

## Development of vocabulary learning application by using machine learning technique

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### ABSTRACT

Nowadays an educational mobile application has been widely accepted and opened new windows of opportunity to explore. With its flexibility and practicality, the mobile application can promote learning through playing with an interactive environment especially to the children. This paper describes the development of mobile learning to help children above 4 years old in learning English and Arabic language in a playful and fun way. The application is developed with a combination of Android Studio and the machine learning technique, TensorFlow object detection API in order to predict the output result. Developed application namely "LearnWithIman" has successfully been implemented and the results show the prediction of application is accurate based on the captured image with the list item. The inclusion of the user database for lesson tracking and new lesson will be added for improvement in the future.

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## 1. INTRODUCTION

Mobile devices such as smart phones and tablets are becoming part of human's daily life communication, as well as entertainment. With the advanced of mobile technologies, it can provide an interactive learning content application for children educational purpose which can be simply accessed anywhere and anytime. The fact that children are best learns through playing, the making of an interactive application for Android mobile attracted the research attention. There is a high potential in the usage of mobile technology, in term of how a language can be learned and enhanced. This might be a big help for children to become proficient in second language at early age. Stockwell in his paper shows that the effects of vocabulary learning through mobile platforms are comparable with the traditional ways [1]. This is also supported by Basal et al. through the experiment done that proved the effectiveness of learning vocabulary through mobile applications compared through the traditional paper-based activities [2]. Vocabulary learning is very crucial to build the blocks of language such as read comprehension and language speaking [3].

Numerous studies have reported on the use of mobile devices to develop language skills through language learning application in past years. Makoe and Shandu implemented a mobile-based application to develop vocabulary learning mobile app to enhance the English vocabulary teaching and learning [4]. Wang also develop a mobile app to improve the college student's English vocabulary learning with both English and Chinese description [5]. While Sweeney and Moore are investigate the potential of mobile devices to be used in language learning. They found that language learning through mobiles has high potential but with the collaboration of both developer and educator to make sure that it can benefit and help the students [6]. The most common method for mobile application development using image processing machine learning technique is Mobile Cloud Computing (MCC). MCC is combination of mobiles and cloud computing which can simply processing from the user local devices to the data centre facilities over the internet [7-24]. The major service providers of MCC are including Google, Amazon, Microsoft and Yahoo. Figure 1 shows the general architecture of MCC.



Figure 1. Mobile cloud computing (MCC) architecture

The users can simply accessing the cloud storage as long as the internet connection is there. However, this can be disadvantage of the MCC. The overall performance of the machine learning can be affected depended on the internet connection speed which it cannot perform inference locally on the device without internet [25-26]. Thus, TensorFlow technique can be a solution to the running machine learning on mobile devices. TensorFlow is able to runs the machine learning inference computation locally on the device. With low latency and small binary size, TensorFlow also can be a lot faster and more reliable than MCC [27-28]. This paper presents the development of Android mobile application namely "LearnWithIman" for language learning through capturing image based on the word given, that aim for toddlers above 4 years old to enhance their English and Arabic vocabulary. TensorFlow deep learning techniques will be used to train the models of captured image for image prediction.

## 2. METHOD

### 2.1. Android application development

In order to attract the children interest, "LearnWithIman" is developed to be a fun application with the learning through playing concept. "LearnWithIman" introduces two basic languages of English and Arabic which divided by different categories. Prior to the application development, the selection of each category is crucial to match the level of the children age. The categories are including the 'Read Easy', 'School Bag', 'Sweet Home', 'Fruits and Veggies', 'Speak Arabic' and 'Explore Science'.

For the development of the Android mobile application namely "LearnWithIman", the TensorFlow deep learning technique and Android Studio were used. As mention in Introduction Section, TensorFlow will be used as a machine learning method to predict the image captured from "LearnWithIman" application. "LearnWithIman" application is preloaded with TensorFlow object detection API which uses single shot detector (SSD) with MobileNet pre-trained model that is trained on Microsoft Common Object in Context (COCO) dataset. The captured image will be compared with the preloaded image dataset with the highest score in order to predict the output result. Android Studio is used to customize the look of the application in Android platform. Figure 2 provides the architecture of "LearnWithIman" android mobile application.

Upon entering "LearnWithIman" application, the user is presented with its main interface for categories selection as shown in Figure 3. The application will then display the name of the item with sound that requires the user to capture the image of the item. TensorFlow will perform the prediction by giving the score of the captured image. Once the click button is pressed, the application will compare

the score with the name of the item. The correct sign will be displayed if the captured image is matched with the name of the item. This will be repeated until all the items are displayed. The point will be shown at the end of application.



Figure 2. “LearnWithIman” application architecture



Figure 3. The main interface of “LearnWithIman” application

The Flowchart of “learnWithIman’ application is shown in Figure 4. While Figure 5 presents the screen of image capturing from the application. There are three buttons are available as illustrated in Figure 5, left button is the count of correct item based on the captured image, middle button is to capture the image from the rear camera and the right button is to skip the current item and go to the next item. The name of the item is displayed at the bottom of the application.

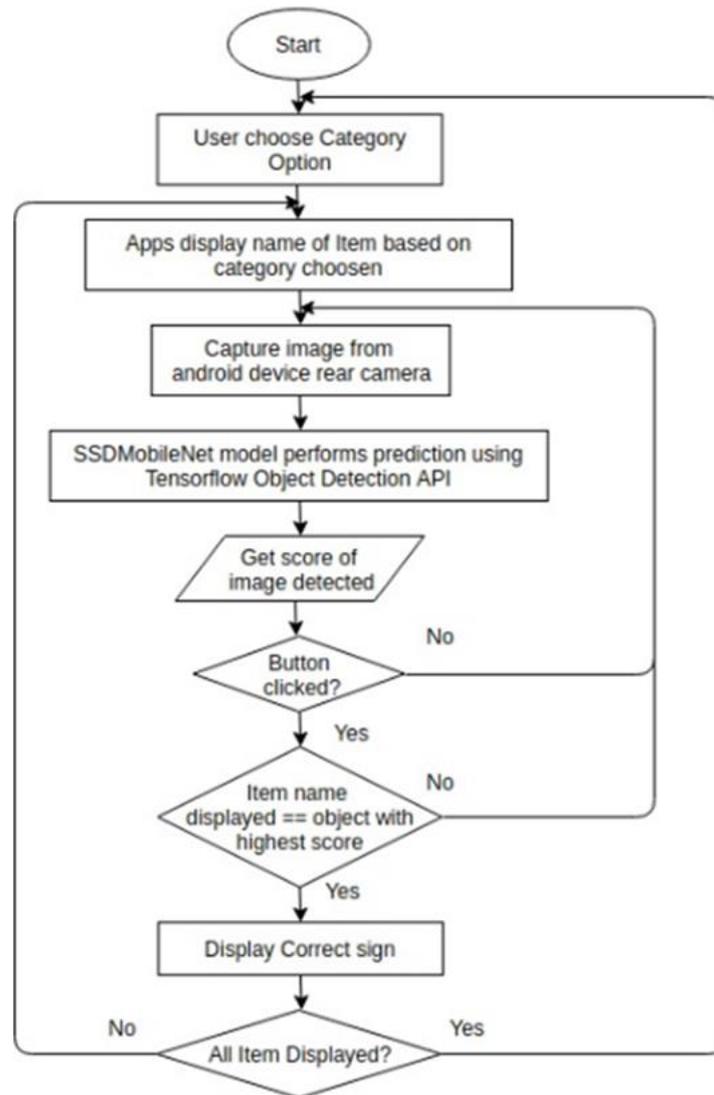


Figure 4. The flowchart of “LearnWithIman” android application

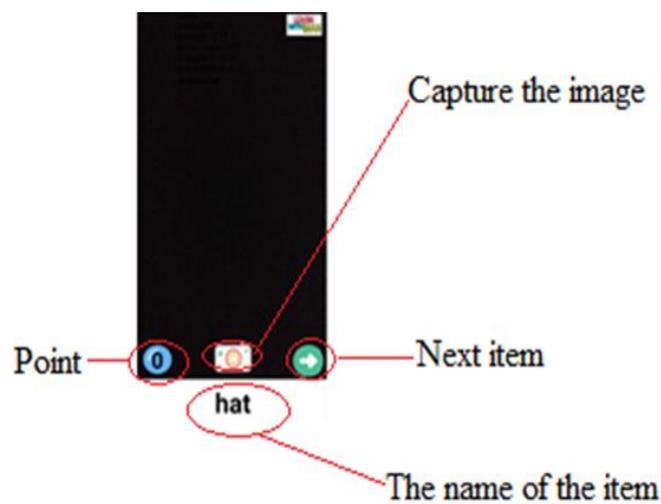


Figure 5. Screen of application to capture the image

### 3. RESULTS AND DISCUSSION

Several experiments have been done with different requirements to observe the practicability of the application in image detection and prediction. At first, the application was tested with random categories as shown in Table 1. Then, the test for the same item with the different captured image was observed to check the reliability of the application. Last but not least, to see the effect of the image background for the application prediction. Table 1 presents the comparing scores between the captured image and the list item through TensorFlow Object Detection API. As can be seen from the table, “LearnWithIman” is able to detect the captured image accurately according to the list item. On average, the detection time of the captured image took only 100 ms which considered as sufficient enough.

Table 1. The score of the matched item from different categories

Category-Name of the Item	Captured image	Detection time (ms)	Score
Read easy-mug		105	0.58
School bag-sharpener		136	0.95
Sweet home-pillow		74	0.86

Table 2 illustrates the prediction of the same item but different captured image. It is apparent from the table that “LearnWithIman” consistently matches the item correctly even though the image captured is different. The results shown indicate that the prediction of the application is reliable. Table 3 provides the results of the same item and captured image but with different background. The results obtained revealed that “LearnWithIman” able to detect the matched image even with a different background.

Table 2. The result from same item with different image

Captured image	Score	Prediction
	0.71	Matched
	0.84	Matched
	0.87	Matched

Table 3. The result of same image with different background

Captured Image	Score	Prediction
	0.83	Matched
	0.69	Matched
	0.55	Matched

#### 4. CONCLUSION

This work has presented the development of Android application for children in language learning namely "LearnWithIman". The developed system is able to perform the prediction of the image captured by "LearnWithIman" application for children language learning with high accuracy. The application is implemented with a combination of interactive elements, visual and sound for pronunciation to attract the children interest to learn through mobile application. As for future work, the inclusion of the user database for lesson tracking will be considered. Moreover, new lessons for language learning will be added as well.

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