



System Design of Augmented Reality Technology to Strengthen Sustainable Imaging of Kujang Products Based on Local Culture

Eneng Tita Tosida, Deden Ardiansyah, Agung Djati Walujo, Ahmad Sofyandi

Abstract: *Kujang products, which are reproduced by a number of micro businesses in West Java, have not been able to increase public interest in preserving them as high value tourism products. Kujang's image as a "valuable" local culture-based product in the community is still low. This results in a still low level of quantity and quality of tourism based on local culture, especially those related to Kujang. Although the government has launched a work program to achieve the target for the next five years. One way that can be done to improve the image. This paper aims to design a digital-based information system, to strengthen sustainable imagery related to local culture-based cleaver products. The digital information system design techniques are carried out using Augmented Reality technology. The design of information systems about Kujang products is not only targeted at students, but also at the national and international public. Based on the usability test results using the Sumi approach obtained a statistical value of 71 for general evaluation, indicating that the information system about Kujang products is very useful. This information system is more accessible, and preferred by the public because it is equipped with an attractive three-dimensional display. Augmented Reality Technology can even become a learning medium that supports the curriculum, especially in historical sub material. Augmented Reality technology in the information system about Kujang is able to increase public interest in knowing more about Kujang information, and can be upgraded to an edu-tourism idea that collaborates with the Kujang micro business.*

Keywords : *Kujang product, information system, Augmented Reality Technology, local culture, micro business.*

I. INTRODUCTION

Kujang is a traditional weapon typical of West Java. The shape of this weapon is unique, in terms of design no one is equal to this weapon in any area. The absence of the right

words to mention the name of this weapon in the international language, so the Kujang is considered to be the same meaning as "sickle", of course this is very distorted much because in terms of its form is also different from sickle. This term is also

different from "scimitar" which has a convex shape. And in Indonesia, the sickle is called "chelurit". Efforts to respond to these language barriers, the duties and obligations of Sundanese culture, and the local print media in Sundanese which must be more intensive in publishing these Kujang weapons to the international world [1].

The origin of the term Kujang comes from the word "Kudihyang" with the root words "Kudi" and "Hyang". "Kudi" is taken from the old Sundanese language which has the understanding of weapons that have magic supernatural powers, as a talisman and a repellent, for example, to banish enemies or avoid danger/disease. These weapons are also stored heirlooms, which are used to protect the house from danger by placing it in a chest or a certain place in the house or by placing it on a bed. "Hyang" can be equated with the understanding of God in some mythologies, but for Sundanese people, Hyang has meaning and position above God, this is reflected in the teachings of "Dasa Prebakti" which is reflected in the Sanghyang Siksa Kanda Ng Karesian manuscript mentioned "Dewa Bakti di Hyang" [2].

The Kujang is not only as we know it today, but it also has a slim, flat shape with four or five holes. Many types of Kujang are no longer or difficult to find again. Previously, there were more than 20 types of Kujang, but now there are 7 types of Kujang that have been determined by the Ministry of Law. Almost all types of Kujang taken from the names of animals as Sundanese people such as "Bangkong Kujang" or cigars. Types of Kujang are explained in detail on [1], and even the ideas and philosophy of each type of Kujang are related to the character of the owner. Kujang as one of the products based on local wisdom is well known in the West Java region. Kujang which is identical to Sundanese heritage weapons has been used as symbols and icons in several city centers, including the Kujang Monument in the city center of Bogor. However, most of the people of West Java do not know more detailed information about Kujang. This information may include history, types, functions, benefits, philosophical meaning of each type and level. Detailed information about Kujang as a local wisdom-based product is only explained briefly on a few online sites, Sundanese history books and other sources that are still relatively limited.

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This information is important to strengthen the image and public awareness of the nation's history. This process is also very important and relevant to the government's efforts to strengthen the foundation of local wisdom as the strength of the nation's character [1], [2]. The Kujang products which are reproduced by several micro-businesses in West Java have not been able to increase the public interest to preserve them as high-value tourism products. The image of Kujang as a product based on local wisdom that is valuable in society is still low. This resulted in the still low level of quantity and quality of tourism based on local wisdom, especially related to Kujang. Even though the government has launched the program in achieving its performance for the next five years. One way that can be done to improve the image of Kujang as a local wisdom product is to create digital-based information media. The intended digital information media uses Augmented Reality (AR) technology. The goal of making AR technology for Kujang information is not only targeted at students but the general public. This information media is more accessible and is preferred by the public because it is equipped with an attractive three-dimensional display. AR technology can even become a learning media supporting the curriculum, especially in the historical sub material [3], [4], [5]. The increased interest in tourism products based on local wisdom is expected to be a driving force for strengthening micro Kujang businesses [6] and other related micro businesses. Continuous strengthening of this micro-business [7],[8] is one of the efforts to achieve the vision of the people's economic development [9].

The purpose of this research is to design and build Augmented Reality Based Traditional Kujang Weapons Catalog Application. This application is also a synergy with digital learning media that is in line with the integrated thematic national curriculum, specifically related to the nation's cultural topic. This is expected to be an alternative effort to strengthen the image of Kujang as Indonesian culture, especially West Java. Continuous strengthening of local wisdom-based products is very important to build the nation's character [10]. This application can be used on an Android-based mobile phone, which allows people to use it more easily because users of these devices are spread in various circles of society [11], [12], [13], [14].

II. METHOD

This research was conducted comprehensively using the Multimedia Development Life Cycle (MDLC) approach. This research aims to develop information media as well as more interesting and efficient learning media using Augmented Reality by utilizing Android / IOS Smartphone camera features. The concept of instructional media has been used in several similar studies [3], [12], [11], [15]. This method has 6 stages, namely concept, design, material collecting, assembly, testing, and distribution. This method has an organized and structured form with stages as presented in Figure 1.

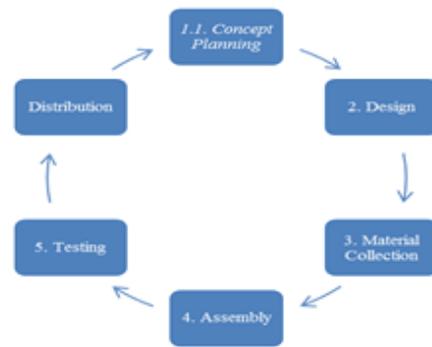


Figure 1. Multimedia Development Life Cycle

III. RESULT AND DISCUSSION

3.1 Concept Planning

The concept underlying this application is an interesting, interactive and collaborative learning media about the types, functions, and philosophy of traditional Kujang weapons. This application uses Augmented Reality-based technology that allows users as if to see the real form of types of Kujang through a cellphone camera because the animation created is a 3-dimensional animation [11], [13], [16]. The target audience is the general public, especially the people of West Java. This application is expected to help preserve the culture of Indonesia and the people of West Java can find out more about Kujang at this time [10], [11], [15], [17], [18].

Table Application concepts can be seen in the attachment, Table 1.

Table 1. Application Concept

Title	Augmented Reality Based Traditional Kujang Weapons Catalog Application
Audiens	The general public, especially the people of West Java
Duration	Splash screen duration is 4 seconds & loading time is 6 seconds
Image used	Use the jpg file format and png
Audio used	Narration of Sound and Backsound use MP3 file format
Video used	Menggunakan format mp4
Application Types	Learning Media
Software	Unity 3d, Zbrush dan Blender Animasi
System Requirements	Android with a minimum 4.2.2 Jelly OS, and an internal memory free space of 70 Mb. RAM 2GB or more.

3.2 Design

The design phase is carried out making detailed specifications regarding the architecture of the program. In this design phase, several designs will be made including storyboard, navigation structure design and user interface flowcharts [3], [17], [19].

A storyboard is a sketch of images arranged in sequence according to the script. Based on the storyboard, story ideas can be conveyed to others more easily, because someone's imagination can be guided to follow the images presented, to produce the same perception of the story ideas [20], [21].

The storyboard can be seen in attachment Table 2 (In Appendix).

AR-based kujang catalog application design is also done through the flowchart model and navigation structure. The flowchart shows a chart with certain symbols that describe the sequence of processes in detail and the relationship between a process (instruction) with other processes in a program [15], [16].

Another design model is done through the creation of a navigation structure in the form of a hierarchical diagram that connects between scenes. The navigation structure used uses a hierarchical model with overall modification. Flowchart and navigation structure of AR-based traditional weapon catalog

application Kujang are shown in Figures 2 and 3. This design instrument or model is very important because it is related to the validation of information that will be collaborated into learning media. Based on the results of research [15], it shows that AR is eligible to become a learning medium for an environment and is successfully implemented in the areas of learning related to language, mechanical skills, and spatial abilities. The more dominant advantage over the use of AR as a learning media is the factor of increasing motivation and the development of the learning process. The success of the implementation of AR as a learning medium depends on the design model created [3], [5], [21].

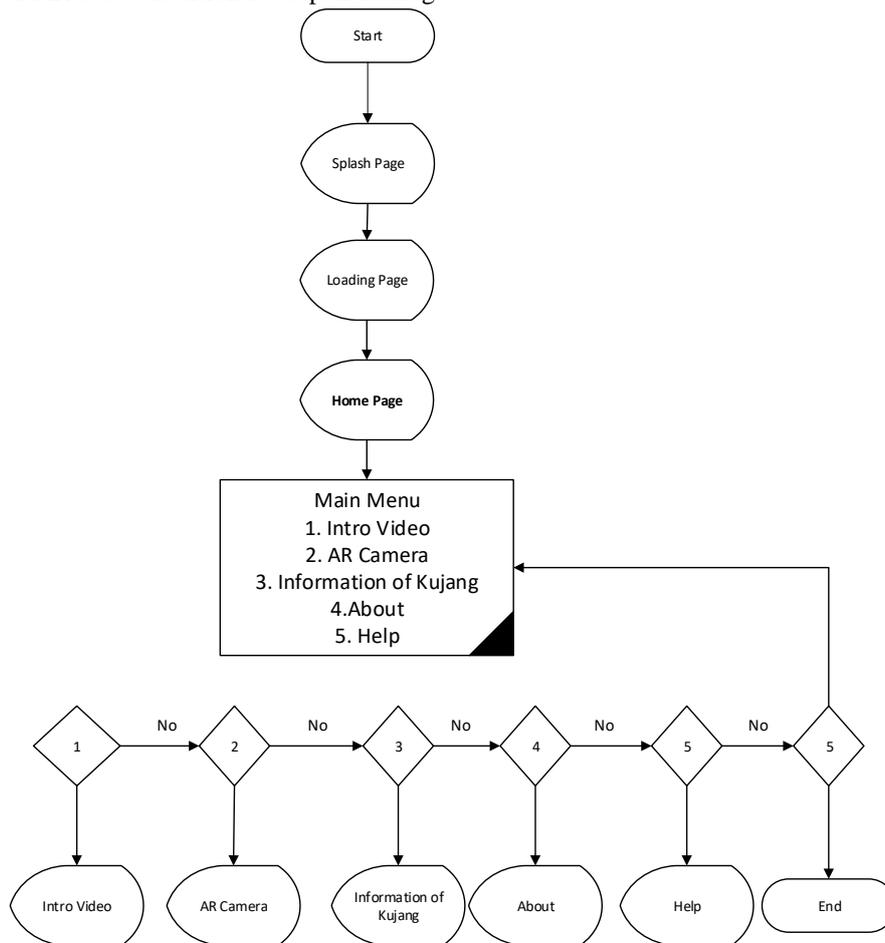


Figure 2. AR-Based Kujang Traditional Weapons Catalog Flowchart

3.3 Material Collection

The material collection phase is carried out using observation and in-depth interviews with the creator, as well as the owner of the Bogor Kujang Pajajaran Gallery (“Guru Teupa”). All assets by application requirements are collected in systematic and structured stages, by technical and non-technical specifications for the achievement of research objectives. Digital assets in the form of images, sound, animation, and video are optimally processed to produce good output. This stage can be done in parallel with the assembly stage.

a) List of Kujang

Initial data collection is done by identifying the type, function, and characteristics of Kujang [1, 2] which will be used as material to make Augmented Reality. The types of Kujang based on the shape there are 7 namely “Kujang

Ciung”, “Kujang Jago”, “Kujang Kuntul”, “Kujang Bangkok”, “Kujang Naga”, “Kujang Badak”, and “Kujang Pekarang”. Each type of kujang has a philosophical and artistic value that is very meaningful. The value of this philosophy is very important to be socialized to the wider community.

The meaning of philosophy and art contained in each type of kujang needs to be protected by intellectual property rights [1], [2]. This intellectual property can be in the form of a unique and distinctive design motif, the work of the owner of the Kujang gallery. Local culture-based products have the potential to become a tourism asset [7], [8], [22], [23].

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In this study, the assets that exist in Kujang can be more optimally exposed to learning material [5], [11] for elementary to middle school students.

These assets can be synchronized with the competency standards that exist in the national curriculum.

b) Marker Design

Marker design that will be made which is in the form of QR Code images and photos. The method used in this Marker is a Single Marker (Marker Based Tracking), which is reading or identifying one Marker through 2-dimensional image media [16].



Figure 4. Marker Design

c) Modeling and Texturing

The process of making object models in 3D using Unity 3D tools, ZBrush and Blender animation [23]. In Modeling, there is also a Texturing process which is to create texture (surface material) into the Kujang model in Figure 5.

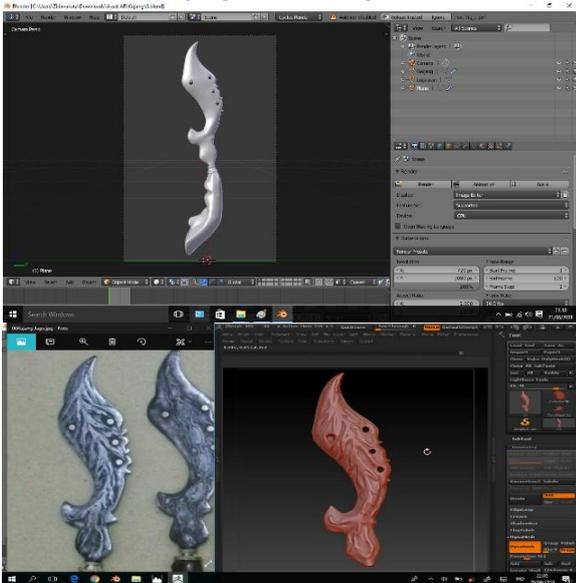


Figure 5. Modeling and Texturing Kujang

3.4 Assembly

This stage includes the creation of interfaces using C# programming, integration of all assets, synchronization of all media and integration of AR functions, using the Vuforia package [16], [24].

Kujang Traditional Weapons Catalog AR-Based Application. The application starts with a splash screen and then enters the main menu. There are several menu options including Video Intro, Starting AR (AR Camera), Kujang Info, About, Help. The menu arrangement is made simple but the Kujang information remains optimal. Information is displayed in various media, so this application becomes more interesting and informative [3], [16], [22], [24]. AR Camera menu is the main menu of this application. Users can scan the

target marker so that it displays a three-dimensional object Kujang along with complete information. On this page, there are also several buttons whose functions are to view info, save images, download Markers, zoom in, zoom out and rotate three-dimensional objects. AR Camera page views can be seen in Figure 6. The AR facilities provided are very useful for digging Kujang information [8], [13]. In this condition, the user's enthusiasm increases so that this learning media is very potential to be developed as a digital learning media [3], [14]. The splash screen menu and AR Camera are shown in Figure 6.



Figure 6. Display splash screen and AR Camera menu

Detailed Kujang information that is displayed on the AR Camera page, is the result of the integration of three-dimensional Kujang animation forms that are processed in stages. The results of the three-dimensional animation are the results of the three-dimensional Kujang design created using the Blender and ZBrush applications. Figure 7 displays the results of three-dimensional animation for 7 types of Kujang.



Figure 7. 3D Kujang

The Intro Video page is the same as the AR Camera. The user will be brought into camera mode. After the user scans the target marker, video playback will appear showing the video from an interview with one of the Kujang craftsmen in the city of Bogor, who is very active in producing kujang in a variety of main products and its derivative products [6], [25]. This application is also equipped with a text-based Kujang information menu and how to use the application that shows in Figures 8 and 9.



Figure 8. Intro Video Page Display



Figure 9. Kujang Info and Help Page Display

With the existence of a digital catalog that can be synergized with an integrated thematic national curriculum, it is expected to be a strategy to strengthen the imaging of sustainable local culture-based products. Strengthening imaging is directed to elementary to build a millennial generation's care for a noble culture. Millennials need learning media that are representative of their era. Therefore AR technology and educational games become one of the solutions to the problem of the degradation of the nation's character [19],[20], [23].

Local culture-based products such as Kujang Bogor is very closely related to tourism [25], [26]. The application socialization is carried out in several ways, including through door to door to schools, especially elementary schools [27]. This process is effectively carried out along with the enthusiasm of students and teachers towards the culture of Kujang Bogor displayed millennial. In addition to coming to school, socialization was also carried out through exhibition

activities, fashion competitions, learning activities of kujang motif, and others, which were packaged in the form of cooperation with various stakeholders. The intended stakeholders include hotels, factory outlets, related agencies as well as companies/agencies that are moved to care about the preservation of Kujang Bogor.

This socialization activity is carried out sustainably can be used as a tourist attraction [26], [27], [28]. Local culture is very close to tourism activities which are now one of the priority programs of the Indonesian government's Nawacita. The development of tourism-based activities is the strength of this concept [10], [29], [30]. Especially if this digital application continues to be developed equipped with a comprehensive information menu. One example of the information presented by the digital kujang catalog application is displayed in a combination of text, audio, video and AR media [31], [32].

3.5 Testing

The testing phase of the application includes 5 stages namely structural, functional, validation, android specification, and user preference testing/usability testing.

i) Structural Testing

This stage suitable to determine whether the application has been well structured by design that has been made. After testing each menu, it can be seen that the structural validation in this application. Structural trial results indicate that the implementation results are by the design that was made. This is indicated by the process of tracer each menu, each button, and each sub button.

ii) Functional Testing

The functional test phase is carried out by testing every function, every menu, every key, and the output results are analyzed. The results of this functional trial involving 3 multimedia experts. The trial results show that all available functions, menus, and buttons are functioning properly. This application contains 5 main menu and 8 main function keys that are run serially. The focus of the main function is to display clear and complete Kujang information (both text, images, sound, animation, three dimensions, and video) [3], [25], as well as systematic and structured. This function is very important because this application becomes one of the alternative media to learn local culture-based tourism products Kujang which is full of philosophical meaning.

The main function of this AR Kujang Kujang catalog application can display Kujang objects by the original. Three-dimensional animation of Kujang supplemented with sound explanations of the characteristics of each Kujang is strengthened by the rotation and zooming functions which facilitate the user interactively. This function is very important to broaden the user's imagination in the learning process of local culture-based tourism products [18], [26], [27].

iii) Validation Testing

Validation testing results are performed to determine whether or not the user has succeeded in detecting a Marker, in this validation a marker test is conducted based on the brightness, angle, distance and multi-marker.

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The validation testing result can be seen in the attachment Table 3 (In Appendix).

In that table, there are durations and lux. The duration is used to find out how fast the required duration of the 3D Kujang object appears when the camera is pointed at the marker and for lux is the metric unit of measure of light on a surface that is used to determine the level of brightness in the light [3], [13].

iv) Android Specifications Testing

Android specification testing is carried out to find out to what extent the application performance capabilities on every specification that exist on the android system. The result of this testing can be seen in attachment Table 4.

Table 4. Trial of Android Specifications

No	Specification	Results
1	- 1.2GHz Quad-Core CPU - 1GB RAM - 5MP Rear Camera	Application could not be installed
2	- CPU Quad-core 1.4GHz - 2 GB RAM - 8MP Rear Camera	The application runs slowly and the camera for scanning markers is a little dark
3	- CPU Octa-core 2.0GHz - 3GB RAM - 13MP Rear Camera	The application runs smoothly and the camera scans clear markers
4	- CPU Octa-core 2.2GHz - 6GB RAM - 16MP Rear Camera	The application runs very smoothly and the camera for scanning is very clear

v) Usability Testing

This stage was carried out through a survey of 100 respondents using the Software Usability Management Inventory (SUMI) instrument. The results generally show that this application is representative and good with a value of 71.

IV. CONCLUSION

AR-based digital kujang catalog application can display the design and information of each cleaver in three dimensions, by placing virtual objects into the real world. To be able to display three-dimensional objects requires a certain angle and distance, also sufficient lighting so that the object can be easily detected by the camera.

The application of AR in this application is intended to visualize Kujang products that are rich in cultural treasures. This concept has the potential to be developed into an Edu-tourism model that is integrated with an integrated thematic national curriculum [32]. Therefore, ongoing and active socialization activities to elementary students as the next generation of the nation. It is expected to increase student enthusiasm for Kujang.

Increased enthusiasm for Kujang is expected to increase demand for Kujang products. If this condition is consistently maintained and continuously developed by the synergy of various stakeholders, the competitiveness of Kujang as a local culture-based product is also expected to increase [33]. Digital technology approaches that are in line with the millennial generation character can be a stimulus for the process of strengthening the image of Kujang as a product

based on local wisdom that appears in a modern way.

The features in this application not only display three-dimensional objects but also display detailed information on each type of kujang. Information is delivered in integrated multimedia in the form of audio, animation and video texts. Applications can be smoothed with the help of a marker [34]. Markers of each cleaver can be downloaded via the intro menu.

Markers are easily detected by the camera because they use QR-Code Based Tracking Markers. A variety of marker patterns is needed in this application. The more patterns the greater the Marker rating and the easier it will be to detect.

The idea to integrate AR-based digital learning media specifically for local wisdom-based products such as Kujang Bogor, into one of the integrated thematic curriculum competencies until finally developing into the Edu-tourism concept is the novelty of this paper. Kujang, which is less popular, even in the West Java region as its domicile, is now increasingly well-known by the community, especially elementary school students who are the target of this project. Activities that are sustainable, vital and involve relevant parties reinforce the lack of image as a dignified local culture. The enthusiasm of students towards kujang develops along with the development of digital media by the development of millennial generation.

This increased enthusiasm is expected to drive the search and demand for Kujang products so that the sustainable imaging of Kujang is getting stronger. This can be used as a momentum to strengthen the nation's character created from the forerunner to the millennial generation, namely elementary students.

This application is required for development in terms of 3-dimensional objects and other features. For further development Augmented Reality Kujang can be combined with Animated Films such as "Kabayan", "Cepot" or other animation to tell about the history of Kujang. The animation film itself will be placed in the Kujang Pamor (Kujang Pattern). When the user is trying to scan the Marker to display the 3D Kujang object, after that the user zooms in to the Kujang 3D object in the clever portion of the Kujang, and then displays the animated film video. And can also be combined with virtual reality so as if the user is in Augmented Reality itself like entering into the prestige of Kujang, then the user can enter a room that can be traced like playing a game.

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System Design of Augmented Reality Technology to Strengthen Sustainable Imaging of Kujang Products Based on Local Culture



Ahmad Sofyandi was a student of Computer Science Department, Faculty of Mathematics and Natural Sciences, Universitas Pakuan. He was active on Augmented Reality (AR) based educational digital media research.

APPENDIX

Table 2. Storyboard

Scene	Visual	Object					BTN	Hyperlink
		Txt	IMG	3D	Video	Sound		
Scene 1 Splash Screen		✓	✓	-	-	-	-	-
Scene 2 Loading Screen		✓	✓	-	-	-	-	-
Scene 3 Main Menu		✓	✓	-	-	✓	✓	✓
Scene 4 Information of Kujang		✓	-	-	-	✓	✓	✓
Scene 5 Video Intro		-	-	-	✓	✓	✓	✓

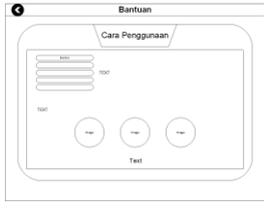
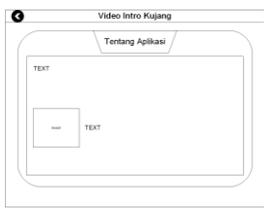
Scene 6 Start (scan Marker)		✓	-	✓	-	✓	✓	✓
Scene 7 Help		✓	✓	-	-	✓	✓	✓
Scene 8 About		✓	✓	-	-	✓	✓	✓

Table 3. Validation Trial

No	Marker	Gambar	Durasi	Lux	Hasil
1	Normal Distance		1 second	9,809	Object detected and displayed
2	20 cm distance		1 second	8,573	Object detected and displayed
3	30 cm distance		1.2 seconds	10,002	Object detected and displayed

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4	1 m distance		1.5 seconds	10,002	Object detected and displayed
5	50°		1.1 seconds	10,748	Object detected and displayed
6	90°		-	9,973	Undetected and not displayed
7	Multi Marker		2 seconds	11,001	Object detected and displayed
8	High Brightness		1 second	17,082	Object detected and displayed
9	Medium Brightness		1 seconds	9,154	Object detected and displayed
10	Low Brightness		2 seconds	5,976	Object detected and displayed