UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPING RECYCLING MACHINE FOR BOTLLE PLASTIC WITH REWARD BY USING ARDUINO

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Engineering Technology (Industrial Electronic) (Hons.)

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Industrial Electronic) with Honours. The member of the supervisory is as follow:

ABSTRAK

Plastik memainkan peranan penting dalam kehidupan seharian. Plastik adalah bahan-bahan yang murah, ringan dan tahan lama yang mudah dihimpun ke pelbagai produk yang digunakan dalam pelbagai aplikasi. Bahagian plastik yang dihasilkan digunakan untuk membuat barang pembungkusan atau produk yang berpanjangan. Ketahanan polimer dibuang hujung-hayat yang plastik terkumpul sebagai serpihan di tapak pelupusan dan kebiasaan semula jadi. Tindakan yang sedia ada dalam mengurangkan impak adalah dengan mengitar semula. Pelaksanaan teknologi dan menambah pengubahsuaian ke arah mesin, projek ini keluar dengan perkembangan baru mesin yang mesin ini melibatkan sistem ganjaran. Mesin kitar semula ganjaran ini terletak dan kelihatan khusus dalam kampus FTK. Projek ini akan melibatkan dua bahagian yang sebahagian perisian dan perkakasan. Bagi bahagian perisian, pengekodan yang boleh diprogramkan dibuat bagaimana cara memaparkan nombor matriks pada skrin LCD, mengawal komponen yang terlibat dalam mesin dan mencetak ganjaran. Untuk bahagian perkakasan, mereka bentuk selongsong mesin kitar semula dan sebahagian daripada botol yang memampatkan. Selepas itu, menggabungkan keseluruhan komponen yang telah direkabentuk. Mesin ini dibangunkan untuk menyuburkan pelajar supaya lebih bertanggungjawab ke arah alam semula jadi dengan mengurangkan penggunaan botol plastik melalui kitar semula.

ABSTRACT

Plastic plays an important role in daily life. Plastic are inexpensive, lightweight and durable materials which readily mouded into various products used in wide range of application. Portion of plastic produced is used to make disposable items of packing or short-lived products. Durability of polymer is discarded end-of-life which plastics accumulated as debris in landfills and natural habits. Action currently available in reducing the impact is by recycling. Implementation of the technology and adding a modification towards the machine, this project come out with a new development of machine which this machine involved the rewards system. This reward recycling machine located and spotted specializing in FTK campus. This project will be involve of two parts which software part and hardware part. For software part, programmable coding is created on how to display the matrix number on LCD screen ,the controlling the component involved in the machine and print the reward. For hardware part, designing a casing of the recycling machine and part of compressing bottle. After that, combining entire component that had been design. This machine is develop to nourish the student to be more responsible toward the nature by reducing the usage of plastic bottle through recycling.

DEDICATION

This report is dedicated to my beloved parents who educated and supported me throughout the process of doing this project. I am also wanted to say thank u to my supervisor and my friends who have encouraged, guided and inspired me to complete this project.

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Special thanks to Allah S.W.T for His blissful and gift because giving me this ability to finish my Projek Sarjana Muda (PSM). This report is as a mark of my sincere appreciation to Universiti Teknikal Malaysia Melaka (UTeM) by giving me this opportunity further study on Bachelor's Degree in Electronics Engineering Technology (Industrial Technology) in Faculty of Engineering Technology (FTK). I would like to thank to my supervisor, Mr Tg Faisal Bin Tengku Wook for the guidance, advices, encouragement, inspiration and attention given throughout the day in development of my final year project and while writing this report entitled as Development of Recycling Machine for bottle with Reward System. With this continuous support and interest, he guided and supported me in completing this project with full commitment and dedication. My gratitude goes to my beloved family and my friends that always give courage and support me to achieve the goal of my project. Thanks to their moral support and care they had given to me up until this project done.

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LIST OF SYMBOLS AND ABBREVIATION

RVM	=	Reverse Vending Machine
LCD	=	Liquid Crystal Display
LED	=	Light Emitted Diode
FPGA	=	Field Programmable Gate Array
SBRM	=	Smart Bottle Recycle Machine
IDE	=	Integrated Development Environment
DC	=	Direct Current
NO	=	Normally Open
NC	=	Normally Closed
ICSP	=	In Circuit Serial Programming
USB	=	Universal Serial Bus
AC-DC	=	Alternate Current to Direct Current
SRAM	=	Static Random Access Memory
EPROM	=	Erasable Programmable Read-Only Memory
PWM	=	Pulse Width Modulation
LCD	=	Liquid Crystal Display
LED	=	Light Emitted Diode
FPGA	=	Field Programmable Gate Array
SBRM	=	Smart Bottle Recycle Machine
IDE	=	Integrated Development Environment
TTL	=	Transistor-Transistor Logic
UART	=	Universal Asynchronous Receiver-Transmitter

CHAPTER 1

INTRODUCTION

1.1 Background Information

Reverse vending machine (RVM) is just same as other vending machine that accepts used empty beverage container but only its additional name “reverse”, this machine gives a reward to the user such as money, shopping coupon or any other types facilities in exchange of material when given to the machine. The machines are popular in some places that have a mandatory recycling laws or container deposit legislation. Bottles paid funds into a centralized pool to be disbursed to people who are recycled the containers. Example, in Norway, the state mandated that a vendor pay for the recycled bottles but left the system to the private industry.

In 1920 century, the first patent for a Bottle Return and Handling Machine was introduced in America. In the late of 1950, the first working bottle returns machine was invented and manufactured in Sweden by Wicanders. Aage Tveitan, the owner of his company Arthur Tveitan AS was designed an advanced automatic bottle return machine and manufactured the machine in Norway. Kansmacker Mfg followed Aage Tveitan in year of 1994 and invented the first 3in 1 machine and is still in operation in Detroit Mi.

RVM is an inventiveness concept that been introduced to the countries to help in collecting a recycling materials and boost recycling activities. This machine has the ability to accept used beverage container such as beverage can, empty bottles, glasses and plastics. This machine works as an automatic container recycling by accepting the container directly from user, counting each of the containers and refunding the deposit to the user.

TOMRA is a world leader in the field of reverse vending with over 75000 installations across more than 40 markets. TOMRA machine is the best in collecting and recycling aluminium cans, glasses and plastic bottles. Proper handling of used beverage container

can preserve the energy, water and reduces the greenhouse gas emulsion. This TOMRA machines give an instant reward to the user when returning used container and also motivated the repeating raising collection rates of recycling materials. Every year TOMRA facilitate the collection of empty drinking bottles and cans up to 35 billion.

1.2 Problem Statement

According to the ministry's data, about 650, 080.34 kg of recycled waste was collected from the state that implemented the Solid Waste and Public Cleansing Act 2007 (Act 672). Kuala Lumpur recorded the highest collection rate of 172, 611.75 kg, followed by Pahang with 166,637.09 kg. Despites the number, the national recycling rate for the last year was 15 percent, 3.2 points basis point increase from 12.8 percent in 2014.

Recycling has been debated so many years endlessly now. The argument in support of recycling concerns the negative impacts of waste and emissions on our planet. Now days, the plastics bottles and supporting frames are normally used but for after using these plastics, they are disposed and normally take a lot of space and cause an increasing of the pollution. On recycles, 5% of its plastics waste even though it is one of the largest industrial cities in the country and it is growing concern about its part in the releasing the greenhouse gases from industry and the waste system. The cost emissions can be kept low simultaneously using an increased recycle rate. Hence, this can have to be recycled taking in consideration and environmental concerns. Plastic crushed can be melted and can be used to produce different kind of product but it is an extremely laborious work. So, we need a simple machine which will reduce human effects.

1.3 Project Objective

This proposed project is to the development of recycling machine for bottle with reward system. This project was developed by giving an instant reward to the user and provides receipt with user matrix number and quantity of recycled empty bottle. This machine also developed to boost recycling activities among the student. Instead, there are several objectives as follows:

1. To study a system for bottle recycling with reward.
2. To develop a machine for bottle recycling with reward.
3. To analyse the effectiveness of the system

1.4 Scope of Project

The scope of this project is to develop a prototype of recycling machine with reward system. This project focuses among the FTK UTeM society. This machine focuses on plastic material disposal among the FTK area. This project is more focus on mechanical part where the main system used is Arduino mega and it will control the whole operation of the machine. This machine involved with the capacitive proximity sensor, LCD display, DC motor, matrix keypad and thermal printer. A set of programs is installed in Arduino IDE in terms of controlling the components that involved in the machine and their function in each part of the machine. Firstly, before the system start operates, user will enter their identification number by using matrix pad and user need to confirm their identification number by pressing the OK button in matrix pad. The system continues by inserting the bottles in hole A for large bottle or hole B for small bottle by user. Once the bottle been inserted, the capacitive proximity sensor will sense the bottle and count the number of bottle. After finish insert the bottle, user need to press DONE button in matrix pad and the receipt will print out the number of bottle and matrix number of user automatically. Lastly, the DC motor will compress the bottle to minimize space of storage.

CHAPTER 2

LITERATURE REVIEW

A reverse vending machine (RVM) is a device that accepts empty or used beverage containers and return money to the user. Now a day, this machine is popular in a place where have a mandatory recycling laws. This machine is involving two basic steps where recycler places an empty bottle into the receiving aperture which allows the recycler insert the bottle at one time. Then, the bottle is rotated automatically. As the reward system, RVM distributes a token in form of coins or coupons when the bottles are recycled.

RVM is an inventiveness concept that been introduced to the countries to help in collecting a recycling materials and boost recycling activities. This machine has the ability to accept used beverage container such as beverage can, empty bottles, glasses and plastics. This machine works as an automatic container recycling by accepting the container directly from user, counting each of the containers and refunding the deposit to the user.

Current application of RVM is an electronic rewarding system where personalized smart card system issues the recycler reward points. This system also can integrate with other types of card such as student ID card.

2.1 Past Related Research

2.1.1 A Conceptual Approach of Smart Waste Management with Integrated Web Based System

(Kadir *et al.*, 2014) paper is about the smart recycle bin application based on the information store in smart card. The recycle bin will automatic calculating and converting weight into the point form and store it to the card. This system consists of RFID based system which integrated the web-based information at the host server. This machine equipped with a microcontroller, sensor and calculator module. This smart bin caters the recycling glass, paper, aluminium and plastics product. All this recycled material is classified into different colour code and different rates. This bin automatically evaluates the waste value and provide the 3R card whereby this card is used to rebate an item or cash out in bank account according to the recycled waste thrown into the smart bin. Every recycle bin has an automated door and a sensor that detach on the bin. Automated door functioning as receiving one or more disposal object through into it and detach sensor is to sense the types of disposal object. The target device that installed at the recycle bin has a reader which it will send information to the reader. The microcontroller regulates the recycle bin by establish a communication between the door, sensor and reader. A calculator module will determine how amount of point collected by user and display on online platform where the point can redeem for products or services. Reward-based recycle system spread widely developing a motivation of the community to support clean city campaign (T. K. Leong, 2011) and now Malaysia really concern in providing a systematic technique in waste management of this country (Zamali Tarmudi, Mohd Lazim Abdullah and Abu Osman Md Tap, Dis 2009).

Figure 2.1: Prototype of a Smart Recycle Bin

Table 2.1: Recycling rate

Material	Rate
Aluminium can	RM 3 per kg
Paper	RM0.23 per kg
Plastic	RM 0.4 per kg
Glass	RM 0.16 per kg

2.1.2 Smart Recycle and Reward Bin

(T.K.Leong, 2011) aims to develop a solar power prototype for Reverse Vending Machine. This smart recycles and reward bin includes the features of integration between the microcontroller, sensors, stored value/ point card, programming and mechanical mechanism. This machine is powered by a solar energy and which is capable in auto recognition of container material in order to separate it in consequence. This machine is use a smart card as a reward system to overcome the difficulty occurred by the manual reward redemption as to save on the paper usage. The working of recognition and automatic separation recycled items when the sensor integrates with the microcontroller and mechanism. The system starts when the sensor sense and differentiates the recycled material then all information will send to the microcontroller, thus the separation part will start their work. The separation is work by mechanism using a servo motor. The separation part involves 3 servo motors, 4 holes for reject item and three types of container which is glass, plastic and tin. The

microcontroller also works as an auto summation and storing a total reward points into smart card. This machine also consists a LCD which to display the type of material and reward point to the user. The overall machine is operated by using electricity from a battery and the battery is charged by a solar panel using solar energy. The utilization of solar energy consists of solar panel, solar charge controller and battery.

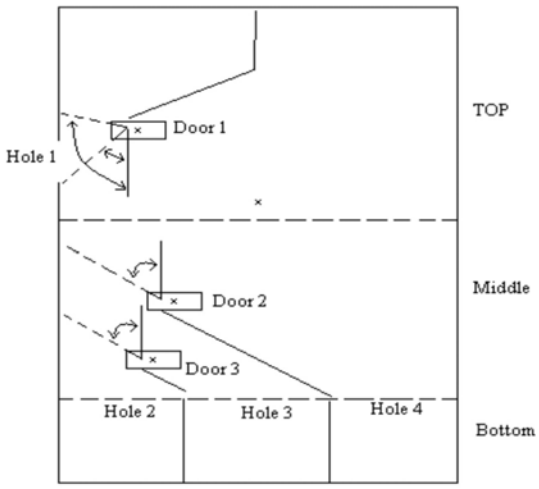

Figure 2.2: Drafting of the Casing for Smart Recycle and Reward Bin

2.1.3 Gamification of a Recycle Bin Emoticons

(Berengueres *et al.*, 2013) introduced an emoticon bin which is a recycle bin giving a smile and sounds as a reward to the users. In this project, they scope in consumption of plastics bottles which is in the third highest rank in the world where about 750 million bottles per year but only 10% to 12 % of plastics bottles being recycled in 2011 (Abu Dhabi Environment Agency, 2010). The PET bottles that not being recycled will damage the environment when it goes to landfills. This project also motivates to recycle and increase the recycling rates. This emoticon bin consists of LCD screen, proximity sensor and speakers. The system starts when a user drops the PET bottles, the sensor sense and a coin sound is played. In the same time, the LCD screen that displays a poker face will change into a smile figures during one second. The ultrasonic sensor is used in this machine as a non-moving part bottles detector.

Recycle Stage	Pre consumed	Post consumed	After hot wash
Value of PET plastic	100% *€ 0.031*	50% *€ 0.015*	87% *€ 0.026*

Figure 2.3: Value of PET bottles

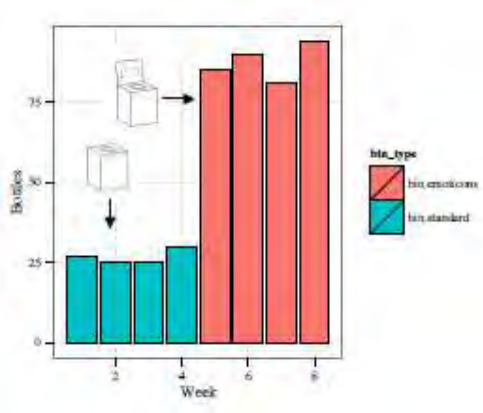

Figure 2.4: Comparison recycling rates between standard bin emoticon bin

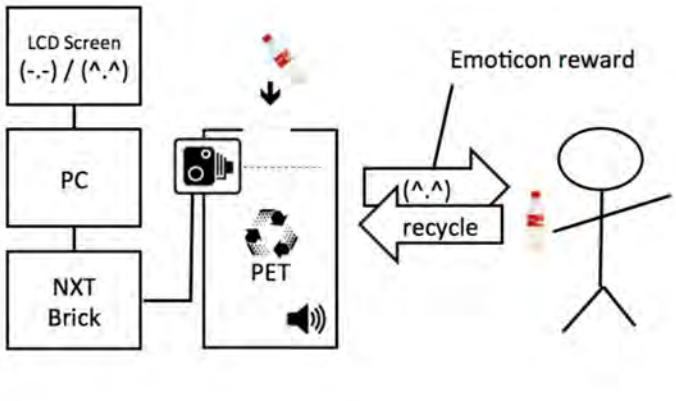

Figure 2.5: System of Emoticon Bin

Figure 2.6: An Actual of Emoticon Bin

2.1.4 Hardware Based Design and Implementation of a Bottle Recycling Machine using FPGA (Field Programmable Gate Array)

(Karin, 2016) represented the design of Smart Bottle Recycle Machine (SBRM) where this designed on a Field Programmable Gate Array (FGPA). This designed involve an ultrasonic sensor which is used to calculate the number of bottles and differentiate them. This SBRM prototype is designed with reward system where the user enables to obtain the reward points through the plastic bottle recycle. The implementation of FGPA based on hardware is faster than the software implementation on microcontroller. This purpose of this SBRM is to boost the recycling and provide attraction to the user. The attraction can be cash, reward points, shopping coupon, any type of facilities such as bus ticket, train ticket or donate to charity to the user. This RVM is allows the user to recycle the plastics bottles. Bottle is detected by a sensor and RVM gave out such as coins and snacks as an output (S. Sharma and A. Monga, 2014). The sensor that used in this project is an ultrasonic sensor which is to recognize different bottle sizes based on the calculated cash reward. This system is consisting of FPGA which is used in designing the whole system operation. For detecting and differentiating the input to the system, this prototype is used HC-SR04 and ultrasonic sensor. The system starts when HC-SR04 ultrasonic sensor is detect and differentiate the bottles. A signal from the sensor will send to the

FGPGA board and then runs the operation. The reward points will display on the LCD while the height of the bottles will display on 7-segment. This project design has two push buttons which one push button is used when each of the bottles is placed into the machine and the other push button is for DONE button where when all the bottles are placed into the machine. The final recycling value for the user receives will display on the LCD that mounted on the design. In the middle of the design, there is one hole for placing the bottles and at the top of the design the HC-SR04 sensor is mounted. When the sensor detects the bottles, they will fall through the hole.

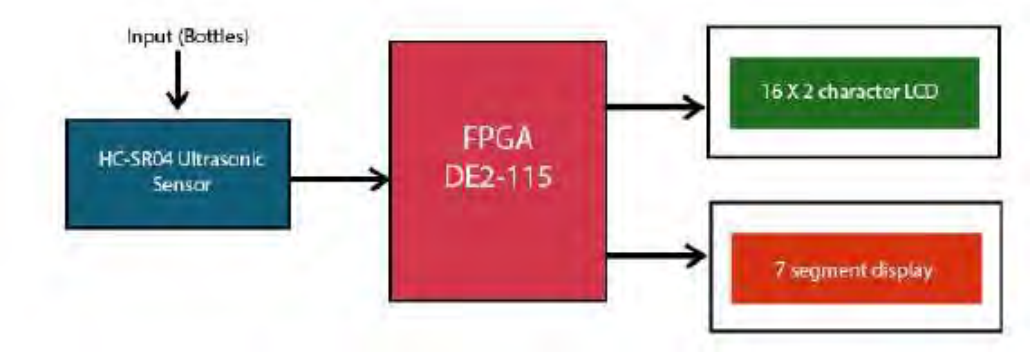

Figure 2.7: Architecture of a System

Figure 2.8: Illustration of Smart Bottle Recycling