

Scales+

Smart scales with object identification and wireless connection

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ABSTRACT

Machine learning is currently used wider in the image identification application, such as the object identification, face identification and so on. This IoT project Scales+ is the normal scales equipped with the camera and raspberry pi which makes the Scales+ can capture images, run CNN model and use socket to do the communication between scale and mobile device. Using this Scales+ can save the label wasting and make life easier. In the meantime, an Android App is developed with display and checkout features.

KEYWORDS

Internet of Things, Smart Scales, Machine Learning, Object Identification, Digital Identification

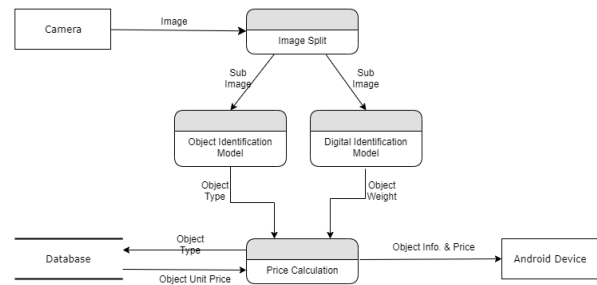
1 Introduction

Scales+ is a normal scale equipped with camera and raspberry pi. It can capture image according to the request and do the following object identification, digital identification and socket communication. The related Android App can send request and receive the result. It can also display the current item information and do the checkout.

2 Design

Scales+ is designed to implement the automatically scaling and wireless connection with the mobile device. The camera is connected with the raspberry pi and it is set above the scale. After capturing an image, it will be processed by the raspberry pi and the processing result will be sent to the mobile device for display and do more operations.

2.1 DFD



At first, the camera captures an image. The image is split into two sub-images, the one containing object is sent to the Object Identification Model and the one containing digital is sent to the Digital Identification Model. After two models' processing, the results including Object Type and Object Weight are sent to the Price Calculation. The Price Calculation gets the Object Unit Price using the input information and sends the Object info. & price to the Android Device for display and following operation.

2.2 Hardware

2.2.1 Android Device Samsung S7 edge with Android OS for the display and following operation on the order.

2.2.2 Raspberry Pi 3B Installed with the Raspbian OS. For the ML model running and camera control.

2.2.3 Scales Normal kitchen scales. For the scaling and weight reading.

2.2.4 Camera 5MP 1080P Video Camera Module for Raspberry Pi 3 b+.

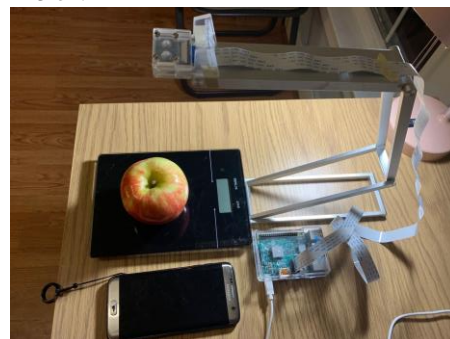


Figure 1: All hardware.

3 Implementation

3.1 Software/Tools

3.1.1 TensorFlow Lite 2.3 This is installed on the raspberry pi due to the limited performance of raspberry pi. This is the python library for the Machine Learning algorithm running on the embedded device.

3.1.2 PiCamera This is a python module to control the camera connected with the raspberry pi.

3.1.3 Socket This is a python module supporting the socket communication which is used to do the communication between raspberry pi and android device.

3.2 CNN

3.2.1 Dataset

This project uses the dataset generated manually.

3.2.1.1 Object Identification Dataset Four kinds of fruit (apple, orange, pear and mandarin) and each fruit category has 40 images.

3.2.1.2 Digital Identification Dataset Ten categories from 0 to 9. Each digital has 10 images.

3.2.2 CNN model

3.2.2.1 Object Identification Model This model uses the AlexNet8 as the basic model.

3.2.2.2 Digital Identification Model This model uses the LeNet5 as the basic model.

3.2.3 Training

Object Identification Model and Digital Identification model are both trained using the desktop which has better performance.

3.2.4 Deploying

Object Identification Model and Digital Identification model are deployed on the raspberry using the TensorFlow Lite 2.3 platform which is designed of the embedding system.

3.3 Android App

The Android App is developed using the Android Studio.

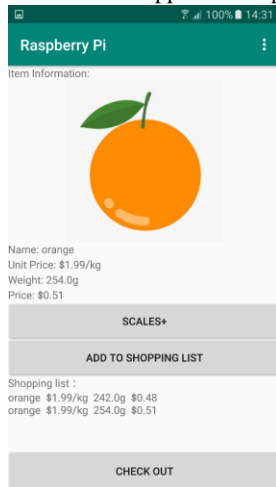


Figure 2. Initialization Interface.

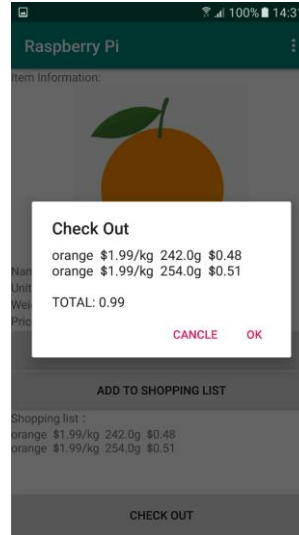


Figure 3 Checkout.

Scales+ button Pressing this button can send the scale request to the raspberry pi which is the server.

Add to Shopping List button Pressing this button can add the current item to the shopping list.

Check Out button Pressing this button can do the summation among the shopping list.

Item information field This field shows the image related to the current item, the item name, the item unit price, the item weight and the price.

Shopping List field This field shows the added items.

4 Evaluation

I achieved all the goals set at the beginning of the semester.

4.1 I finished the assembling of all the hardware.

4.2 I finished the generating of two kinds of datasets.

4.3 I finished the socket communication between Raspberry Pi and Android Device.

4.4 I finished the training of two CNNs.

4.5 I finished deploying CNN on the raspberry pi.

4.6 I finished the development of the Android App.

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REFERENCES

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