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Object Recognition Applications in the Home for Early Children's Education Based on MobileNet

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Abstract**—** *This study aims to: (1) produce an object recognition application in the home for early childhood based on MobileNet, (2)Knowing the quality of eligibility application of object recognition in the home for early childhood based on MobileNet using standard testing ISO/IEC 9126. The type of research used in this research is Research and Development (R&D) using the Rapid Application Development (RAD) development model., consists of 3 (three) stages, namely, (1) Requirements Planning, (2) Design Process (Workshop Design) and (3) Implementation (Implementation). The subjects in this study were early childhood of students Aisyiyah Parangtambung Kindergarten, Makassar City, which amounted to 20 people. Data were collected through literature study, questionnaires and documentation. The data were analyzed using the ISO/IEC 9126 software testing method which includes aspects of functionality, usability, portability and efficiency. In the aspect of functionality using test cases by two system experts, the usability aspect usesUSE Questionnaire, aspects of portability using various types of smartphones and aspects of efficiency using Real-time object detection.*

The results of this study are Home object recognition application for early childhood education based on MobileNet. Test result aspect functionality the system is considered good because X is close to 1, the usability aspect scores 78.2 in the "very high" category, the portability aspect has no errors in various types of smartphones, the efficiency aspect gets a 88.18% or fall into the "very high" category. So it can be concluded that the quality of the software already meets the software quality criteria.

Keywords**—** *Application, Object recognition, Early Childhood, MobileNet.*

I. INTRODUCTION

The rapid development of technology at this time is very fast and almost comprehensive in all circles and all fields. One of the fields that cannot be separated from technology is education. The development of technology in the field of education will make education at this time more advanced and developed so that people can live more creatively and innovate in the world of education. However, the problem that often arises is how to take advantage of the technology that is around us to be implemented in the world of education. According to Ki Hajar Dewantara in Safa (2011) Education is an effort to advance the development of character (inner strength), mind (intellect), and the body of children, in harmony with their nature and society. This means that education aims to help students so that later they are able to improve and develop the potential that exists in themselves and as members of society in real life.

The goals of national education are the general goals of the national education system. This goal is a long-term goal and is very broad and becomes the guideline for all educational activities or efforts in our country. This goal is then used as the basis for determining the goals of the school and the goals of the school curriculum, the goals of formal and non-formal education. The goals of national education are the guidelines for all activities of educational institutions in our country. The goals of national education as stated in Law no. 20 of 2003 concerning the National Education System (SISDIKNAS)(Indonesia, 2003), the implementation of education needs to be done from an early age.

Preschool education (early age) is education to help the physical and spiritual growth and development of students outside the family environment before entering basic education, which is held in the school education pathway or in the out-of-school education path.(Indonesia, 1990). Early childhood is a child who is at the age of 0-6 years (Indonesia, 2003) and 0-8 years according to child education experts. This period is valuable years for a child to recognize various facts in his environment as a stimulus to his personality, psychomotor, cognitive and social development. Based on research results, about 50% of adult intelligence capabilities have occurred when children are 4 years old, 80% have occurred when they are 8 years old, and reach their culmination point when children are around 18 years old.(Jalal, 2002).

So much convenience and practicality offered in the use of technology. Currently, communication can be done very real without being hampered by space and time. Technologies such as gadgets (smartphones) are now increasingly sophisticated, not only in sending voice to sending pictures more easily without spending a lot of money. Smartphone is a technology that cannot be separated from everyday life. In addition to being easy to obtain, smartphones are also easy to use anytime, anywhere and almost all circles of society are now able to operate smartphones. At this time, there are many smartphones with advanced technology circulating in the community, ranging from those based on Java, Symbian, Blackberry, Windowsphone, Iphone and Android.

According to Melissa & Reith (2020), Android dominates the market with total sales reaching 86.1%, followed by iOS 13.9% and the remaining 0.0% for others. Android users can maximize the function and performance of their smartphones and tablets with a variety of applications. Android is an operating system released by Google, especially for smartphones and tablets. Android also has a store where there are 1 billion active users. Talking about programming, of course, cannot be separated from the Integrated Development

Environment (IDE) that can be used by developers(Permana & Imaduddin, 2017)The use of Information and Communication Technology creates a pleasant atmosphere in learning, because there are pictures, videos and sounds that appear so that children don't get bored quickly and can spur learning in early childhood.

Smartphone users are not only dominated by adults, even early childhood can use smartphone technology. However, the applications that are used in the current smartphone technology are dominant or more commonly used for adults, while the applications that are intended for children, especially at an early age are still very few, where the development of children is very influential with what they do on a daily basis. , especially in learning problems. However, the use of smartphones poses wider problems for children, for example the development of smartphones has the potential to cause children to spend more time interacting with the smartphone world than interacting with the world around them.(Haddon, 2013). According to Chusna (2017), now children's social life is more affected by technology, early childhood interacts more often with gadgets that affect the child's thinking power of things outside of this, he will also feel alien to the surrounding environment because of the lack of social interaction. However, technological advances can also help children's creativity if their use is balanced with the interaction of children with the surrounding environment. They know how to use technology to satisfy their gaming desires. Parents should supervise when their children play gadgets so that they are not too dependent on gadgets and do not forget to socialize with the surrounding environment. Learning media is very influential on children,

Being a parent of children who live in the era of globalization of information as it is today is not easy. It takes not only determination, skill, patience and wisdom in attitude but also in acting. Especially in this day and age where technology is needed to carry out any activities. This causes the role of parents to play an important role in the development of their children who are increasingly sophisticated with the gadgets they have. Gadgets are indeed needed as a means of communication for everything. However, parental supervision and guidance of children must always be carried out. Because if parents are complacent with children who can play gadgets for a long time, children can only play gadgets and cannot communicate with the surrounding environment. Parents should introduce gadgets to their children and also introduce technology as a learning medium in the sense of using technology for learning media. So that the role of children, especially at an early age, in utilizing technology more precisely.

One of the media for using technology in education related to mobile technology is mobile vision. Mobile vision is a computer intelligence system that has the ability to see and analyze objects, especially on mobile devices. In recent years mobile vision has made tremendous progress in solving real tasks where more and more algorithms are supporting this technology(Ess et al., 2008). One implementation of mobile vision is object recognition or object recognition. The complexity of object recognition on mobile devices with limited computing power and memory resources encourages increasing the effectiveness of the Convolutional Neural Network (CNN) model to function properly (Wang et al., 2018).

One CNN model that can run well on mobile devices is MobileNet. MobileNet has low specifications, low latency, and low power consumption so it is very good to be implemented on smartphone devices (Howard et al., 2017). The basic difference between the MobileNet architecture and other CNN architectures is the use of a convolution layer with a filter thickness that matches the thickness of the input image. MobileNet divides the convolution layer into depthwise convolution (Chollet, 2017) and pointwise convolution (Hua et al., 2018) and in its development, new features have been added, namely linear bottlenecks and shortcut connections between bottlenecks (inverted residuals) (Sandler et al., 2018). By implementing the MobileNet method on smartphone devices using ML-Kit Firebase as a model liaison with smartphones, it is hoped that it can educate good smartphone use for early childhood by developing mobile vision applications that can help early childhood recognize objects around them.

Based on the problems described, the author wants to conduct research with the title "Application of Object Recognition in the Home for MobileNet-Based Early Childhood Education". The author hopes to produce an application that is expected to be used as an educational system for early childhood in recognizing objects around them.

II. Research Methods

This research is research and development or Research and Development (R&D) using the Rapid Application Development (RAD) development model, consists of 3 (three) stages, namely, (1) Requirements Planning, (2) Design Process (Workshop Design) and (3) Implementation (Implementation). The subjects in this study were early childhood of studentsAisyiyah Parangtambung Kindergarten, Makassar City, which amounted to 20 people. Data were collected through literature study, questionnaires and documentation. The data were analyzed using the ISO/IEC 9126 software testing method which includes aspects of functionality, usability, portability and efficiency.

III. Research Results and Discussion

Research Result

Requirements Planning

Needs Analysis

Needs planning or analysis stage is done through information collection including literature review relevant to the development of home object recognition applications for early childhood based on MobileNet and reviewing the latest research findings related to research conducted, classroom observations and observations and information seeking related to learning activities carried out. all this time. The following describes the results of the analysis of the collection of information.

1. The age of students at Aisyiyah Parangtambung Kindergarten is in the age range of 4-6 years.
2. Learning media is very influential on children, where children are better able to understand or capture learning by

playing so that children not only get fun while playing but also gain knowledge or learning that can develop children's brain abilities.

3. Learning that is implemented in the learning process for early childhood at Aisyiyah Parangtambung Kindergarten is the introduction of objects to the surrounding environment.
4. Media utilization of technology in education related to mobile technology is mobile vision. The implementation of mobile vision is object recognition or object recognition.
5. MeasurementHome object recognition application for early childhood education based on MobileNetit is very important to do to ensure that the designed application meets the software quality aspects (Quality In Use) based on the software quality standard in ISO/IEC 9126.
6. By implementing the MobileNet method on smartphone devices using ML-Kit Firebase as a model liaison with smartphones, it is possible to educate good smartphone use for early childhood by developing mobile vision applications that can help early childhood recognize objects around them.

Analysis of Hardware and Software Requirements

Needs analysis can also be in the form of analysis of hardware (hardware), software (software) and data materials needed for system design. The hardware requirement needed for this application to function properly is a smartphone. While the software requirements needed for this application to function properly are Android 6.0 Marshmallow or higher and Find Objects.

Research Instrument Validation Results

Based on the results of the validation of research instruments conducted by Dr. SGZ, S.Pd., MT and Dr. eng. JMP, ST, M. Kom. obtained results as shown in the following table:

TABLE 1. Recapitulation of the results of the validation of research instruments by Dr. SGZ, S.Pd., MT and Dr. eng. JMP, ST, M. Kom.

Validator Name	Instrument Type	Average	Information
Dr. SGZ, S.Pd., MT	Content/Material Expert Validation Questionnaire	4.7	Very Valid
	System Expert Validation Questionnaire	4.9	Very Valid
	User Response Questionnaire (Usability)	4.4	Very Valid
Dr. eng. JMP, ST, M. Kom.	Content/Material Expert Validation Questionnaire	4.9	Very Valid
	System Expert Validation Questionnaire	3.9	Very Valid
	User Response Questionnaire (Usability)	5	Very Valid
Total		**4.6**	**Very Valid**

Source: Results of data processing, 2021.

Material Expert Validation Results

Recapitulation of the validation results of the content/material expert questionnaire by Dr. SGZ, S.Pd., MT and Dr. eng. JMP, ST, M. Kom.

TABLE 2. Recapitulation of the results of research questionnaire validation by Dr. SGZ, S.Pd., MT

Validator Name	Average Validation Results	Category
Dr. SGZ, S.Pd., MT	4.6	Very Valid
Dr. eng. JMP, ST, M. Kom.	4.7	Very Valid
Average	4.7	Very Valid

Source: Results of data processing, 2021.

Design Process (Workshop Design)

Flow chart

Home object recognition application for early childhood based on MobileNet begins by selecting the type of question to determine the level of difficulty in the questions. Taking pictures serves to answer questions from questions using the camera on a smartphone. Image objects will be classified with the MobileNet model that has been designed and use ML Kit as a link between the application to the MobileNet model. The score will increase to 10 when the image object is correct, while if the image object is incorrect, it will get a score of 0. The total score is based on the sum of the scores from the questions that have been answered correctly.

Interface Design

Design of the display (interface)Home object recognition application for early childhood based on MobileNet designed using a main display consisting of 3 menus namely Easy, Normal, and Hard menus. The main display is designed in such a way as to make it easier for users to interact with the application. The main display is designed with attractive features and makes it easy for users to operate (user friendly). The design for the main display of the application can be seen in Figure 1 below:

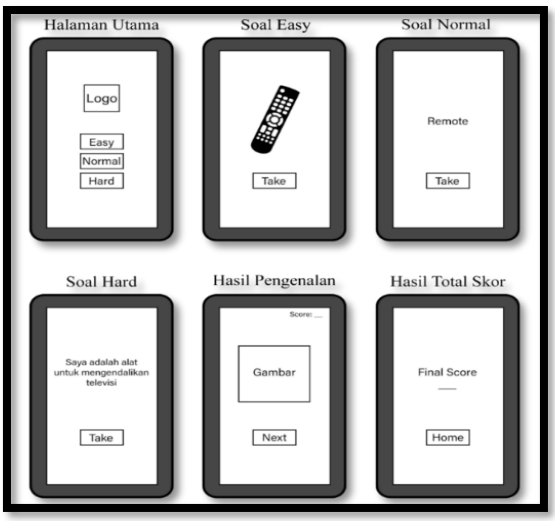

Fig. 1. Interface Design for Object Recognition Applications in the Home for Early Childhood Education-Based*MobileNet*

Implementation

At this stage all the designs that have been made will be implemented into an application that will later be tested. Design feasibility trials on Home object recognition application for early childhood based on MobileNet by using the ISO 9126 standard, namely, functionality, usability, portability and efficiency.

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Functionality

Testing is carried out using a test-case sheet that tests the application against 2 experts in the application field itself. The following is a list of experts who carried out Functionality testing on this application.

TABLE 3. List of experts who conducted the test *Functionality*

	Areas of expertise	agency
Dr. Satria Gunawan Zain, S.Pd., MT	Computer Engineering	FT UNM
Dr. Jumadi Mabe Parenrengi, ST, M. Kom., Ph.D.	Computer Engineering	FT UNM

Functionality test results for Home object recognition application for early childhood based on MobileNetis as follows:

TABLE 4. Aspect Test Results*Functionality*

Evaluation	Validator			
	Validator 1		Validator 2	
	Yes	Not	Yes	Not
Main View	1	0	1	0
Sound Main page	1	0	1	0
Easy Menu				
Instruction	1	0	1 0	
Sound Instruction	1	0	1	0
Question	1	0	1	0
Sound Question	1	0	1	0
Object Recognition Results	1	0	1	0
Total Score	1	0	1	0
Normal Menu				
Instruction	1	0	1	0
Sound Instruction	1	0	1	0
Question	1	0	1	0
Sound Question	1	0	1	0
Object Recognition Results	1	0	1	0
Total Score	1	0	1	0
Hard Menu				
Instruction	1	0	1	0
Sound Instruction	1	0	1	0
Question	1	0	1	0
Sound Question	1	0	1	0
Object Recognition Results	1	0	1	0
Total Score	1	0	1	0
Amount	**19**	**0**	**19**	**0**
	38			

Source: Results of data processing, 2021.

Based on the test results above, the value of the Functionality aspect test can be seen as follows:

$$X = 1 - \frac{A}{B} = 1 - \frac{0}{38} = 1$$

Then testing Aspect *Functionality* The system is considered good because X is close to 1.

Usability

Usability aspect testing on Home object recognition application for early childhood based on MobileNet with the number of respondents 20 people. Usability aspect testing using a questionnaire with a total of 18 statements. The following is a summary of the results of the Usability aspect testing conducted at Aisyiyah Parangtambung Kindergarten, Makassar City:

TABLE 5. Aspect Test Results*Usability*

Scoring scale	Amount	Score	Total x Score
Very good	158	5	790
Well	168	4	672
Pretty good	34	3	102
Not good	0	2	0
Not good	0	1	0
Total Value			**1564**
Maximum Value			**1800**

Source: Results of data processing, 2021.

The test results are converted into percentages using the following formula:

$$\frac{Total\ Score}{Maksimal\ Score}\ x90$$

The total value is the total score on the test results and the maximum value is the respondent's choice to choose strongly agree with a score of 5 and the minimum obtained is a score of 1.

$$\frac{1564}{1800}\ x90 = 78{,}2$$

Usability testing generates value 78,2 if compared to the category level included in the "Very High" category, namely at vulnerable 76 - 90.

Portability

Testing the Portability aspect using 5 types of smartphones, namely: Oppo, Honor, Xiaomi, Samsung and Asus. The following table shows the results of the Portability aspect test:

TABLE 6. Aspect Test Results*Portability*

Smartphone	*Operating System*	Results
Oppo A31	Android 9 Pie	No errors
Honor x8	Android 8.1 Oreo	No errors
Xiaomi Redmi Note 7	Android 10	No errors
Samsung A51	Android 10	No errors
Asus Zenfone	Android 9 Pie	No errors

Source: Results of data processing, 2021.

Efficiency

Testing on Android with the Real-time Object Detection application to find out objects in the dataset that can be detected with various camera angles, namely front, top, right, and left with a white background. The 10 objects that will be tested at this stage include bowl, clock, keyboard, remote, spoon, calculator, laptop, stamp, stapler, and thermos. The test results on the Real-time Object Detection application can be seen in Table 7.

TABLE 7. Real-time object detection

Object	Front	On	Right	Left
Bowl	0.96	0.80	0.89	0.87
Spoon	0.93	0.79	0.70	0.78
O'clock	1.00	0.74	0.96	0.98
Laptop	1.00	0.99	1.00	1.00
Keyboard	0.99	0.86	0.99	0.99
Remote	0.97	0.87	0.68	0.73
stapler	0.84	0	0.89	0.83
Thermos	0.99	0.98	0.96	0.91
Calculator	0.94	0.87	0.85	0.89
hangers	0.99	0.88	0.99	0.99
Total Value	**35.27**			
Maximum Value	**40**			

Source: Results of data processing, 2021.

So from the results that have been obtained and then used as a percentage, the results of the efficiency testing aspect are as follows:

$$\frac{35,27}{40} x\ 100\% = 88.18\%$$

Efficiency testing produces a value of 88.18%ifcompared to the categorized percentage rate(Guritno et al., 2011)included in the "Very High" category, namely in the vulnerable percentage81% - 100% = Very High.

The test data results in Table 4.7 show that the camera angle from the front, top, left and right can detect almost all objects with a white background. So based on the results of this test, it can be analyzed that the camera angle from the front can detect all objects with the highest accuracy than the camera angle from above, right, and left has a lower accuracy in detecting several objects because such as remote objects and calculators have characteristics. a shape that has many buttons in front of it so that it will be more difficult to detect apart from the front direction while for spoon objects it is also difficult to detect from these three directions due to the characteristics of its thin shape compared to other objects, In addition, the stapler object cannot be detected from above because the shape characteristics are almost the same only on the front, right and left sides. So, based on the analysis of this stage of the test, it can be concluded that the varying viewpoints of objects in the dataset will affect the results of the model's performance in recognizing objects on mobile devices.

Discussion

This study offers a learning media by combining artificial intelligence (AI) technology into a learning media, the AI technology used is part of the technological development of a classification algorithm, namely deep learning. Deep learning is a branch of machine learning (Ahmad, 2017). A deep learning model can learn its own computations using its own brain. Deep learning is designed to continuously analyze data like the human brain in making decisions. To make deep learning more powerful, deep learning uses the Artificial Neural Network (ANN) algorithm, which is inspired by the biological network of the human brain. Deep learning has several classification methods, one of which is Convulution Neural Network (CNN). This method is specifically for classifying an object in an image, where CNN works on the convolution process by moving a convolution kernel (filter) of a certain size to an image, the computer gets new representative information from the results of multiplying that part of the image with the filter used. CNN will generate a feature,

This study offers a combination of deep learning classification algorithms with learning media for object recognition, which is a new breakthrough in the world of education. The object recognition application developed leads to learning by utilizing the use of smartphones in early childhood. Learning is done by recognizing several objects in the house, ranging from laptops, keyboards, spoons, bowls, fans, remotes, buckets, trash cans, hangers, clocks, staplers, thermos, calculators, teapots, irons, toothbrushes, hats. , flashlight, scissors and broom.

The purpose of this research is toproduces an in-home object recognition application for early childhood based on MobileNet and Uto find out the level of eligibility Home object recognition application for early childhood based on MobileNet seen from the ISO 9126 standard with four characteristics, namely functionality, usability, portability, and efficiency.

Home object recognition application for early childhood based on MobileNetThis is an android-based application so it can be operated using a smartphone by the user. This application was developed using a deep learning classification algorithm with the MobileNet architecture.

ApplicationIt has a main page that contains three menus, namely the easy, normal, and hard menus. The easy menu is used to display questions with an easy difficulty level, the normal menu is used to display questions with a normal difficulty level, and the hard menu is used to display questions with a hard difficulty level.

Testing in this study uses the standard software testing model ISO 9126 which focuses on four characteristics, namely the characteristics of functionality, usability, portability, and efficiency. The test is intended to measure the level of quality and feasibility Home object recognition application for early childhood based on MobileNet.

Testing functionality using an instrument that contains 19 questions. Instrument functionality is validated by two expert lecturers. The two validators stated that each test case carried out got results that were in accordance with its function. The total score of the two validators is 19 each. Then the calculation is carried out to produce X = 1. Based onISO 9126 system is said to be good if X is close to 1. Thus this system meets the functional aspects according to the ISO 9126 standard. Usability testing results obtained for respondents' responses is 78.2 with a very high category, it can be seen in table 5. This can be seen from the results of the questionnaire data analysis obtained from 20 respondents.

Portability testing of this application is done by checking the application using the5 types of smartphones, namely Oppo, Honor, Xiaomi, Samsung and Asus. The portability test results show that the application can be accessed with various smartphones, which can be seen in table 6. Efficiency testing using the application*real-time object detection* by using 10 objects where the data obtainscore 88.18% or fall into the “very high” category, which can be seen in table 7.

IV. Conclusion

This application was developed for learning media by combining deep learning classification algorithms with learning media for object recognition. The classification algorithm uses the CNN method for the process of obtaining features from the image object, which is then forwarded to the mobilenet architecture to build knowledge on the system. The system that has been built is then applied to Android as an interactive medium in the object recognition process. The results of testing the quality of the feasibility of the application of object recognition in the home for early childhood based on MobileNet based on the ISO/IEC 9126 standard stated that functionality the system is considered good because X is close to 1, the usability aspect scores 78.2 in the "very high" category, the portability aspect has no errors in various types of smartphones, the efficiency aspect gets a88.18%or fall into the

"very high" category. So it can be concluded that the quality of the software already meets the software quality criteria.

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