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Reverse Vending Machine (RVM)

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Abstract
The purpose of this project is to learn and study more about IoT. The reverse vending machine that provides for the separation and counting plastic, bottle and metal can. This project is made in order to fulfil the objective of this project which is to improve waste segregation specifically for waste bottles by using Arduino microcontroller in reverse vending machine, to develop a system that can encourage community to involve in recycling project by giving reward and to build the systematic and clean rubbish handling system. Significantly this project is almost same with the vending machines system, but it has a slightly different between them. The main component of this project is keypad, IR sensor, proximity sensor and counter, this component will connect to Arduino Uno as their microcontroller. The output component for this project can be listed such as LCD Display, LED, and WI-FI Module. This project will encourage people to join the recycle program that can save the world from pollution such as water pollution, air pollution and environment pollution.

Keywords: Component; Reverse Vending Machine, Recycle IoT

Introduction

Nowadays, increasing in amount of waste generated by human's and limited landfill sites for dumping waste, recycling it is one of approaches to manage the waste effectively. The present recycling practice in which the people need to bring the waste in bulk to the recycling center and inconvenient recycle bins might bother and become a discouraging factor for them to recycle. To overcome such an issue, an automated recycle bin designed and installed in many countries on subways, malls etc. with are ward featured is developed from a reverse vending machine (RVM) concept. In present time, Reverse Vending Machine is become very popular in countries like Greece, Japan, Europe, South Korea, America and China. Reverse Vending Machine (RVM) reduce employee work, saves time and energy also motivate human's being, even cost effective. In this report will explain about the working of Reverse Vending Machine based on detection sensors which start to work after insert the empty beverage into it, where it can be checked by the proximity sensor. There are very attractive rewards for the users of Reverse Vending Machine, they get discount coupons as a reward. This report explains the simulation of Reverse Vending Machine Inductive Proximity Sensors and Infrared Sensor to detect presence of empty beverage. Reverse Vending Machine process by accepting plastic or can beverage and gives discount coupon as a reward for every 5 items recycle by user. In this, Reverse Vending Machine supports only plastic and can beverage as an input, discount as an output. Reverse Vending Machine (RVM) for Charity is the title of this project where as the main idea of this project is to encourage people especially the students and staff in the college to join the recycle program by using convenient machine. This machine is supposed to be a smart system that can ease the cleaner staff to separate the rubbish in the college. In a nutshell, this reverse vending machine will much easier to use for all level of age. Our institute has provided the recycle bin as shown in Figure 1 however, it is not frequently used due to its inconvenience and ineffectiveness in recycling processes.

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Fig 1: Segregated recycling bins for glass (Kaca), paper (Kertas), and plastic & aluminum waste.

This system will be able to notify user for the discount coupon by using Internet of Things (IoT) which is ES Presso Lite V2.0 as Wi -Fi module and IFTT application that can be more useful and ease user to get discount. This project will collaborate with bakery and mart outlet in college to archive the target of give discount to the user. The\ discount notification will be sent via SMS and valid within 24 hours after the notification. Basically, this system will be using an Arduino UNO as microcontroller and servo motor that plays an important role which is to separate the empty beverage.

Methodology

Figure 2 showed a system block diagram of reverse vending machine. One of the inputs of this reverse vending machine is keypad for user to enter their ID number as a reference record. The concept of IR sensor as an input is to detect obstacle by to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver. It has three connectors which one connected to any digital I/O in microcontroller, connect to 5V and connect to ground. In this project, IR sensor acts as counter to count the empty container that were insert into the chute at the front of the reverse vending machine. The inductive proximity sensor as one of the inputs was used to detect the presence of metal. This sensor uses 5Vsupply, one analog pin and ground from Arduino. In this, project, this sensor is use to differentiate item either its metal or nonmetal. The signal is Arduino UNO that acts as microcontroller. The outputs are Liquid Crystal Display (LCD), Light Emitting Diode (LED), Espresso Lite 2.0. The LCD displays the user ID and the number of empty containers that has been insert into the machine. The servo motor connected directly to Arduino to control the shaft position precisely. Servomotor use feedback to determine the position shaft. It can rotate 0° to 360°. and acts as separator to separate the metal and non-metal empty container in reverse vending machine. Espresso lite 2.0 is small module allows microcontroller to connect to a Wi-Fi network and make simple IOT connections using Blynks application. This application used to show appreciation to user by sending SMS and discount coupon at selected store.
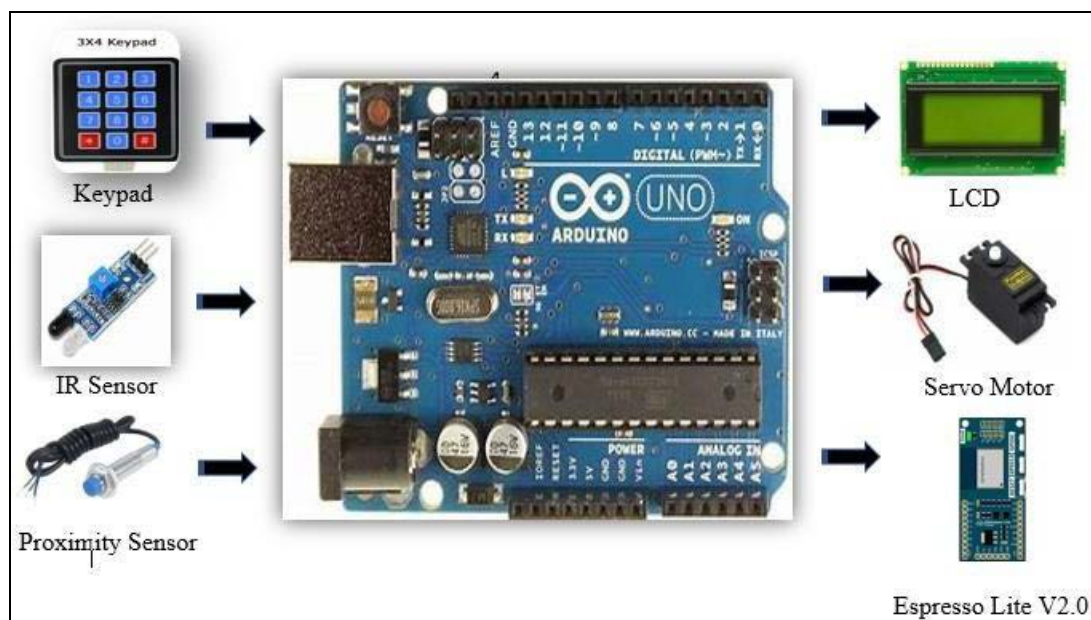

Fig 2: block diagram of reverse vending machine

Fig 3 showed the schematic diagram of reverse vending machine. The LCD will display ―WELCOME TO RVM‖ and ―INSERTID NUMBER‖. When the user inserts the ID number by using keypad, LCD will display the name of the student by enter ―#‖button. If the ID user is not recognized, LCD will display ―REGISTER FIRST‖. After entering the ID number, LCD will display ―Pleaseinserttheitem‖, ―TOTALCAN=0‖, ―TOTALPLASTIC=0 ‖and―TOTAL ITEM = 0‖. Currently, user need to enter the item that they want to be recycle. Firstly, proximity sensor will detect the type of empty beverage either metal or non-metal. Of that entered the RVM and send the signal to the servo motor through Arduino UNO. If the material insert is metal, servo motor will rotate to 100°, but if it is non-metal servomotor will rotate to 0°. This how the item can be separated between two conditions. When the proximity sensor is high,

LCD will display ―TOTAL CAN = 1‖ and it will increase as the Can be detected. Plastic item also been count by using IR sensor and it also will display in LCD ―TOTAL PLASTIC = 1‖. Then, at bottom LCD also display ―TOTAL ITEM = 2‖. After all the items has been insert by the user, the user needs to press ―*‖ button to execute from the program. If the total item of can and plastic are equal and more than 5, the Arduino will send signal to the Espresso Lite V2.0 to send discount message to the user through their smart phone. The discount coupon can be claim at selected stores.
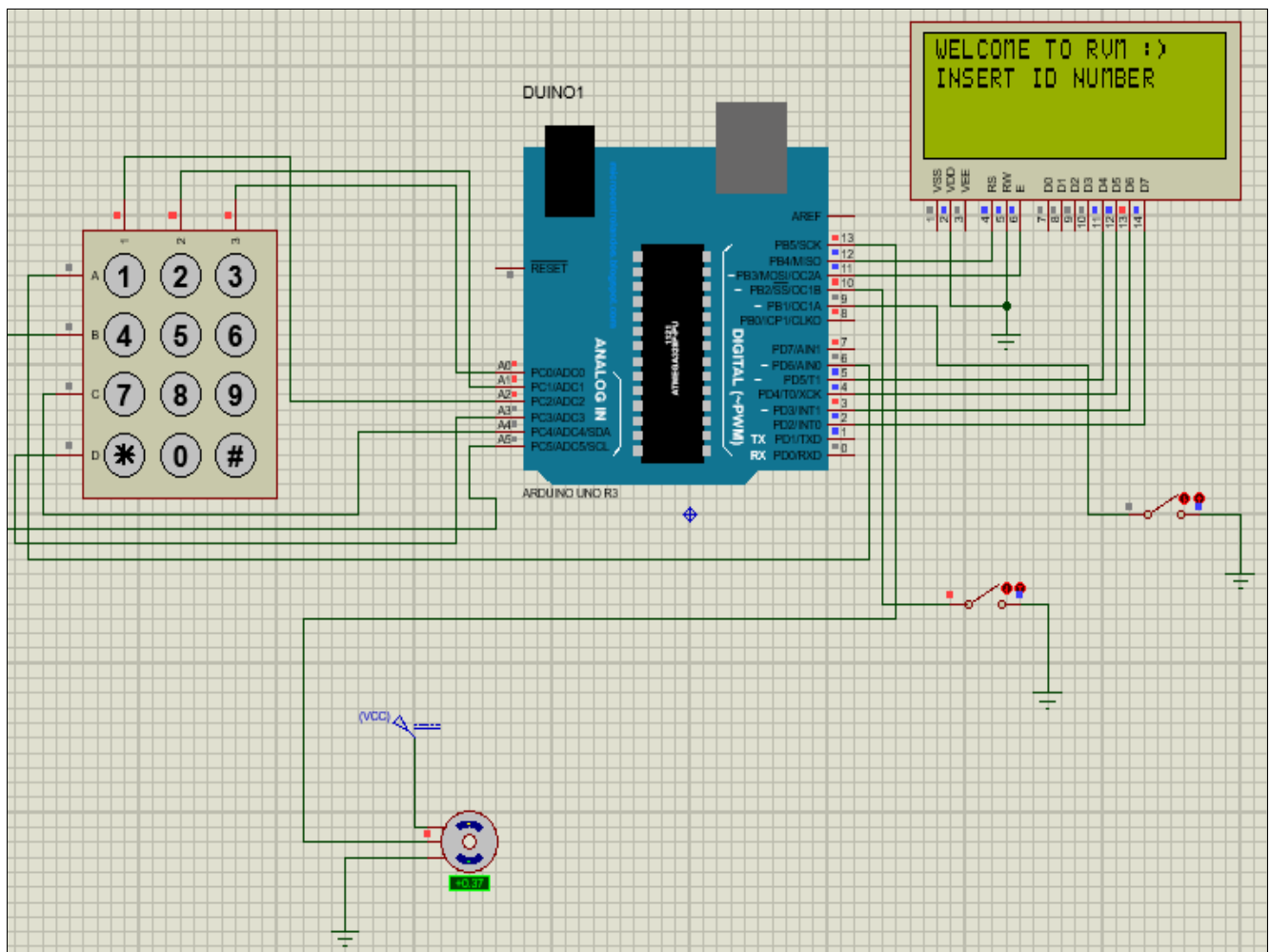
Fig 3: Arduino-based password authentication system using keypad input and LCD display.

Figure 4 shows the flowchart of the reverse vending machine. Firstly, the user needs to enter the ID Number using keypad as input, then the user needs to pressed button‖#‖, ―#‖button is used to recognised the user's name so that the LCD can display the name of the user. If the numbered is not in system, LCD will display ―Register First‖. This user needs to register to join this program. Next after the LCD display ―WELCOME _user name '‖, machine will tell the user to start to enter items by display in LCD― PLEASE INSERT ITEMS. When the use Renter the item, proximity sensor will detect whether the materialise metal or non-metal. If metal it will increase the amount of total can that display in LCD and it will send signal to servo motor to rotate 100 degrees, otherwise the servo motor will remain 0 degree. The IR sensor is used to count plastic materials. If the total of the item is more than 5 the LCD will display ―THANK YOU AND DISCOUNTWILL SEND‖ and the ES Presso Lite will get the signal from Arduino and it will send SMS to the user. If the items is less than 5 the LCD will
display ―THANK YOU‖.
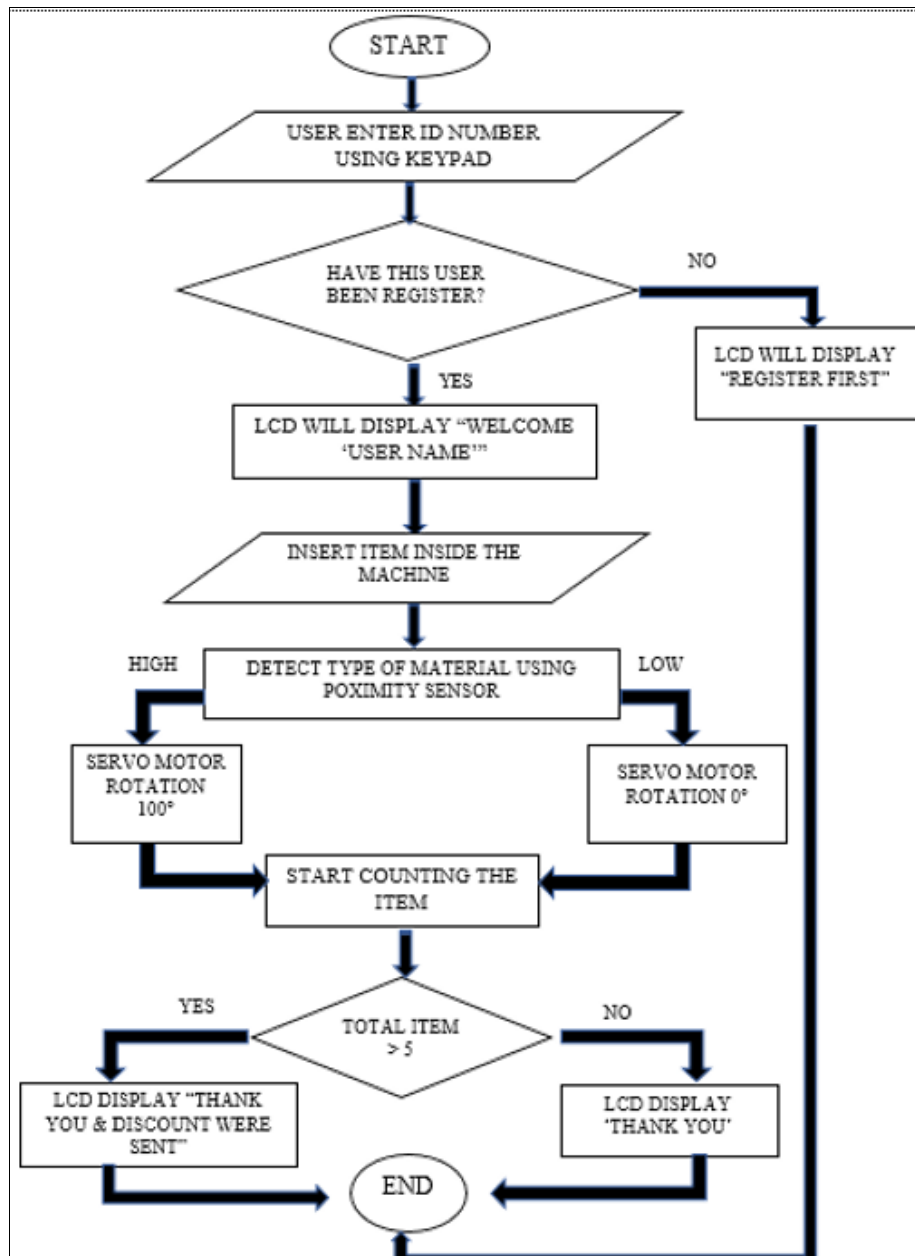
Fig 4: Flowchart for User Identification and Item Counting System Using Proximity Sensor and Servo Motor

Result and Discussion

Figure 5 (a) shows the simulation design that consist of six components, which are Arduino, keypad, LCD display, Servo motor and two switches. Switches are for replacing the Proximity sensor and IR sensor as the counter items. Espresso Lite V2.0 are not presence in the Proteus simulation design, but its presence in real hardware. In this simulation design Arduino acts as microcontroller. Keypad is function for the user to insert ID number. LCD display is for display some instruction that need to be knew by the user, for instance, greet user, instruction for the user to key in their ID number. After user key in their ID number, the LCD display will notify either the user has registered or not. If the user is not register yet, the LCD will display ―REGISTER FIRST‖ that shows in Figure 6 (c) below. When user has successfully register in the system, they need to pressed ‗*'button on keypad to execute the program. LCD will display ―Thank You, Discount were sent‖ to the user.
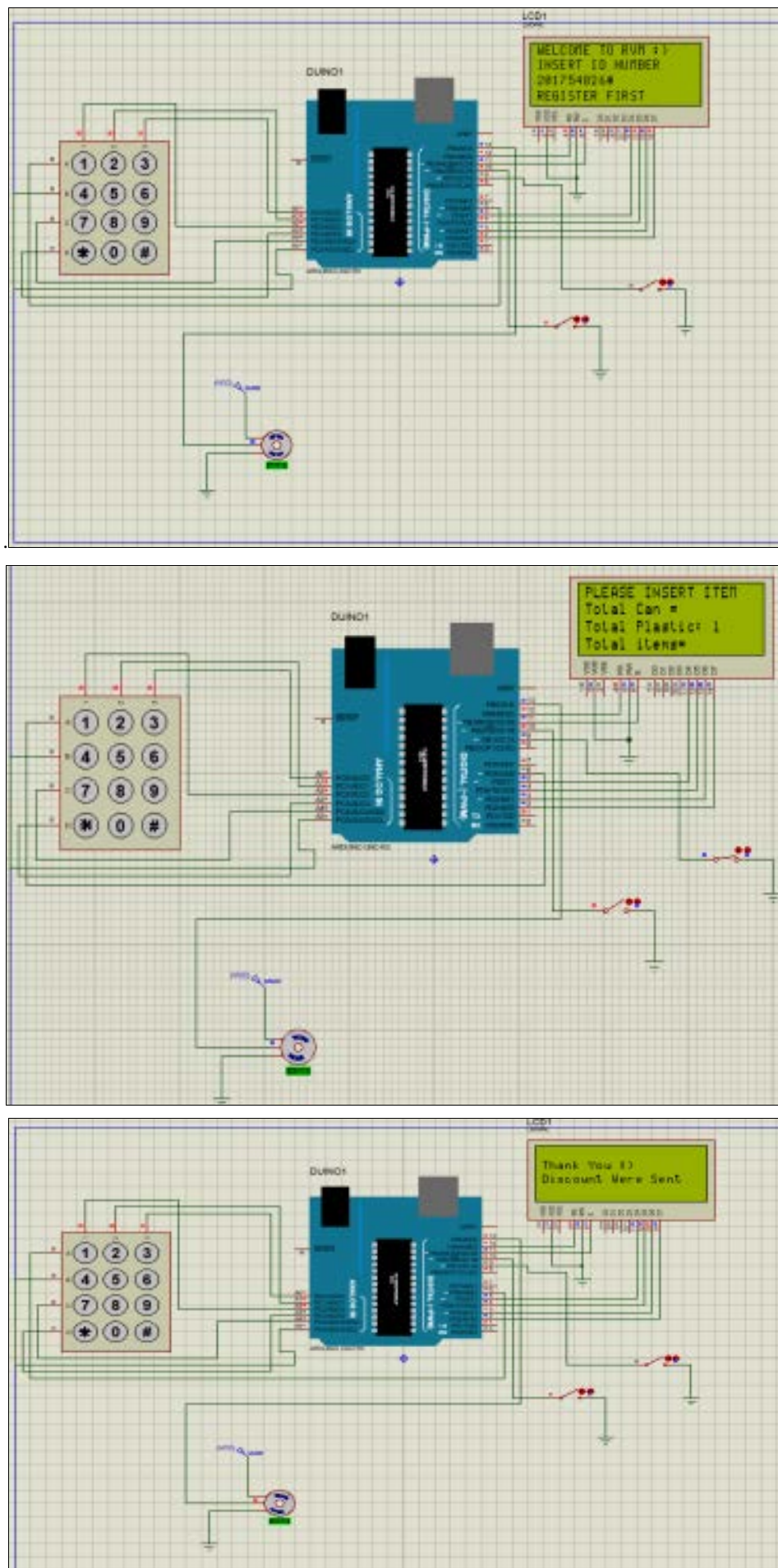
Fig 5: Arduino-Based Automated Item Registration and Counting System Simulation

Figure 5 Circuit simulations of the reverse vending machine Figure 6 show an LCD display for the operation of this reverse vending machine. It is started with the ID recognition and registration of the user. Initially, the LCD will display ―WELCOME TO RVM; INSERTID NUMBER‖. When the user enters the ID number, LCD will display the name of user by enter ―#‖ button. If the ID user is can 't be recognized, the LCD will display ―REGISTER FIRST‖ in the system. After entering the ID number, LCD will display ―PLEASE INSERT ITEM‖. Then, user need to deposits the item that he/she wanted to recycle into chute in front of the reverse vending machine. In addition, proximity sensor will detect the type of material that been insert into the machine and send the signal to the servo motor through Arduino UNO. If the inserted material is non-metal type,

servo motor will rotate 0 degree, if the item is metal type the servo motor will rotate 100 degrees. This how the item can be separated into 2 conditions. When the proximity sensor is high, LCD will display total can= 1 and it will increase as the metal can be detected. Plastic item also been counted by using IR sensor and it also be display in LCD. After all the items has been entered, user need to press ―*‖ button to execute from the program. Ifthetotalitemofcanandplasticwere5itemsandmore, the Arduino will send signal to the Espresso Lite V2.0 and notify discount message by link to the IFTTT apps to user as shown in Figure 7. The discount coupon can be redeemed at selected store. The prototype of this reverse vending machine is shown in Figure 8.

Fig 6: LCD display for (a) prompting user to enter ID number, (b) displaying registered user ID and name, (c) showing the number and type of items inserted by the user, (d) displaying appreciation and discount confirmation to the user.

Fig 7: Message notification to user

Fig 8: Reverse Vending Machine prototype

Conclusion

The convenient Reverse Vending Machines (RVM) that can be use by all people, should be implement this world which is one of approaches to manage the waste effectively. The idea that come out about this project when people need to bring the waste in bulk to, they're cycling center and in convenient recycle bins might bother and become a discouraging factor for them to recycle. The function of Espresso Lite V2.0 as Wi-Fi Module will be the last part of this project to notify user through SMS after they use the RVM.

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