Smart Vending Machine System Prototyped with Deep- and Machine-Learning Technologies

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Abstract
This paper proposes a smart vending machine system combined with deep learning and machine learning technologies. The proposed system is combined with temperature and camera sensor to obtain consumer without individual information and upload this information to cloud server. The system uses face recognition with deep learning to obtain the gender information. It uses the k nearest neighbors (KNN) machine learning method to group based on temperature, time, price and gender information. The proposed system relies on grouping information to dynamically adjust price in real time.

Keyword: Smart Vending Machine System, Deep Learning, Machine Learing;

1. Introduction

Vending machine system is popular around the world and thus is very convenient and indispensable for people [1]-[3]. There have been researchers proposing new ideas and implementation for vending machine systems [4]-[6]. This paper proposed smart vending machine system combining wtih deep learning and machine learning technologies in order to provide smart vending services. The proposed smart vending machine system uses tensorflow technology to identify gender of users and use Raspberry pi embedded system to obtain temperature information. The proposed system collects the vending record and uses k-nearest neighbors (KNN) method to model groups to predict consumer behaviors and dynamically adjust the price in real time. In Chapter 2, we introduce the system architecture. In Chapter 3, we presents the experimental results. Finally, conclusions of this study are shown in Chapter 4.

2. System Overview

The system architecture of the proposed method is shown in Figure 1. The hardware includes Raspberry pi embedded system, webcam and DHT sensors. The software includes tensorflow, opencv and KNN methods. The Server provided the UI interface and MySQL to store data.

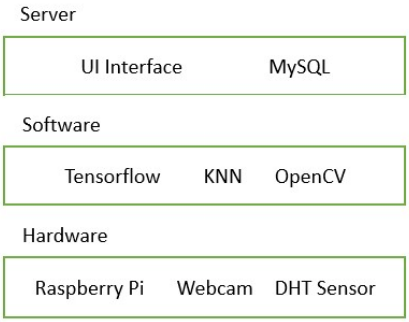

Figure 1: System Architecture

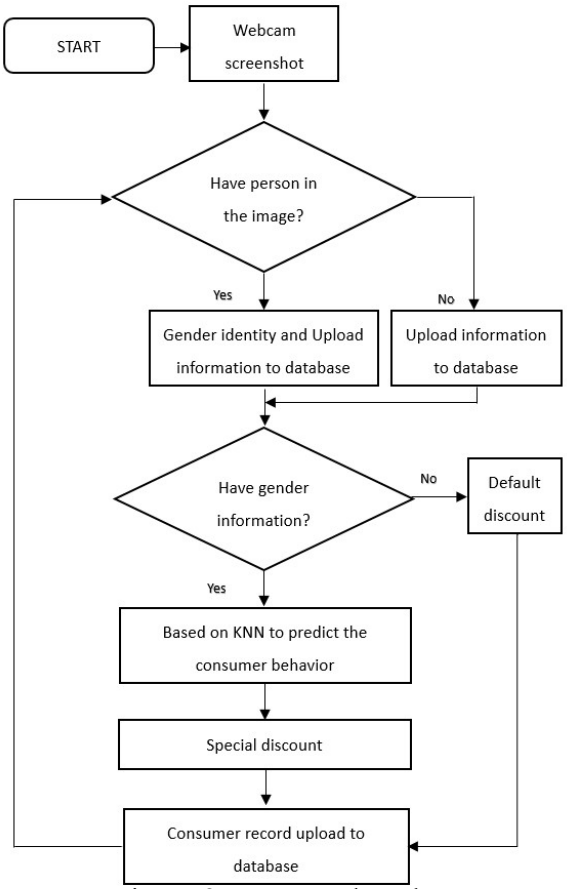

Figure 2: System Flowchart

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The proposed smart vending machine system flowchart is shown in Figure 2. The webcam device will continue to capture images on second basis. The capture image will run tenserflow gender detection program and return the results. The gender identity and temperature information will be uploaded to database when detection program determines the gender. If it fails to determine gender, it will upload the rest of information to database. When the information includes gender information, the proposed system will run the KNN method to obtain the grouping information. This grouping information will be used to dynamically adjust the price and pesented in the user interface. When the information does not include gender information, the proposed system will use default discount for users. The default discount is determined by time and temperature information. For example, cold drinks will be on sale when temperature reaches 30 degrees Celsius and coffee will be on sale in the morning. Finally, the consumption record with sensing information will be uploaded to the database for new KNN training data.

3. Implementation Results

Figure 3: Implementation Results

The proposed system uses Raspberry pi 3 model B embedded system, DHT-11 sensor and LEGO Mindstorms EV3 device to implement the prototyping. The gender identity adopts tenserflow to train and detect gender from fetch images from webcam devices. The grouping information uses KNN method wherer k is set as 4 by python language in this paper. The user interface uses Android App for display, and the database system uses MySQL. The system implementation results are shown in Figure 3. The system uses webcam to capture images and identifies the gender of users, and information such as temperature is accordingly used to dynamically adjust price. This price will change on user interface in Android App in real time. According the result of KNN, the system will recommend suitable items for buyers.

4. Conclusions

This paper proposed a novel smart vending machine system prototyped with Internet of Things and Tensorflow technologies. In order to provide good consumer experience for users, this system uses history vending record to group consumer preferences. The proposed system uses information including gender, time and temperature to determine discount to evoke consumers' desire to buy commodities. In the future, the proposed system will involve more information to build the grouping model for enhancing the accuracy of prediction.

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