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CaFiAR: Software to Learn Fish Cultivation in the Bucket to Support Food Security Program in Society

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***Abstract*— Budikdamber is a method of cultivating fish and vegetables in the bucket to support food security in the community. This cultivation is easy to install, cheap, and suitable for narrow areas or limited water. This technique is implemented in various community groups; however, many of them are facing difficulties because of a lack of information and experiences. To overcome this issue, an application, CaFiAR, based on augmented reality technology was built to bestow information of 3D pictures of ready to harvest and sick catfish. The 3D objects were developed using Blender and Android Studio software. After several tests, we found this application behaving according to its framework and acceptable among the cultivator.**

Keywords—software, fish, cultivation, food, security, orphanage

I. INTRODUCTION

Fish cultivation in the buckets, also known as budikdamber, is a technique of cultivating fish in a container or bucket as a medium to substitute the pound. This cultivation has many advantages such as being suitable on a narrow land, limited water area, tools and materials are easy to find, and zero electricity [1]. Thus, we can use this cultivation technique to support food needs in households, boarding schools, and orphanages to meet the nutritional and food security of the community [2]. Budikdamber is implemented in various regions in Indonesia, such as Bandar Lampung [2], Way Kanan [3], North Lombok [4], and North Maluku [5].

The community groups that develop this cultivation experience difficulty because most of them do not have sufficient knowledge about cultivation and harvest management. Usually, information is obtained through social media such as YouTube, Instagram, and Facebook. Based on our experiences with the development economic autonomy team in some orphanages in Lampung, these media did not provide all the required information, such as the catfish's growth.

Currently, the team use brochures containing management procedures and pictures of ready-to-harvest fish as examples. However, the images are unclear, partial, and there is no example of sick fish. To overcome this problem, we have built CaFiAR, a catfish Augmented Reality, the 3D application to give a clear picture of sick and harvest-ready catfish.

Some application to classify fish using 3D technology was published, such as introducing ornamental fish to toddlers [6] and betta fish to help farmers to identify 73 variants of this fish [7]. The CaFiaR is not only built as a learning media for the farmers, but also to support the expansion of the Budikdamber and food independence program. This app is acting as an education tool to allow the community to learn to cultivate in new ways; attractive, interactive, and existing, thus, it can advance their knowledge [8].

This paper is organized as follow; the first part provided a piece of information about the background behind the development of 3D catfish, in part two, we explored some related researches, continued by a scheme we proposed in this project. Moreover, we discussed the result of this research in part four and concluded it in part five.

II. RELATED WORK

Augmented Reality (AR) has been used in many sectors as an education medium. In 2014, zooAR was proposed to replace the signage with AR to let the visitors have individualized connections with animals in the zoo with minimum budget and keep the natural environment safe [9]. To find out visitors' satisfaction and difficulty in using this app, one hundred eighty surveys were collected in three exhibits of panther, orangutan, and elephant at Tampa's Lowry Park Zoo. The result was the majority of them like the zooAR as an education medium rather than signage.

In 2017, Fransiska, et al [10] proposed ARANIMALS software to virtually introduce some animals such as bears, lions, cows, and horses to the children to help them know the shape and the voices of these animals interactively. As this software is intended for pupils, the splash screen and menu are animated.

Karundeng, et al [12] also take the advantage of AR technology by creating software called Aria, to familiarize people with rare animals in five islands of Indonesia. The 3D animals were built by using blender and Asset 3D applications.

In terms of learning biology using AR, Weng, et al [13] stated students found studying more interesting and enjoyable, though they found it was difficult to discover the marker and required amount of time to scan the marker that might be due to inadequate internet reception. These statements gathered from the experimental groups consist of 68 ninth graders in one of the junior high schools in Indonesia.

AR technology also offered an ability to detect fish disease, specifically Labeo bata species, along with artificial intelligence [14]. This technology allows users to identify and visually match fish diseases.

III. PROPOSED SCHEME

To develop CaFiAr, we used this five-phase framework from collecting data, designing, modeling, coding and testing, to distribute the apps (table 1).

TABLE 1. FRAMEWORK

Phase	Purpose
Communication	At this stage, we collected data on cultivation and installation of budikdamber, harvest, problems in cultivation, and user needs. For this purpose, we interviewed some parties: Experts in the field of fisheries/inventor of the budikdamber technique. Manager of the orphanages. In addition, we did observations at the orphanages during the installation and maintenance of cultivation to get information about the knowledge of the cultivators.
Quick design	Based on the data collected at the previous stage, we determined the user need.
Quick design modeling	The design modeling stage will quickly focus on what end-user can see in the Apps. We divided this stage into four models: Menu structure Use case diagram Activity diagrams Interface
Prototyping	We built CaFiAR using Blender and Android Studio Software, continued by testing it to explore the holes and user views.
Software distribution	The software would be installed directly on the smartphone of orphanages management and uploaded to the Apps store.

A. USER NEEDS

Based on interviews and observation, we make a list of what kind of information the user needs to begin and run the cultivation. The list consists of:

General information about budikdamber.

Material about the installation and maintenance of budikdamber.

Figure the growth of catfish.

3D object of healthy and sick catfish.

B. QUICK DESIGN

The menu structure (fig.1) describes the feature of the application. When the application is running, a *splash screen* is displayed then switch to the home menu page as the main view. This menu has three sub-menus to choose: general information, installation, maintenance, and fish growth. Scan AR menu has two-sub menus to guide user on how to scan and view the 3D Catfish by clicking AR scan guide and Scan respectively.

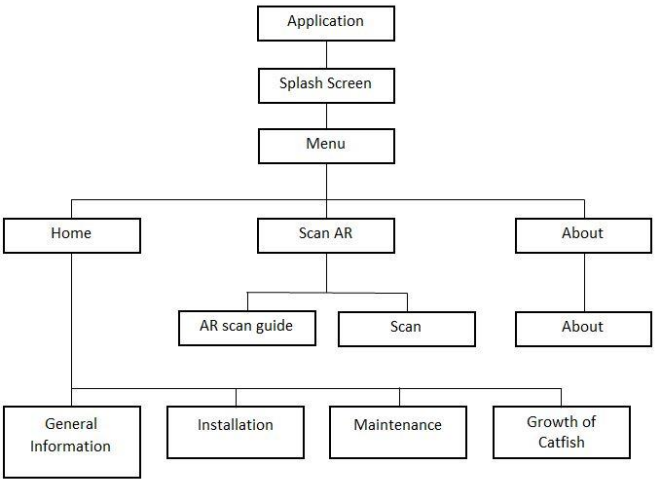

Fig 1. Structure of Menu CaFiAR

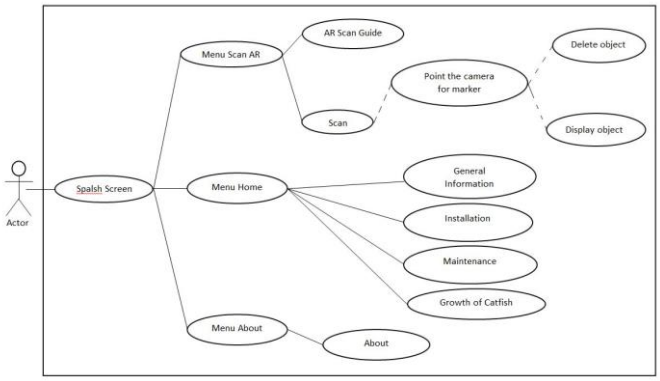

Fig 2. Use Case CaFiAR

While the use case diagram illustrates the relationship between the actors (the cultivator) and the system, the activity diagram describes the workflow of the existing system in software. We have drawn three diagrams: home, scan AR, and about. Moreover, we designed ten interfaces to visualize the software.

C. PROTOTYPING

In this stage, we created the 3D object frame by adjusting the shape modelling of the source of the existing object. The 3D design was built based on the pictures taken during the fish harvesting. Fig 3 is the creation of a 3D object frame by adjusting the shape modelling of the existing object source.

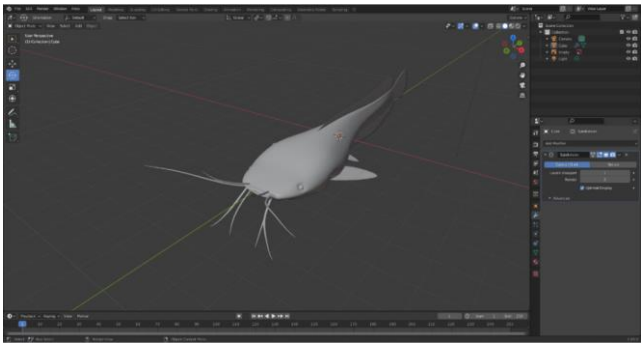

Fig 3. The 3D Modelling

We tested this application on foster children in one of our fostered orphanages through a community partnership service program. This experimental group consisted of 24 children, all of whom were boys.

IV. RESULT AND DISCUSSION

The growing of catfishes had different times until harvest yields. These are influenced by many factors, such as the level of water turbidity and bucket drain. Hence, the cultivators need to have a good understanding of these issues.

This research has produced 3D software to allow the community to learn how to farm fish, particularly catfish, in the bucket. In addition, there is some information on how to plant spinach using plastic cups and charcoal. This is to make sure that the cultivators can get benefit from fish and vegetables as well.

When the cultivators activate the software, the splash screen will appear to welcome them (fig. 4). This page has duration of 5 seconds before entering the home menu view.

Fig 4. Splash Screen

Figure 5 demonstrates the home page that works for calling four sub-menus. Figure 6 displays the installation plant media page consisting information on planting some vegetables such as kale and spinach in the bucket.

Fig 5. Home Menu

Fig 6. Installation Plant Media

Additionally, in figure 7, some pictures are enlightening about the growth of catfish, including the length and weight of the fish. Further, figure 8 is a page to display a 3D shape of a healthy and sick catfish. The 3D object will appear after the camera has detected a flat surface then marker points appear to show 3D objects.

Fig 7. Cat Fish Growth

Fig 8. 3D Catfish

We run the application in various light conditions and distances to explore how its reaction in such scenarios. Tables 2 and 3 in the index show several assessments from three different environments. We can see the application can run in dark, low, and bright light also it is able to scan the marker up to a 2-meter distance.

To find out if this application can help farmers to get some knowledge of the growth and sick fish, we tested this program in one of our cultivation communities, where at this moment they cultivate 2,000 catfish using budikdamber method. This community consist of 24 foster kids between aged 10-14 years. Their education level is primary school and junior high school. The entire participant had experienced using a smartphone, though not using it daily due to orphanage regulation. Half of them have interacted with some 3D apps previously.

There are 11 questions divided into four groups: a first three questions are about general question age, sex, and level of education of the respondents; the second two questions are asking their experience using 3D with optional answer YES or NO; the third two questions are exploring their knowledge about the fish with the possible answer is YES and NO; and the last group of question is asking about their experience using the CaFiAR software.
The distribution of the age of respondents was: the most age, belonging to 10 respondents, is 13 years, followed by eight kids aged 12 years, and two groups of three kids are ages of 10 and 14 years respectively (figure 9).

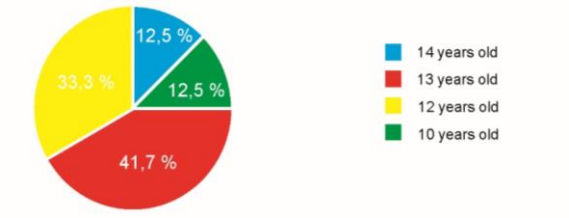

Fig 9. Age Distribution

The answers on the sheet revealed that all the youngster do not have knowledge about the sick and ready harvest fish (figure 10).

Fig 10. Respondent knowledge

The last part of the questionnaire investigated if the kids understand and can operate the application. The respondents who response with very easy and easy were 41,7% and 58.3% respectively. None of them thought it was either difficult or very difficult (fig 11).

Fig 11. Operate the App

Also, we throw question if this application helps them in knowing the growth of catfish and other knowledge on budikdamber. 83,3% of them stated it is very helpful and 16,7% said helpful (fig 12).

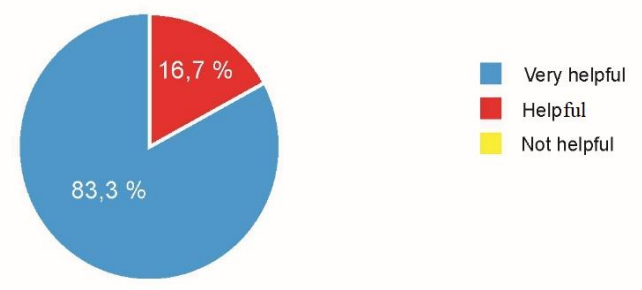

Fig 12 Utilize of CaFiAR

Moreover, we asked them if they feel uncomfortable such as nausea or dizziness when using the app. 24 respondents found this application is comfortable to use (fig. 13).

Fig 13. the feeling of Using CaFiAR

The last question delivered was if they want to recommend this app to other farmers, they all responded with yes (fig. 14).

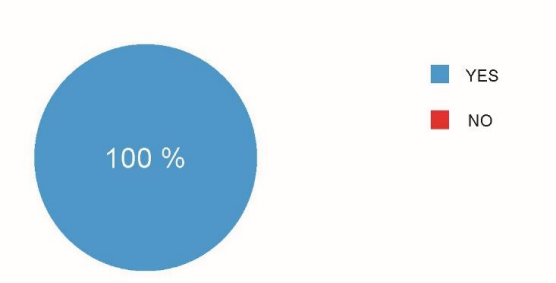

Fig 14. Recomend the App

After 76 days of cultivations, these young farmers measured the length and weight of 100 fishes using their knowledge from the CaFiAR. The average length is 20 cm and the weight is 80 grams that mean ready to harvest. They also investigated if there was sick fish; the result was all of them were healthy (figure15).

Fig 15. Catfish in the Bucket

Based on these results, this application has helped the young farmers to learn how to cultivate the catfish using budikdamber technique.

V. CONCLUSION

In summary, budikdamber is a new technique in fish farming. Efforts to convey information about fish growth by distributing brochures still have some shortcomings. The sample of fish distributed with the flyer is unclear, such as not all sides of the fish can be seen there and no samples of sick fish. As a result, some cultivators do not have a clear understanding of fish cultivation.

We successfully developed software under augmented technology, called CaFiAR, to visualize a 3D model of catfish. In Addition, this application has some features such as installing and taking care of the budikdamber and using the bucket to plant the vegetables. Further, clear pictures of fish growth also presented.

We tried this application with various tests such as distance and light. Besides, we tested it on our foster children where we do fish cultivation in buckets. Based on these trials, the application runs well and can help the cultivators to know the condition of the fish.

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