

MOBILE WEB APPLICATION PURWOKERTO TRADITIONAL FOOD GAME CLASIFIKATION USING MOBILENET V2

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Abstract— Indonesia is a large country where there are thousands of aspects of culture, language and tourism. All of these aspects are an identity for the Indonesian state and each region within it. Culinary is one aspect that is included in the field of tourism. In Indonesia, each region has a special food that is an icon of the area. With so many foods from foreign countries entering Indonesia, this is feared will make the younger generation lose their identity about the regional heritage in special foods. Current technological developments have become excellent in various fields to solve the challenges that exist in the surrounding environment, it does not rule out the possibility that technology can be used to preserve the special foods that exist in each region. Based on the problems outlined above, this research will build a mobile web-based application for the introduction of local specialties through imagery and implement computer vision to mobile devices with CNN MobileNet V2 architecture. In this study a mobile web application was produced that was able to recognize Purwokerto's special foods that could be run well on various devices and operating systems.

Keywords: *web mobile, computer vision, traditional food.*

Intisari— Indonesia adalah negara yang besar dimana didalamnya terdapat beribu aspek budaya, bahasa, dan pariwisata. Aspek tersebut adalah sebuah identitas untuk negara Indonesia dan masing-masing daerah di dalamnya. Kuliner adalah salah satu bagian yang masuk dalam aspek pariwisata. Di Indonesia masing-masing daerah memiliki makan khas yang menjadi ikon dari daerah tersebut. Dengan banyaknya makanan dari negara asing yang masuk di Indonesia, hal ini di khawatirkan akan membuat generasi muda kehilangan identitasnya tentang warisan daerah pada makanan khas daerah. Perkembangan teknologi saat ini telah menjadi primadona di berbagai bidang untuk menyelesaikan tantangan yang ada di lingkungan sekitar, tidak menutup kemungkinan juga bahwa teknologi dapat digunakan untuk melestarikan makanan khas yang ada di setiap daerah. Berdasarkan permasalahan yang telah diuraikan di atas maka dalam penelitian ini akan di bangun sebuah aplikasi berbasis *web mobile* untuk pengenalan makanan khas daerah melalui citra dan mengimplementasikan *computer vision* ke perangkat mobile dengan arsitektur *CNN MobileNet V2*. Pada penelitian ini dihasilkan sebuah aplikasi *web mobile* yang mampu mengenali makanan khas Purwokerto yang dapat dijalankan dengan baik di berbagai *device* dan sistem operasi.

Kata Kunci: *makanan tradisional, computer vision, web mobile.*

INTRODUCTION

Indonesia is a big country where there are thousands of aspects of culture, language and tourism. This aspect is an identity for all regions in Indonesia. Culinary is one part of the tourism aspect, culinary is part of the creative economy which is the backbone of Indonesia's economy [1].

Every region in Indonesia has a traditional food that is an icon of the area, with the large number of traditional foods becoming a challenge for the younger generation to continue to maintain

cultural heritage in the form of regional specialties [2]. This is also an effort to reduce the dominance of foreign cultures [3].

With so much food from foreign countries entering Indonesia, it is feared that it will make the younger generation lose their identity about the regional heritage of traditional food [4]. The young generation's view of traditional food is insignificant [3] and consider it to be of no interest [5], so that the younger generation is increasingly not recognizing the form and name of traditional foods in their own area [6].



Current technological developments have become excellent in various fields to solve the challenges that exist in the surrounding environment, so technology can be used to preserve traditional foods in each region.

Computer vision is a topic included in the deep learning section which is currently a popular topic for solving problems in various parts of human life, computer vision can be used for classification [7][8], face detection [9], semantic segmentation [10], object detection [11][12][13], and for calculations [12]. There are 2 approaches for classification and detection that currently exist, namely machine learning, namely Support Vector Machine (SVM) and deep learning approach, namely Convolutional Neural Network (CNN). Based on the results of the Large Scale Image Classification and Recognition Challenge (ILSVRC), there are many researchers who use CNN to overcome the problem of object recognition and classification, Advances in this field are supported by the availability of computational abilities and datasets used for training [8]. Convolutional Neural Network is a deep learning method based on the development of a Multi Layer Perceptron (MLP) algorithm with a design for processing two-dimensional objects [14].

Many things have been done to attempt to introduce and maintain traditional foods using technology. Traditional food can be introduced through the recipe by implementing it into the Android application, on research [15] design an android application for traditional food recipes that aims to explore and get to know Indonesian traditional dishes. Introducing traditional foods can also be done by entering traditional food content into recipe sharing website portals such as cookpad.com, on research [16] clustering of traditional Banjar food was carried out, the result is a collection of traditional Banjar food recipes that are often shared between users. Traditional foods can also be introduced using location-based mobile technology, on research [17] android application was made to make it easier to find traditional food information in the city of Kudus using Google maps.

MobileNet is a neural network convolution architecture developed by Google to deal with low resolution image problems, a hardware device that is low cost but has a high recognition accuracy so it is suitable for use in mobile devices [6][18].

On research [6] MobileNet is used as fingerprint recognition to classify 500 different palms with 6000 datasets, the results increased 100% compared to previous studies. On research [19] modify the architecture of MobileNet to classify vehicles through aerial images with objects of trucks, cars, buses, bicycles and motorbikes, the

results tested on the iPhone X got an increase of 1.2% from the previous architecture. On research [20] a combination of faster RCNN and MobileNet for classification of logos using a mobile device, the result is an increase in accuracy of 1.6% from previous studies.

Based on the problems outlined above, this research will build a mobile web-based application for the classification of traditional foods with images and implementing computer vision to mobile devices with the CNN MobileNet V2 architecture in the dataset training process, in this study the case study taken was Purwokerto's traditional food.

MATERIALS AND METHODS

In this study the application is designed for the classification of traditional foods in the Purwokerto area with a game model so that users are more interested. Game is one of the extrinsic motivation techniques that can be used to encourage someone to do something [21]. In this study the game was made in the form of a search for traditional food objects in Purwokerto. In the process, making the application is done in 2 stages, namely training on the dataset and application design.

A. Object Recognition

At this stage the process of collecting datasets and training data is carried out to produce inferences that can be used by applications for object classification.

1. Dataset

The collection of the dataset is done by scarping in google image in accordance with the name of the object that has been determined. Each object has at least 100 images as its dataset. In this study there were 483 different objects with the division into 3 categories. In Table 1 describes the category division of all criteria..

Table 1. Dataset Category

Category	Qty	Description
Purwokerto traditional food	19	Main object
Indonesian traditional food	11	Deceptive objects that have similarities to the main object
General Objects	454	Deceptive objects that do not have significant similarities but are often encountered

In Table 1 the traditional food category in the Purwokerto area is the main object to be used as a game. While the Indonesian Traditional food category and general objects are objects that are recognized by the application but their knowledge is not used for games, the existence of this knowledge is to avoid the effects of overfitting when introducing classified objects.

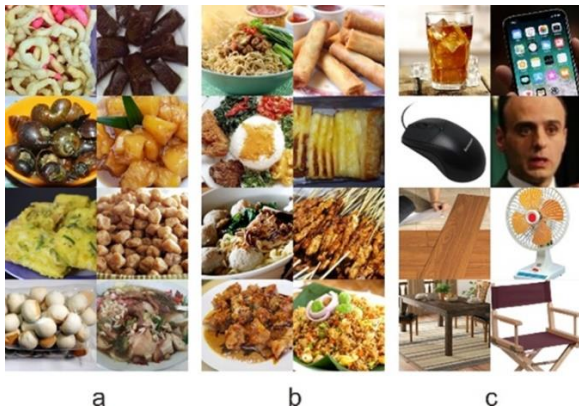


Figure 1. Example Dataset

In Figure 1 (a) is an example dataset for the Purwokerto traditional food category which is used as the main object, Figure 1 (b) is an example dataset for the Indonesian traditional food category which is used as an object of deception with a similarity that approaches the main object category, Figure 1 (c) is an example dataset for a general object category that is used as a deceptive object with a similarity far enough from the first category but its existence is often found.

2. Dataset Training

The data training process is done using Google Colab with a Tesla K80 GPU. Using the tensorflow 1.7.0 framework for training and tensorflowjs version 0.6.1 for conversion to web models. In the dataset training process the CNN Mobilenet_V2_0.25_224 network model is used [22] for its extraction feature.

```
!python3
/content/tensorflow/tensorflow/examples/image_re
training/retrain.py
--image_dir '/content/drive/My
Drive/dataset/update'
--how_many_training_steps=8000
--eval_step_interval=50
--architecture mobilenet_0.25_224
--output_graph '/content/drive/My
Drive/dataset/datagraph.pb'
--summaries_dir '/content/drive/My
Drive/dataset/data/summaries'
--output_labels '/content/drive/My
Drive/dataset/data/output_labels.txt'
--bottleneck_dir '/content/drive/My
Drive/dataset/data/bottleneck/'
--intermediate_store_frequency 1000
--intermediate_output_graphs_dir
'/content/drive/My
Drive/dataset/data/intermediate'
--saved_model_dir '/content/drive/My
Drive/dataset/data/saved_model'
```

Figure 2. Code of Training Dataset Code Commands

In Figure 2 is the code used to perform the dataset training command, training is carried out using 8000 training steps and by evaluating each step interval 50.

```
!tensorflowjs_converter
--input_format=tf_saved_model
--output_node_names='final_result'
--saved_model_tags=serve '/content/drive/My
Drive/dataset/data/saved_model'
'/content/drive/My
Drive/dataset/data/saved_model_web'
```

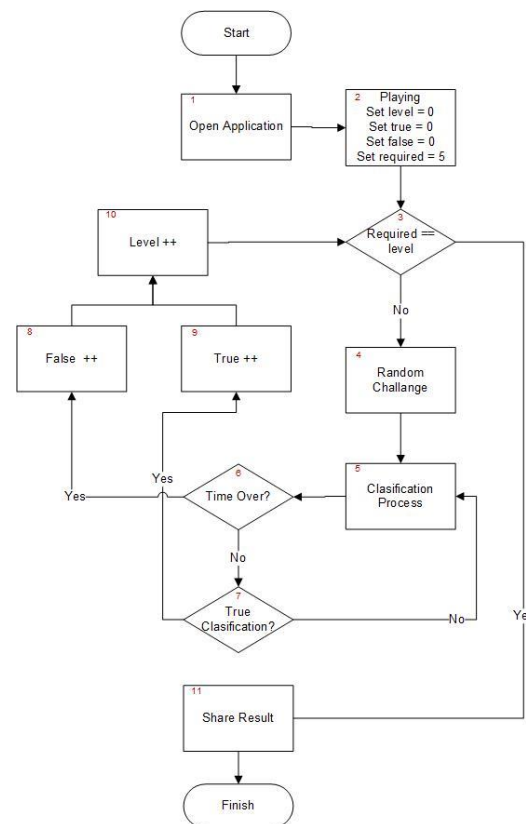
Figure 3. Code Cut of the Inverensi Conversion Command

In Figure 3 is the code used to perform the inference conversion command generated by Tensorflow so that it can be run on a mobile web application with low specifications.

B. Application Design

At this stage the application and game design are performed using the knowledge inference that has been generated at the training stage of the dataset. In Figure 4 is a flowcart of the application usage process flow.

Figure 4. Application Flowcart



The game process flow in this study is in Figure 4, which is when the user opens the application and starts the game, the 4 main

variables will be set as initial values. Furthermore, the application will bring up challenges to find random Purwokerto traditional food objects, in this challenge users will be given instructions in the form of pictures and descriptions, after the instructions are well understood then the user can start the game and the camera will activate automatically, the application will classify in real time based on the object captured by the camera and display the prediction of the object name, This classification process uses inferences that are formed from the faster RCNN algorithm model. If the object being classified is in accordance with the challenges given by the application, points will increase and the challenge will change with other objects. This application is designed for 5 object challenges that must be found, at the end of the game users can share points through social media Facebook and Twitter.

Based on Figure 4, the use of knowledge inference is in part number 5, which is used during the game process to classify images captured by the camera.

RESULTS AND DISCUSSION

The training process was successful with 36 minutes duration, got train accuracy of 97% and validation accuracy of 72%. In Figure 5 are the results of the log during the data training process.

```

2019-06-18 08:59:59.405509: Step 0: Train accuracy = 29.0%
2019-06-18 08:59:59.405877: Step 0: Cross entropy = 4.803048
2019-06-18 08:59:59.800958: Step 0: Validation accuracy = 0.0% (N=100)
2019-06-18 09:00:13.119928: Step 50: Train accuracy = 46.0%
2019-06-18 09:00:13.120179: Step 50: Cross entropy = 3.092439
2019-06-18 09:00:13.383224: Step 50: Validation accuracy = 28.0% (N=100)
2019-06-18 09:00:26.823722: Step 100: Train accuracy = 72.0%
2019-06-18 09:00:26.824019: Step 100: Cross entropy = 2.083265
2019-06-18 09:00:27.107324: Step 100: Validation accuracy = 32.0% (N=100)
2019-06-18 09:00:40.488242: Step 150: Train accuracy = 72.0%
2019-06-18 09:00:40.488603: Step 150: Cross entropy = 1.806078
2019-06-18 09:00:40.768238: Step 150: Validation accuracy = 46.0% (N=100)
.....
2019-06-18 09:36:01.264041: Step 7850: Train accuracy = 95.0%
2019-06-18 09:36:01.264370: Step 7850: Cross entropy = 0.354664
2019-06-18 09:36:01.555576: Step 7850: Validation accuracy = 70.0% (N=100)
2019-06-18 09:36:14.965536: Step 7900: Train accuracy = 96.0%
2019-06-18 09:36:14.965797: Step 7900: Cross entropy = 0.304155
2019-06-18 09:36:15.233599: Step 7900: Validation accuracy = 65.0% (N=100)
2019-06-18 09:36:28.904311: Step 7950: Train accuracy = 95.0%
2019-06-18 09:36:28.904651: Step 7950: Cross entropy = 0.324219
2019-06-18 09:36:29.210201: Step 7950: Validation accuracy = 63.0% (N=100)
2019-06-18 09:36:42.533301: Step 7999: Train accuracy = 97.0%
2019-06-18 09:36:42.533622: Step 7999: Cross entropy = 0.281412
2019-06-18 09:36:42.804062: Step 7999: Validation accuracy = 72.0% (N=100)

```

Figure 5. Log Training Process

In Figure 5 shows the log of the results of the training, the calculation of the accuracy process is calculated at every step to 50. In step 7999 shows that the accuracy is already high enough, so that the training can be stopped.

The application design in this study resulted in a web-based game application that can be run on mobile and desktop browsers. Figure 6 shows the application when it was first run in the chrome browser on an Android smartphone.

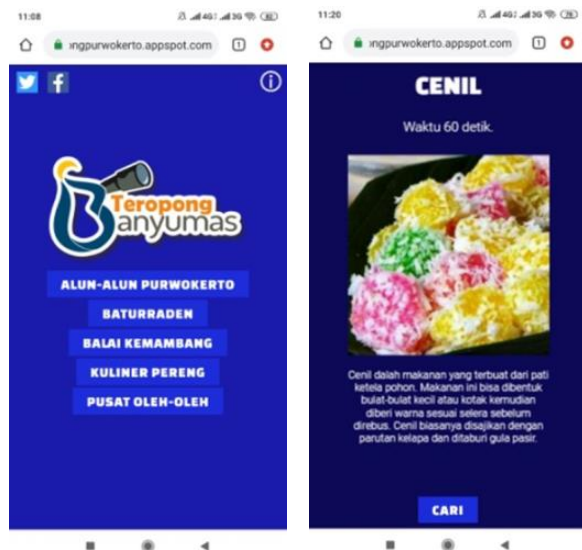


Figure 6. (Left) Home Page (Right) Quiz Page

In Figure 6 (Left) is the application's home page to select an existing game category, Figure 6 (Right) is a game instructions page that must be completed, the criteria for the challenge are obtained randomly and must be completed within 60 seconds, users must find objects that match the challenges using a smartphone or laptop camera.

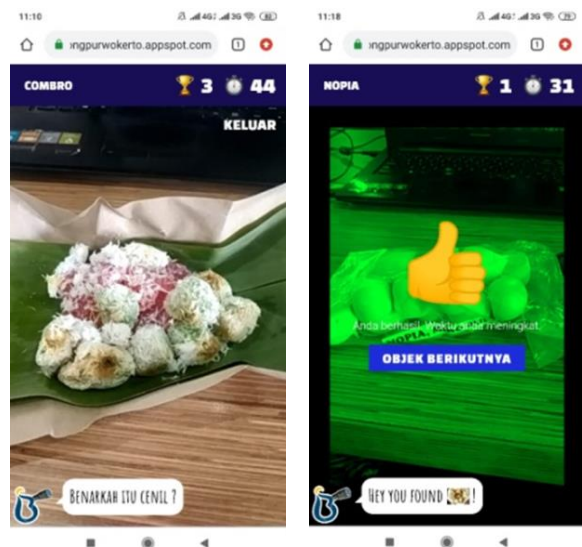


Figure 7. The active camera page

In Figure 7 (Left) is the object search page, in the picture it appears that the object to look for is a combro food but the screen leads to cenil food and the application classifies the object as cenil. In Figure 7 (Right) is a nopia food object search page with the camera pointing to the object that matches the challenge object is nopia food, so that it appears on the screen is the application successfully captures the nopia object.

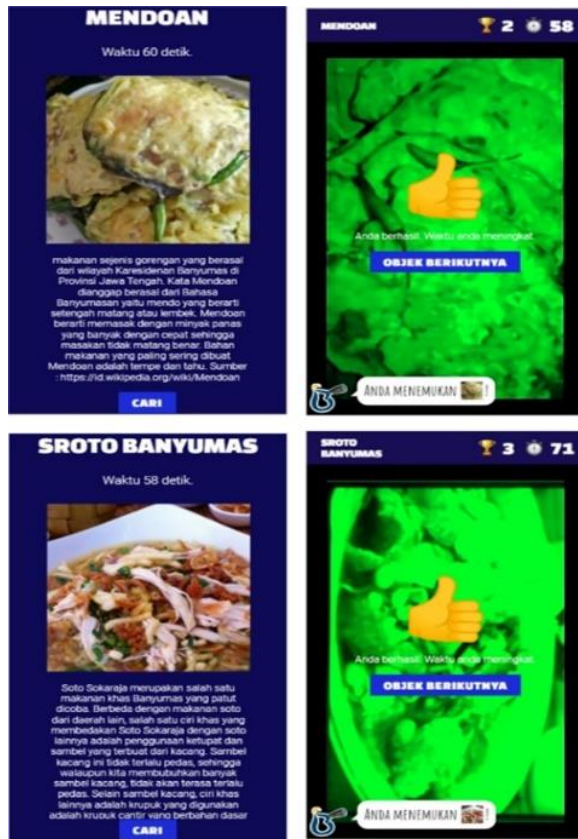


Figure 8. Instructions and Classification Results
 In Figure 8 (Left) is an information page of each challenge, in the picture is an example of the challenge that appears is to find an object mendoan, soto banyumas and kraca. Pada Figure 8 (Right) is an object search page, in the picture are examples of challenges that have been successfully resolved by finding the appropriate object.

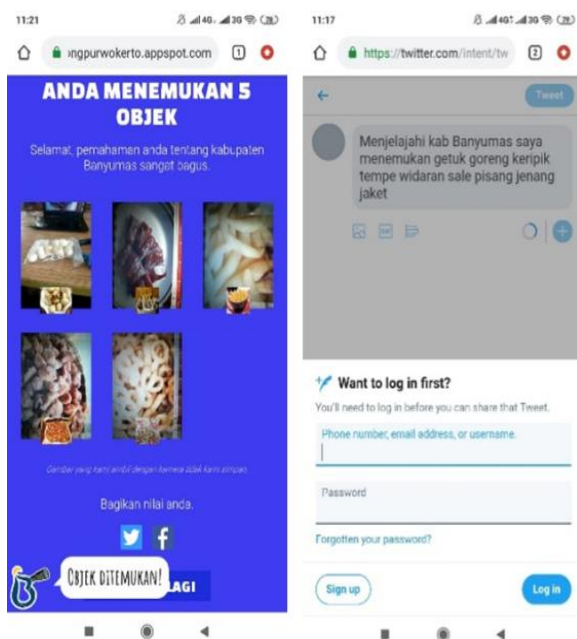


Figure 9. (Left) End Page (Right) Share Point Page

Figure 9 (Left) is the page display game recap, the page is displayed the number of correct and incorrect answers. Figure 9 (Right) is the display page of the results share on Twitter, share of these results can be seen by others and other people can also play the application.

In this study white box, black box and capability testing will be conducted.

White Box Testing

White box testing is a method used to understand every system condition in its design and implementation [23]. The process that is tested in this section is as described, namely when the user starts opening the application until the user ends the game. To determine the number of paths the cyclomatic complexity calculation method is used using the following formula:

$$V(G) = E - N + 2 \dots\dots\dots (1)$$

E = The number of arcs in the flow graph is 30
 N = Number of vertices in flow

From the results of calculating cyclomatic complexity, it is found that there are 4 paths based on flow graphs as in Table 2.

Flow Base	Independent Path
Track 1	1 2 3 4 5 6 8 10 3 11
Track 2	1 2 3 4 5 6 7 5 6 8 10 3 11
Track 3	1 2 3 4 5 6 7 9 10 3 11
Track 4	1 2 3 11

As described in Table 2 that the results of testing of each flow base has the right path, which has an output in the form of share results. Line 1 to Line 3 is the condition of the game that is completed until the end, Line 4 is the condition of the game that is completed when the user wants to stop in the middle of the game. Based on the 4 lines, it can be concluded that the user will not be trapped in one condition that has no output.

Black Box Testing

Black box testing is a method used to understand all functions in an application whether it has been running according to functional requirements, namely the main features of the application [24]. Black box testing is also commonly referred to as functional testing, this test is carried out by expert respondents in application development whose purpose is to test some of the functions in the application [25]. Black box test results can be seen in Table 3.

Table 3. Black Box Testing

Purpose	Condition	Result
Select the menu on the home page	Users can choose the type of purwokerto traditional food classification game groups according to location	Valid
Look at the documentation	Users can see instructions on how to play the game	Valid
Enter the game	Users can enter the game and get challenges in the game	Valid
Showing classification in real live	Pengguna dapat langsung mendapatkan hasil klasifikasi secara langsung pada layar	Valid
Classify correctly	Users can get the correct classification results	Valid
Object search hints	Users can learn the instructions according to the challenges the game can get	Valid
Close the game before it's finished	Users can end the game without having to finish until the end	Valid
Showing final results	Users can see the total classification that has been successful and failed	Valid
Share Results	Users can share results through social media Twitter and Facebook	Valid

From the results of black box testing, it can be seen that all functions have been tested and all are valid, so it can be concluded that the application has been used by users.

Capability Testing

Capability testing is a test scenario to ensure that applications can run on various platforms and platform versions [26].

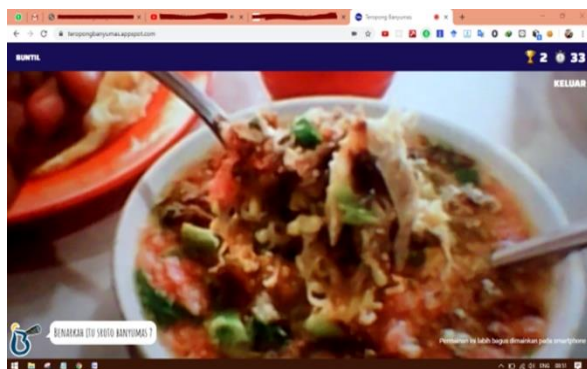


Figure 10. Application Runs on Chrome Browser

Figure 10 shows that the application can run in the Chrome browser on a laptop device with all the features that can be run properly.

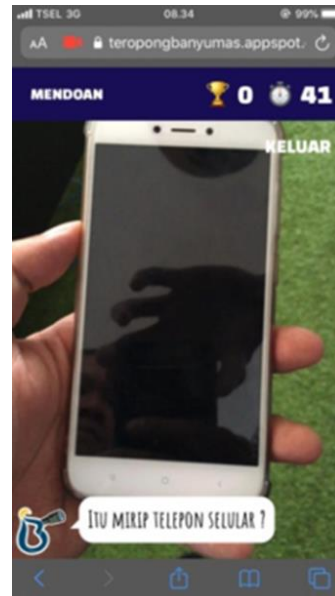


Figure 11. The application runs on the iPhone 6s safari browser

Figure 11 shows that the application can be run in the Safari browser on the iPhone 6s with all the features that can be run properly. The overall results of compatibility testing can be seen in Table 2.

Table 2. Compatibility Testing

Device	Browser	Functional
Laptop Lenovo G405	Chrome	The application runs well with all its functions.
Redmi Note 5	Chrome	The application runs well with all its functions .
Redmi 5A	Chrome	The application can be opened, but stops loading and cannot enter the game.
Redmi 4A	Chrome	The application can be opened, but stops loading and cannot enter the game.
Redmi 4X	Chrome	The application runs well with all its functions.
Samsung J6 +	Chrome	The application runs well with all its functions.
Redmi Note 2	Chrome	The application runs well with all its functions, but the camera movement looks broken.
Azus Zenfone Max Pro M2	Chrome	The application runs well with all its functions.
iPhone 6s	Safari	The application runs well with all its functions.

From the results of capability testing, it can be seen that all devices can run applications through the browser, only the Redmi 4A and 5A series applications stop while loading, then the Redmi Note 2 application can run all features only when accessing the camera, the results falter, but still can be played properly. From the results of this test, it

can be concluded that the application is suitable for use on various types of devices and operating systems..

CONCLUSION

Based on research that has been done, it can be concluded that the application of Purwokerto traditional food classification game can be made and can be run well on various devices and operating systems using a browser application, failure occurred in several types of devices with very low and out to date specifications. The application can be played according to the design on the flowchart and the introduction can be done well according to the image captured by the camera.

This research focuses only on the design and testing process on functional applications, Further research on this application can be done on analyzing the level of accuracy and precision of object recognition in each of its challenges. Applications made in this study can still be developed so that the introduction of more typical foods can be implemented in other traditional foods.

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