Things (IoT), cloud computing, and cognitive computing. Industry 4.0 is a development of industry 3.0, which utilizes information technology and systems as a force in their application. In the industrial revolution 4.0 era, many physical and digital technologies collaborated with analytic systems, artificial intelligence, cognitive technology, and the Internet of Things (IoT) to create interconnected digital companies that can produce more informed decisions.

The application of technology in the field of creative industries in the industrial revolution 4.0 currently has a significant and broad potential to produce products with solutions concerning culture or tradition in Indonesia, specifically in Bali. This opportunity must be utilized in the stability of the economy and creative industries, to be able to compete in the free market. Based on data from the Creative Economy Agency (BEKRAF) and projections of Pricewaterhouse Cooper (PwC) Indonesia, Indonesia's global ranking is one of the largest economies in the world [1]. The problem and challenge that will emerge is the unpreparedness of human resources in the industry that utilizes automated and digital technology today [2]. One of the indigenous Balinese that needs to be developed to support the existence of the industry revolution 4.0 is traditional folklore such as Cupak Grantang which contains...
aspects of regional culture that will add to the cultural richness of a nation. Folk stories are expected to improve educational insights for students, so that they can support the formal or informal learning process, in addition to preserving the national culture that provides provision in applying moral values and character.

One of the technologies that can be useful in industry 4.0 is augmented reality. Augmented reality (AR) is a technology that combines two-dimensional or three-dimensional virtual objects become a reality then bring up or project in real-time. Augmented reality can be used to help visualize or display abstract concepts for understanding and structuring an object. The essence of augmented reality is interfacing to place virtual objects into the real world augmented reality applications are closely related to multimedia itself, in the implementation of augmented reality applications designed to provide interaction and more detailed information of an object in two dimensions or three dimensions. The use of augmented reality technology in multimedia is very influential in several fields, namely in the areas of education, health, entertainment, business, manufacturing, military, engineering design, robotics, and so forth. In the current sustainable development, the role of augmented reality is very appropriate to be applied in various fields of multimedia, because it will increase interaction and effectiveness in the delivery of information.

2. Methodology

Augmented reality (AR) is a term for an environment that combines the real world and virtual world created by computers so that the boundary between the two becomes very thin. This system is closer to the real environment so that real objects implemented in augmented reality systems [3]. Augmented reality (AR) is a technology that combines two-dimensional and or three-dimensional virtual objects into a real three-dimensional environment and projects virtual objects in real time [4]. Ronald Azuma, in 1997, defined augmented reality as a system that has the following characteristics [5] (1) Combining real and virtual environments; (2) Run interactively in real time; (3) Integration in three dimensions (3D). Augmented reality (AR) technology aims to take the real world as the basis by combining several virtual technologies and adding contextual data so that human understanding as users becomes increasingly apparent [6]. This contextual data can be in the form of comments or audio recordings, location data, historical visualization contexts, or other forms. The function of augmented reality is to increase understanding of the surrounding environment, in part making the virtual environment and real as a new interface transition and can display relevant information. So that augmented reality technology can help in the fields of education, training, repair or maintenance, manufacturing, military, games and all kinds of entertainment.

2.1 The Application of Augmented Reality (AR) As a Supporter of Reality

The use of augmented reality can apply to various fields, some of which, such as in the entertainment world, require augmented reality as a support for the effects of the entertainment. For example, when the weather host informs the forecast of the weather forecast, with the help of a green or blue screen and processed with augmented reality, technology will be visualized into an animated weather image. So as if the master of ceremonies, entered the exposure to the event in prepared animation. In military training applied augmented reality as a combat training simulation. So that it becomes a war simulation game that gives the impression that soldiers face real war.

Examples of other augmented reality uses in the field of engineering design to visualize the results of their models in real terms to clients. augmented reality assistance, the client knows the specifications for more detailed design presented. The field of robotics is a robot operator, using optical imaging in operating robots. In the field of consumer design, Virtual reality is used to promote a product. For example, a developer uses virtual brochures as information in 3D visualization so that customers can find out about the products offered. In the medical field, imaging technology is very much needed, such as for simulating preventive actions, making vaccines, etc.
2.2 Implementation of Augmented Reality On Cupak Grantang Stories

In the process of education and learning now, the application of augmented reality technology has an essential role in conveying information with visual displays supported by audio and video. Cupak Grantang story with the use of augmented reality is an intermediary tool to send the right message of the story delivered. Two applications are used in applying Augmented Reality, namely Vuforia and Unity. Next, according to Rawis et al [7], an explanation and usefulness of each in the application used.

2.2.1 Vuforia

By default, the marker that has prepared consists of individual images or symbols that will enter into the Vuforia database. Vuforia is a library that used as a supporter of the existence of augmented reality on Android for the Unity 3D program. Vuforia analyzes images using marker detectors and produces 3D information from markers that have purchased through the API (application programming interface).

2.2.2 Unity

Unity Engine has a complete framework for professional development. The core system of this engine uses several programming languages, including C#, javascript, and boo. Unity3D editor provides several tools to facilitate the development of Unity Tree and terrain creators to facilitate the creation of vegetation and terrain and MonoDevelop for the programming process.

![Figure 1. Principles of working augmented Reality.](image)

The working principle of augmented Reality, and its application explained in figure 1: (1) the camera captures data from markers in the real world and sends information to the computer. Markers provided in the form of images or specific codes that have printed; (2) Software on the computer will track the shape of the image from the marker and detect how many videos it has. (3) When a box has found, the software uses mathematical calculations to calculate the position of the camera relative to the black box in the marker. (4) After calculating the graphics model will appear in the same location and be in the scope of the black box, then displayed to the screen to see graphics in the real world.
2.3 Interaction of Creative Industry and Revolution 4.0

Technological advancements allow for automation in almost all fields. New technologies and approaches that combine the physical, digital, and natural worlds will fundamentally change patterns of life and human interaction [8]. Industry 4.0 as a technological revolution phase changes the way social activities operate in scale, scope, complexity, and transformation from previous life experiences. Humans will even live in global uncertainty; therefore, humans must have the ability to predict a rapidly changing future. Each country must respond to these changes in an integrated and comprehensive manner [9]. The response involved all global political stakeholders, ranging from the public, private sector, academia, to civil society, so that the challenges of industry 4.0 could manage as opportunities. One of the opportunities that Indonesia has, especially Bali, is through the economy or creative industry, data in the Creative Economy Agency or BEKRAF shows that the Creative Economy has a promising potential. In 2016, the contribution of the Creative Economy to the national economy was 7.44 percent and projected to continue to increase. In terms of value, the Gross Domestic Product of the Creative Economy is expected to exceed 1,000 trillion in 2017 and increase to close to 1,102 trillion in 2018 [9]. This opportunity must be exploited by the indigenous people of Bali in improving local content so that it still exists and is better known among the wider community.

3. Result and Discussion

Bali has a variety of cultural storytelling; one of them is the traditional story of Cupak and Grantang. Appointment of stories based on classic storytelling literacy will be compared with augmented reality technology. The use of these technological developments raises opportunities for cultural preservation in creative media. The discussion of the phenomenon of technology-based culture provides a design solution for indigenous Balinese folklore media in the realm of augmented reality technology. The method used for augmented reality is R & D (Research and Development), which is a method used to produce a particular product and test the effectiveness of the product [10]. In detail, the stages of work in the design mindset can be seen in figure 2.

![Figure 2. Process design mindset in augmented reality](image-url)
In figure 2, it can be seen the structure of the design mindset process which begins with the existence of phenomena based on observations of phenomena and literature studies to find the right basis in designing through a reference. The two stages of the survey then become input needs analysis, about various things that must be considered related to the process needs at the next step. Needs analysis is compiled and then becomes a book framework about augmented reality, so that the book can describe in detail the processes carried out in each design step using augmented reality. The structure of the augmented reality framework consists of 3 parts of the process.

The process is: (1) The process of making 3D objects consisting of modeling (making object asset elements), texturing (creating parts of objects/object surface changes), animating (making object motion elements), and exporting (exporting object data to be processed back to the support application). (2) Making markers consists of Configuring 3D objects and markers (the process of mapping between 3D objects with markers so that they can be detected), packing book application (applying the previous combination of steps with the need for further processing). (3) Book layout design is a process requirement by implementing a design strategy in the final result to add the desired value, such as its commercial value.

So that the process can be considered running well, the prototype of the augmented reality design is then tested according to the planned needs. In testing, it will show the user's acceptance of the product that has made. This test also provides input on the continuity of the augmented reality prototype; the sustainability in question is feedback. Feedback will determine the next feasible step, that is, if the feedback is positive or recommended, it will be a final result, but if the feedback is negative, then a follow-up is carried out again on the needs analysis process.

3.1 Overview Of The Cupak Grantang Story
The story of Cupak Grantang is the story of the Balinese people who tell the role of the antagonist (Cupak) and the protagonist (Grantang). Large-bodied lobes have bad qualities, namely jealousy, arrogance, laziness, etc whereas. Whereas a body smaller than Grantang has the opposite, kind, diligent, not proud, etc. One day news came from the kingdom that was owned by a giant kidnapping the princess, and the king held a contest for those who dared to save his daughter with a bundle of gifts.

After the decree announced, then the two brothers hurried off to the giant hideout. When they arrived at the destination, Cupak a lazy man, argued that Grantang had to enter first to save the princess. This step was successful, then Cupak fled with the king's daughter and left Grantang with the giant. Arriving in the royal capital, Cupak handed the princess over to the king as if he were a hero. Cupak also received a vast treasure, but after that came Grantang who turned out to have survived the giant attack. People were shocked by the shocking incident, but after the princess recovered from trauma then told the people and the king about the actual event. All realized that Cupak only deceived them, at the same time the people and the king punished Cupak, who had made a hoax. But with Grantang's kindness, the sentence was commuted by the king by withdrawing all the gifts handed over to Cupak.

Since then Grantang was juxtaposed with the princess and lived happily. The story of Cupak and Grantang has a good message; that is, acts of courage, honesty, and kindness must be upheld.

3.2 Augmented Reality Implementation On Media
In general, augmented reality applications use a reference object in the form of a marker. Markers in the form of images printed on a flat surface (2D). In the Cupak and Grantang stories use augmented reality, giving rise to two-dimensional images printed on paper as markers. The image used as a database, which must consider is when the process of shooting, the image must be clear so that it can read as a marker. The following are the steps to make Cupak Grantang augmented reality. The steps for making AR can be seen in table 1.
Table 1. The steps for making AR Cupak Grantang

| Step   | Description                                                                 |
|--------|------------------------------------------------------------------------------|
| 1.     | Make 3D object with two characters from story Cupak and Grantang.             |
| 2.     | Making marker and publishing in Vuforia.                                     |
| 3.     | Import the Vuforia SDK file into Unity.                                     |
| 4.     | Drag the target image into the hierarchy in Unity and drag 3d object into hierarchy. Then add the license key that was created in vuforia. |
| 5.     | Build setting into .apk for android, when it's finished Cupak Grantang.apk file is ready to be installed on mobile. |

The following is a visual display of augmented reality that can be applied to the Cupak Grantang story that can support to increase the value of authentic Balinese folklore. The following picture is a flash card that contains stories from Cupak Grantang, can be seen in Figure 3 (left).
After being given a marker on the flash card, then use the mobile scanner application on the specified device to see augmented reality. In this case, the augmented reality on the flash card has the theme of Cupak Grantang story and can be seen in figure 3 (right).

4. Conclusion
The application of the Augmented Reality technology in indigenous Bali is very instrumental in increasing the value of existence and economic value by elevating from folklore to a product form in which the Grantang Cupak folklore contains 3-dimensional animation and audio. So that in the future Balinese culture is able to survive and be increasingly known to all circles, especially to folk stories that have deep moral messages. The current method of application is still a prototype of an augmented reality application, which in the future continues to developed so that the visual and animated forms are more alive and more attractive. Media Augmented Reality is undoubtedly one of the media that can provide creative solutions in the middle of the Industrial 4.0 era. The role of augmented reality media has also had a positive impact in developing innovative educational facilities, especially in reviving traditional culture in the contemporary media.

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