AUTOMATED RICE VENDING MACHINE

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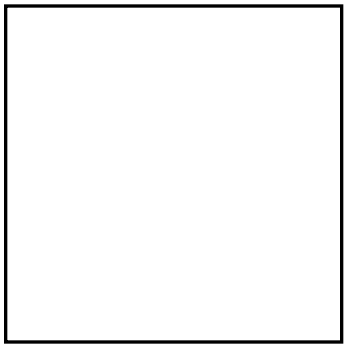
BIOGRAPHICAL SKETCH



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Southern Luzon State University	2015-2020	None

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SLSU's Integrated Computer Engineering Society
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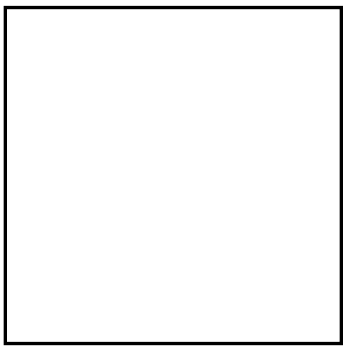
BIOGRAPHICAL SKETCH



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Southern Luzon State University	2015-2020	None

Academic Affiliations:

SLSU's Integrated Computer Engineering Society
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SLSU's Society of Computer Engineering Students
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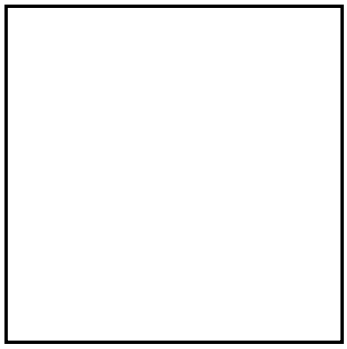
2019

BIOGRAPHICAL SKETCH



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School/University	Inclusive Years	Honor/Award
Plaridel Central School	2005-2011	With Honor
Plaridel Memorial School	2011-2015	Valedictorian
Southern Luzon State University	2015-2019	None

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SLSU's Integrated Computer Engineering Society
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Chapter I

INTRODUCTION

Rice is one among the foremost important human food crop within the world. It can directly feed more people than any other crop. Way back in 2012, nearly half world's population specifically quite 3 billion people relied on rice on a daily basis. Rice is additionally the staple food across Asia where around half the world's poorest people live and is becoming increasingly important in Africa and geographic area. It has also fed more people over a extended time than has the other crop. It is spectacularly diverse in both way it is grown and the way it is utilized by humans. The rice is exclusive because it can grow in wet environments that other crops cannot survive in, those wet environments are abundant across Asia. Domestication of rice ranks together of the foremost important developments in history and now thousands of rice varieties are cultivated on every continent except Antarctica.

Rice is that the most extensively grown crop within the Philippines, it is planted in about 30% of the full agricultural area harvested. Rice farming is the source of over half the household income for two million families. Additionally, lots of landless farm workers, and tens of thousands of merchants indirectly rely on rice for a living. Given the burden of rice's social and economic ramifications, rice has always been the principal focus of the government's food security policies. The Philippine rice production tripled from 5 million tons in 1970 to quite 16 million tons in 2008, with only a 44% increase within the area harvested.

Sometimes rice shortage could be a big issue for the Philippines because it is a staple food. Filipinos cannot last a full day without eating rice unlike Westerners preferring to consume bread or cereals. Rice is taken into account the nation's most vital food crop. The low supply in rice can be the culprit for the continuously increasing price of this commodity. We've got learned in class that if the provision of a product is low, then its demand will increase, increasing additionaly its price (Apun, Bidaswa, & Kirikkanat, 2014).

Due to rice shortage, long rice queues formed in Nueva Ecija province after the National Food Authority (NFA) in Central Luzon ordered its warehouses within the region to stay open on Saturdays. Radio dzRH, a station within the Philippines, reported that in Nueva Ecija, market goers quickly patiently lined up at the Cabanatuan City public market to shop for their staple food. Rice dealers said they were forced to sell rice at a maximum of three kilos rather than the government-approved five kilos, saying they could run out of supplies too quickly. The same report said that the NFA, which sells rice at less than market prices, instructed its warehouses to stay open from 8 a.m. to 5 p.m. during Saturdays, just to accommodate the buyers.

To lessen the long queue and to make rice available anytime, the concept of a vending machine was applied. Vending machine are the most effective technology to innovate for selling rice. Since rice could be a staple food for each Filipinos this problem should be cured for the consumers to possess a simple life. This research study aims to assist people have an easy access to their most important food crop.

Background of the Study

The staple food for about 80% of Filipinos is rice, which accounts for 46% and 35% of their caloric intake and protein consumption, respectively. Rice is that the single most significant agricultural crop within the Philippines (Bordey, 2010). Due to the importance of rice the researchers took an interest in seeking the best way of selling it.

Based on the experience and observation of the researchers, the availability of rice is not 24 hours, it becomes inconvenient for the people who work and come home late. There is an instance that rice is needed at midnight but it is not available because stores are closed. The researchers also experienced disordered queue when buying rice and it takes time before they get to shop fo. They also experienced receiving inexact amount weight of rice because there are vendors that manipulates the weighing scale that is being use to weigh the rice.

To aid these problem the researchers come up to the thought of making an "Automated Rice Vending Machine". This machine can operate anytime, anywhere and might offer the product conveniently. The idea came up because Philippines is now facing modern technologies and innovations, efforts are continuously made to use digital technology in rice production.

Objectives of the Study

The main objective of this study is to sell rice using an automated rice vending machine to reduce the operating cost of the rice stores owner. Specifically it sought:

1. To determine the different factors to be considered to supply the accurate weight of rice.
2. To design the machine in order to work in conjunction with the bill acceptor and user interface.
3. To create a Graphical User Interface and source code for the main function of the machine.
4. To evaluate the accuracy of the machine in terms of dispensing the rice.

Significance of the Study

This research study aims to provide more knowledge on how make a design and code of an "Automated Rice Vending Machine" that will be beneficial to different people.

To the **consumers**, this study will help them to have an easy and convenient access to rice. The machine will give them the exact amount of rice they purchased.

To the **rice stores owner**, this study will give them an efficient way to sell rice. The machine will reduce their work because all they have to do is to refill the rice if empty and change the amount rice if needed.

To the **students, engineers, and innovators**, this research can be used to their study that is related to this. This will serve as their reference.

To the **researchers**, this study will give more knowledge and will fulfil the requirements of Methods of Research.

Scope and Limitation

The scope of this study is to make a rice vending machine for the people who buy rice in retail. This machine can accept bill as the buyer's payment and it dispense the equivalent amount of rice corresponding to the money inserted. It can operate anytime when there is available rice inside the machine. The machine includes a monitor which displays the price, the weight and type of available rice. The owner can change the price of the rice and it automatically calculates its equivalent amount of rice in the display monitor. This machine also provides a log where the time and amount purchase as well as its corresponding weight and type of rice can be seen by the owner.

This vending machine has limited maximum weight of rice to be purchased. When the machine is lacking of rice the refilling is done manually by the owner. The container of the purchased rice is not included in the machine. The amount of money to be inserted is also limited, the maximum bill to be inserted is 20, 50, and 100 pesos only. Receipt for every transaction is not included in the machine.

Definition of Terms

To have a clearer understanding of this research, the following terms are operationally defined:

Automated is operated by an automation. For a process to be automated it should be controlled or driven by a machine.

Bill is the Philippine Peso bill that will be used as the buyer's payment.

Bill acceptor a slot where bills can be inserted into machine as the buyer's payment.

Graphical User Interface (GUI) is an interface where the owner and customer can interact with the vending machine.

Monitor is a touch screen device where the price, weight, and type of the available rice are displayed. This is where the owner of the machine change the price and its corresponding weight as well as the type of rice.

Microcontroller is a single integrated circuit that is just like a small computer that contains memory, processor core and input/output peripherals.

Rice is the product to be sold using a vending machine. It will be the variable that will be weigh and dispense accurately.

Vending Machine is a machine that has a bill or coin acceptor. It can sell a wide variety of products.

Weight sensor is a device used to weigh the accurate amount of rice to be dispensed

CHAPTER II

REVIEW OF RELATED LITERATURES AND STUDIES

This chapter presents the review of related literature and studies that have important bearing on the study being conducted. This part of the study are gathered by the researchers to support the design project and were used as a basis and guide in pursuing this study. The information were obtained from books, from encyclopedias, and from different websites.

Related Literatures

Foreign Literatures

BV20 Bill Acceptor

All bill acceptors have one basic purpose – to simply accept and validate paper money in exchange for a product or service. The patron inserts the bill into a slot (typically called the bezel). The bill acceptor "grabs" the bill, scans it for validity, and sends a corresponding I/O signal to its output connector to record the transaction. All of this takes place in 2-3 seconds. After the bill is validated, it is stacked in a bill cassette or cashbox for straightforward removal by the retailer or kiosk operator.

This bill acceptor accepts Philippine bills (Php20, Php50, Php100, Php200, and Php500). It is lighted arrows on bezel and bill entry area. It has high security against fraudulent bills and dual-stage optical anti-stringing. The high acceptance rate is 95% or

greater. It has speed that is approximately 20 bills per minute. It has pushbutton/LED on-board diagnostics

https://www.kioskmarketplace.com/news/mei-3-frequently-asked-questions-about-bill-acceptors/

Arduino Mega 2560

Arduino Mega 2560 is a microcontroller board supported the ATmega2560. It has a 54 digital input/output pins (of which 15 may be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz oscillator, a USB connection, a power jack, an ICSP header, and a push. It contains everything needed to support the microcontroller; simply connect in to a computer with a USB cable or power it with a AC to DC adapter or battery to start. The Mega 2560 board is compatible with most shields designed for the Uno and also the former boards Duemilanove or Diecimila.

Raspberry Pi

Raspberry Pi 3 Model B is a tiny master card size computer. It just add a keyboard, mouse, display, power supply, micro SD card with installed Linux Distribution and you'll have a fully-fledged computer that can may applications from word processors and spreadsheets to games.

Thonny Programming IDE

It is an integrated development environment (IDE) facilitates computer programmers by integrating fundamental tools (e.g., code editor, compiler, and debugger) into a single software package. Users don't must install the language's compiler/interpreter on their machines; an IDE provides the environment itself. It is free and dedicated IDE for Python designed for beginners.

https://www.educative.io/edpresso/what-is-thonny

Python

Python started as a scripting language for Linux like Perl but less cryptic. Now it's used for both web and desktop applications and is out there on Windows too. Desktop GUI APIs like GTK have their Python implementations and Python based web frameworks like Django are preferred by many over PHP et al. for web applications. (Amarghosh, 2010).

Weight Sensor

Weight Sensor sometimes called a load cell or strain gage can translate up to 20KG of pressure (force) into an electrical signal. Load cells are designed to measure a particular force, and ignore other forces being applied. The electrical signal output by the load cell is incredibly small and requires a load cell amplifier like a HX711 load cell amplifier, or Sparkfun Openscale.

Each weight senor is formed from an aluminium-alloy and is capable of reading a capacity of 20KG and designed to measure force in one direction. They will often measure force in other directions, but the sensor sensitivity are going to be different, since parts of the load cell operating under compression are now in tension, and contawise.

https://www.makerlab-electronics.com/product/20kg-weight-sensor/

Graphical User Interface

It is a visible operating display presents in touchscreen technology. With the assistance of programming languages, GUI can be constructed of various coding methods, and every method will contain commands and statements to perform operations required. It solves blank screen problem for every touchscreen technology which was confronted by the users in early engineering (Norman, 1988).

A direct implement, debug and modify. And, as these interfaces become easier to form, they become harder to create (Myers, 1994).

In regard to personality's being, their mind is that the source of action where it is the one to blame for processing information accurately. The program may be called the mind of the personal computer, where it provides GUI for electronic devices, without it electronic devices are nothing.

For instance, GUI, a computer program that allows an individual to communicate with a computer through the use of symbols, visual metaphors, and pointing devices. Best known for its implementation in Apple Inc.'s Macintosh and Microsoft Corporation's Windows operating system, GUI has replaced the arcane and difficult textual interfaces

of earlier computing with a comparatively intuitive system that has made the operation not only easier to find out, but it is more pleasant and natural. The GUI is now the standard computer interface, and its components have themselves become unmistakable cultural artifacts (Levy, 2013).

In creating GUI green is a versatile color. It is warm and alluring, lending customers a satisfying feeling. Second, it denotes health, environment and goodwill. Finally, green is the color of cash, so it creates thoughts of wealth. (Morris, 2013). Meanwhile, the foremost readable font family in the screen is San Serif according to Jacob Palme. Also in creating GUI it must be simple and avoid unnecessary elements.

Automatic Selling

According to Mary McMahon, automatic selling is the sale of products through a vending machine, where consumers interact directly with the machine to access products immediately, without a clerk or ordering process as an intermediary. Merchandisers can install vending machines across a large area to include coverage, without substantially increasing bottom line, as seen with opening new stores, which needs substantially more resources. Vending companies often offer franchise operations, where business owners can purchase a franchise and also the company provides the machines and products, while the business owner handles on-the-ground operations.

The types of products available through automatic selling can vary and are sometimes restricted by law. Some examples can include snacks, electronics, tending items, and things like spare underwear or shoes. Automatic selling usually relies on high traffic or a captive audience at locations like airports, train stations, and clubs. Items

within the machine could also be priced higher than they would be in other areas of the market, with consumers paying a premium for convenience.

Some facilities may maintain a vending contract with one operator who is allowed to put and maintain machines for the good things about customers. The automated selling agreement may provide exclusive rights, that the facility cannot work with other merchandisers. The vendor pays a fee to be use of the facilities, which can be flat or based on sales, counting on the terms of the agreement. Contracts may include stipulations on vending machine placement, the kinds of items within the machine, and machine maintenance.

http://www.wisegeek.net/what-is-automatic-selling.htm

Vending Machine

Vending machine**s** which are nothing but genies in today's world, have added to our convenience. With a variety of products offered by these tempting titans, one does not have to worry about time of the day for shopping. By visiting ancient Greece time, one can find the earliest vending machine that was founded in Egyptian temples for dispensing water in reciprocally of coins. This was a masterpiece by Hero of Alexandria, a Greek mathematician and engineer. Though the machine was born in 215 B.C, 1880s was the time when it made debut within the commercial world. Earliest of those machines were used for dispensing the post cards in London. And through the time, publisher as well bookshop owner named Richard Carlisle came up with a vending machine that might dispense the books.

During the early 1880s, the primary commercial coin-operated vending machines were introduced in London, England. Invented in 1883 by Percival Everitt, the machines were found at railway stations and post offices, as they were a convenient way to purchase envelopes, postcards, and notepaper. And in 1887, the primary vending machine servicer, the Sweetmeat Automatic Delivery Company, was founded. A coming trend is the advent of smart vending machines that provide things like cashless payment; face, eye, or fingerprint recognition, and social media connectivity. It is likely that the vending machines of the longer term will recognize your identity and tailor their offerings to your interests and tastes.

Dispensing of Product in Vending Machine

Many vending machines are equipped with metal spirals to carry products in place. Of course, those spirals are easy to watch if you're peering through a machine with a glass front. The metal spirals that hold products in place are controlled by a motor, which turns the coils once the main computer has determined you've put within the right amount of cash and your selection has been entered. This enables for your product to drop to the underside where you can finally retrieve it. At the underside of the vending machine, a line of laser beams determines if your product has been released by the metal spirals. Each beam of light is paired with an electronic light sensor. When your product falls it breaks this path, telling the personal computer that it absolutely was a successful transaction.

https://electronics.howstuffworks.com/gadgets/other-gadgets/vending-machine-pictures.htm

Local Literatures

Philippine Peso Coins and Bill

Each Philippine peso bill has different front and back description. The front of the bill shows different person, Manuel L. Quezon for twenty peso bill, Sergio Osmeña for fifty peso bill, and Manuel Roxas for one hundred peso bill while the back side of the bill shows different wonders and different animals in the Philippines. All the bills have the same size, which is assumed to be 160mm by 66mm, but they differ in color, orange for twenty peso bill, red for fifty peso bill, and mauve for one hundred peso bill.
http://www.philippinecountry.com/philippine_money/new_philippine_currency.html

Coffee Vending Machine

A coffee vending machine is a type of vending machine that dispenses hot coffee. Some of the machines, particularly older models, utilize powdered instant coffee mixed with hot water, and some of these offer condiments such as cream and sugar. Some newer models fresh-brew the coffee using hot water and ground coffee beans, and some also grind the coffee to order using coffee grinders installed in the machines, as well as providing various condiments. Some modern machines also provide other hot drinks such as tea, espresso, lattes, cappuccinos, mochas and hot chocolate. Some of the machines dispense canned coffee, and some dispense both hot coffee and iced coffee.

Public coffee vending machines typically require payment, functioning as coin-operated machines, and some also accept bills and credit cards. Some do not require payment; these are typically found at places of employment, whereby the company furnishes the beverage to employees free of charge.

Machines that purvey hot and iced coffee are common in Japan, and many of them are placed in street locations. In Italy, some of the machines purvey up to 18 coffee varieties.

https://baristachoi.com/coffee-vending-machine-business

Related Studies

Foreign Study

The study includes foreign thesis and invention which has significance to the study.

Automatic Paper Vending Machine

This foreign study was conducted by a Mechanical Engineering Students of IFET College of Engineering at Villupuram, Tamilnadu, India, Irshath.

The usage of paper is inevitable and its demand is increasing steadily particularly within the places like educational institutions, government offices, etc. At the same time, time could be a precious thing that one does not want to waste in any way. In stationary shops it is quite difficult to shop for papers during rush fundamental measure and also the counting of the paper depending on the requirement would cause further time delay and

there is an opportunity for the error within the manual counting of paper. To avoid these problems, this project titled “Automatic Paper Vending Machine” is proposed to deliver the paper to the general public by using the sensors and microcontrollers based on the Mechatronics principles. It will be more cheap and economic for majority production and it will be very useful for the school and faculty students. Here it is designed to deliver sheets by inputting the respective coin within the system. It will help us to save lots of time and manual work are going to be nullified.

Local Studies

The study includes local theses and inventions which has significance to the study.

Pencil Vending Machine

A research entitled “Pencil Vending Machine” was presented at Southern Luzon State University by Electronics and Communication Engineering students. This study came up based on the experience of the researchers that they felt the need of a machine that will give them an easy access to school supplies because there are times that engineering students have activities regarding their subject course and they didn’t bring any materials.

Automated Rice Vending Machine

This technical study deals with the design and assembly of "Automated rice Vending Machine" to avail the basic needs of the people. Proper circuit design was made and studied in this research in order to identify the appropriate circuit to be used in the design and construction. This prototype constructed out of fiber glass supported by aluminium brace, censored weighing scale and several motors connected to the relay. This machine vend rice with a maximum of two (2) kilograms. When coins are inserted, relays are activated then the motor will run. Continuously, rice will pour into the weighing scale and will stop flowing if the appropriate weight is achieved, then the gate opened and the collected rice is dispensed to the compartment. They found out that the proper positioning of the sensors on weighing scale is important because it will give the right measure of rice. This technical study has the advantages of selling rice because there is a back-up battery installed in case of the power interruption.

Prototype of Coin-Operated Prepaid Sim Card Loading Machine

"Coin-Operated Prepaid Sim Card Loading Machine" utilizes the purpose of GSM module and Microcontroller Unit (MCU), reducing the monotonous and error-prone manual loading system. It caters the need of the prepaid subscribers of three giant network provides especially during emergency occurrences. This machine is coin-operated and it uses P1, P5, and P10 coin denominations. It can determine if the inserted coin is not the desired amount.

The problem of the study arise when one of the researcher had an instance that she was trapped in a heavy traffic on her way home and failed to find a reloading station. This study aims to develop a coin-operated machine that will serve the need of prepaid users by sending electronic load that is capable of dispensing change for the inserted denomination. This study uses keypad, coin acceptor, MCU, LCD, changer, and GSM mobile. The coin selector determines whether the inserted denomination matches the sample. The inserted coins are counted by the MCU.

This study foresees particularly in the future for commercial applications that would open big opportunity for entrepreneurs while having other modifications such as considering the use of bill acceptors for bigger denominations and touch screen for more sophisticated effect.

Electronic Load Vending Machine

This technical project was presented by the students in Electronics and Communication Engineering at SLSU. It is an "Electronic Load Vending Machine" which is coin operated and capable of sending electronic load for SMART e-load denominations such as P15, P30, P60, P115, All Text, TnT Gaantext, Upsize and All Calls. This machine is capable of accepting authenticated coins for P1, P5, and P10 as a payment for each transactions. This machine is an automation of the existing electronic loading system in the country. The hardware design take account of different procedures done in the assembly of the prototype. They found out that the necessary materials in this study was power supply, keypad, LCD, microcontroller unit, and GSM module. Also, they found out that the C programming language is the suitable program for the PIC

microcontroller. To be able to design and fabricate this technical project, necessary data gathering, circuit design and its assembly are needed. It is also important to test the operation and performance of the machine for its reliability.

Automated Electronics Dispensing Machine

The College of Engineering, Architecture, and Technology (CEAT) students usually includes a slow dispensation of electronic components that causes negative effects basically on the students' maximum time of executing the laboratory experiments due to the factors affecting the borrowing of the electronic components like collecting the group members' laboratory IDs, getting the borrower's slip form, filling it out, getting it signed by the teacher and queuing within the dispensing room.

The Automated Electronic Component Machine is a microcontroller-based dispensing machine of electronic components for Electronics 1 and 2, and Logic Circuits, subjects in CEAT. The researchers focused on three subjects, three experiments per subject and eight groups per experiment only.

The prototype must have a system unit to contol. There are several steps to dispense such experiment assuming the user is a valud student of such subject then the user can then dispense the chosen experiment number, the admin account on the opposite hand are on top of things for the inventory. The programs are created to integrate with the system to function. Lastly, to check the system for effectiveness.

The students experienced a convenient and innovative system of dispensing electronic components compared to the normal manual borrowing of electronic

components. The researchers focused on three subjects that sometimes uses electronic components only.

Automated Paper Vending Machine in the College of Engineering

This study was conducted by Noly O. Navarro, Jesuzette M. Rea, and Jyndra Mae V. Salvatierra, students from Electrical Engineering at SLSU. This study is based on the experience of the College of Engineering students, bond paper is in demand during quizzes and examinations. For some reasons it took them a long time to be able to purchase a bond paper. This technical study used experimental method of research to conceptualize the design project. The researchers of this study used stopwatch, counter, and multi-tester to determine the different variable needed in the computation and analysis of the performance of the machine.

Automated Paper Vending Machine is a coin-operated machine that can accept coins such as P1 and P5 as a payment for each transaction. It can vend two pieces of long or short bond papers as an equivalent for P1 coin. The researches of this study conducted different testing for P1, P5 and its combination to prove that the prototype is functioning properly, effective, and reliable. Through proper evaluation and testing, actual, operation concludes to the effectiveness, reliability and efficiency of the machine.

Wireless Internet Access Vending Machine

This study aims to improve one of the most common form of internet access nowadays, the Wi-Fi Vending Machine. With the existing Wi-Fi Vending machine, the use of thermal printer is needed in every transaction because it prints out the username and password for every transaction. The monthly expenses of this vending machine are great due to the replacement of thermal paper and its great power consumption. The transaction is also limited to one coin at a time service. When a client drops a coin, it will already print out the receipt for the transaction making it harder to manage the time of usage. These problems can be solved by eliminating unnecessary devices and improving the system itself. The researchers used a microprocessor, the Raspberry Pi, as the main processor of the system. The main processor was used as the access point of the system. It handled all the process and data coming from the coin slot, LCD, and Wi-Fi dongle. In order to eliminate the usage of thermal printer, it will be replaced by an LCD screen. All the display for the transaction will be shown in the LCD. The increment of amount of coin is also allowed in order for the client to manage his time of usage efficiently. With this study the researchers are able to understand the uses of a microprocessor in terms of creating an access point. The researchers have acquired the necessary data by testing the system to the CEAT students and by creating a comparative cost analysis. The system was tested for its effectiveness, accuracy, and speed for every different number of simultaneous users. Therefore the system provides the expected results which are to produce a cheaper and efficient Wi-Fi vending machine and as proven by the panelist and students who tested the improved Wi-Fi vending Machine.

With all these researches, it was observed that a vending machine was used to offer different products. The concepts gathered are brought together by the

researchers to come up with a more functional and advance version of the vending machine.

Conceptual Framework

Conceptual framework represents the researchers' synthesis of literature on the way to explain a phenomenon. It maps out the actions required within the course of the study given his previous knowledge of other researchers' point of view and also the observations on the topic of research. It is the researchers' understanding of how the actual variables in the study connect with each other. Thus, it identifies the variables required in the research investigation. It serves as a map in pursuing the research.

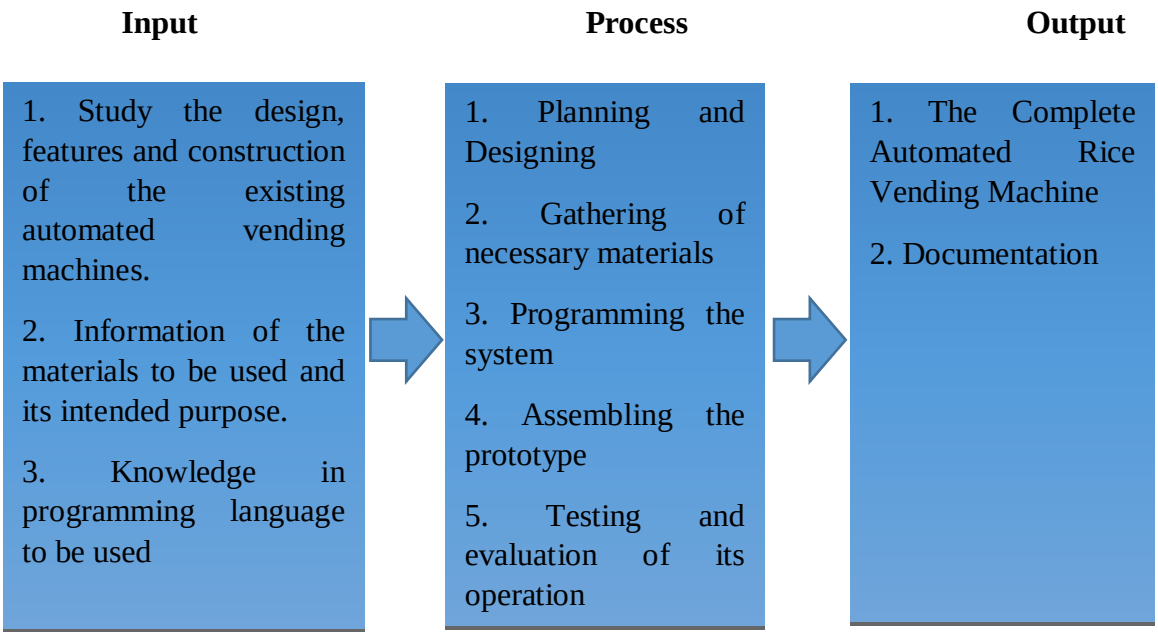


Figure 1. Conceptual Framework

This conceptual framework, serves as the steps on how the researchers will do the research. It composed of three steps: Input, Process and Output. Input serves as the initial steps for conducting the research on. It includes the design and features of the previous Automated Rice Vending Machine that will be the basis of the said improvised machine. Information of the materials needed as well as the purpose of each in the machine and how it works. It also includes knowledge of the researchers in the programming language to be used. Process is the stage where the inputs are taken into action. Planning and designing are the first step in this stage. Then gathering of the needed materials followed by programming the system and assembling the prototype. Finally, testing and evaluation will be done in this stage. The actual Automated Rice Vending Machine as well as its documentation serves as the Output.

Chapter III

METHODOLOGY

This chapter presents the procedure and methods used in order to come up to with a design of an "Automated Rice Vending Machine". Presented here are the research locale that discuss where to conduct this study, unit of analysis/respondents/treatments that discuss who will be the participants of this study, research design that discuss what type of research method will be used, research instrument that discuss where the data will be gathered, and procedures that discuss how this research will be conducted.

Research Locale

The town of Lucban, Quezon specifically those stores that sells rice is the perfect location to conduct the study of an "Automated Rice Vending Machine". Lucban, Quezon was chosen because it is a municipality that is rich in agricultural resources and has a wide rice platform, with that being said there are many stores that sells rice. There are also many residents living there who often buy rice in retail. Convenience to the researchers was also a factor that has been considered to choose the designated place.

Respondents

Selected people living in Lucban, Quezon will be the respondents of this study specifically the rice consumers and vendors in selected locale. The consumers will serve as the evaluator to see if the vending machine is convenient and accurate. The vendors on

the other hand, will evaluate the design and interface of the machine. Questionnaires will be given to the respondents.

Research Design

This study will be conceptualized with the use of experimental method of research. Experimental research is a type of research where the variables are tested while maintaining the other set of variables. This study is experimental because it involves the variable to be test which is the automated selling of rice while the variable to be maintained is the traditional selling of rice. The traditional selling of rice was done manually which require a vendor while an automated vending machine does not require one. These two variables will be compared in terms of their speed.

Before constructing the machine, the availability of the materials is taken for consideration to satisfy the requirements of this study. The significant parts of the design are bill acceptor, which will operate the machine based on the bill inserted, and microcontroller unit as well as weight sensor, to control and determine the weight of the rice to be dispensed.

In order to create the device the researchers will follow the steps in the project development cycle.

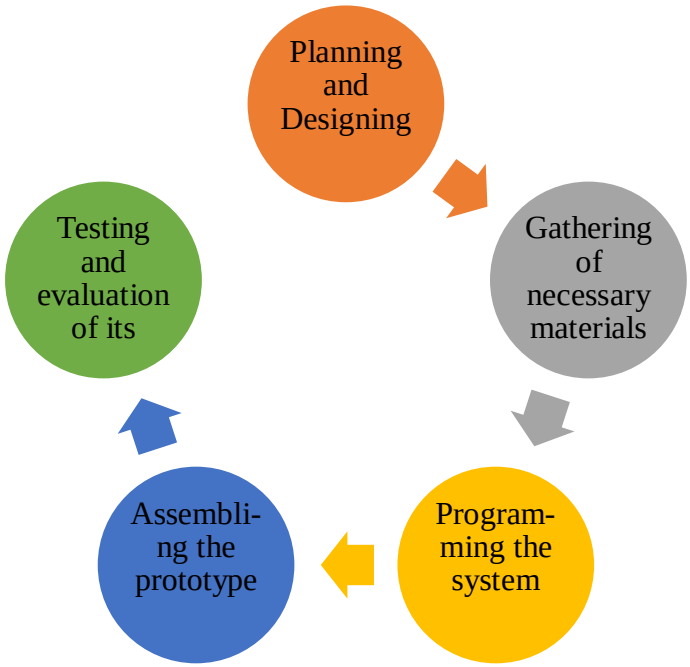


Figure 2. Project Development Cycle

Research Instrument

The researchers used the following resources to fulfill some information in the

Books

Books regarding electronics, electrical, and programming are used to become more familiar with the study and to increase the knowledge on hardware-software-communication interface, microcontroller unit, and other electronics and electrical essential to the study.

Unpublished Thesis

Former and undergraduate research studies from Southern Luzon State University and other various universities were used to become more familiar and to increase the knowledge about vending machines and other related studies.

Internet

The World Wide Web serve as an easy, fast, and reliable source of information. Specifications of the components used in the study come from the internet. Also, articles relevant to this study are also taken for additional information.

Questionnaire

Questionnaires will be used to evaluate if the proposed machine is acceptable in terms of the convenience and how accurate it is for both the consumers and vendors. This will also use to evaluate if the design is acceptable for the machine to work properly. To determine, 5-point like scale was used, it is range from Very Satisfactory to Very Unsatisfactory.

Procedures

The researchers started by gathering information from related studies of the said machine. After the information gathering, it will be followed by planning and designing. Then the researchers will gather the needed materials for the assembling. It will be

programmed based on how the machine will work. After coding the system, the researchers will the start assembling the prototype. Lastly, it will be tested and evaluated to determine if the objectives of the study were achieved.

a. Planning and Designing

First, the researchers will start planning the possible design of this study and the connection of different components to be used for the construction of the "Automated Rice Vending Machine". The researchers considered the necessary materials to create appropriate design.

b. Gathering of necessary supplies and materials

Secondly, the materials needed to construct will be searched and canvassed. The researchers will list the possible material appropriate to the design. The factors to be considered are the price, quality, quantity and its functionality.

c. Programming the System

The researchers will then start coding the instructions to make the microcontroller unit run. The program involves the counting the amount of bill(s) inserted and the Graphical User Interface of the system. It also includes the dispensing of the accurate weight of rice.

d. Assembling the Prototype

After programming the system, the researchers will start constructing the hardware, mount the materials in the right places, and assemble the frame and housing of the prototype.

e. Testing and evaluation of its operation

Finally, testing and evaluating will be conducted to ensure if the system is functioning properly. Once the machine fails, restructuring the program and machine are needed to make it run properly. The researchers repeat and continue to test and evaluate until the machine works properly. The accuracy of the machine will be tested in terms of dispensing the accurate weight of rice. The speed of dispensing the rice will also be evaluated to know how fast it will dispense a specific amount of rice. To evaluate the acceptability of the machine the researchers will use questionnaires.

Chapter IV

RESULTS AND DISCUSSION

This chapter presents the results of the data gathered as well as its analysis and interpretation. These are presented in paragraphs, charts, diagrams and tables following the sequence of the specific research problem regarding the Automated Rice Vending Machine. Discussed below are the System Overview, Technical Description, Planning and Designing, System Block Diagram, System Flow Chart, Materials Used, Circuit Plan, and Physical Design under the Technical Description.

System Overview

This vending machine is design to automate the traditional way of selling rice. This is bill-operated and it uses 20, 50, and 100 peso denomination. Through the mechanical bill acceptor, configured to accept the said amount, it will compute the total amount of bill inserted. Then the machine will dispense its corresponding weight of rice. When the machine was emptied by the customer the refilling of rice is done by its owner.

The machine has three buttons namely: Administrator, New Owner, and Start button. The Administrator button is for the owner to visit the machine's transaction and update the type of rice and its corresponding weight per price. The New Owner button is for the machine's new owner to register his/her account by entering the username and password. Meanwhile, the Start button is for the customers, this is where they can place their order.

This vending machine will be using different components such as Microcontroller Unit that controls all the other components, LCD that serve as the monitor of the machine, Raspberry Pi that connects the LCD to the microcontroller, Bill Acceptor that accepts the customers payment, Weight Sensor that weighs the available rice inside the machine and Servo Motor that is responsible in dispensing the ordered rice. In order to perform the system's process well the mentioned components were used.

Technical Description

This section discussed the technical aspects in the development of the Automated Rice Vending Machine. Technical aspect is an important part of the machine's development because this factor responds to the technicalities and structure of the system. It also comprises how the system and machine itself developed.

A. Planning and Designing

The researchers start with planning and designing to implement the system. First, the researchers gathered needed information in order to develop the prototype. Secondly they studied the different hardware components on how it will be connected with each other for the system to work. Then the step by step process of each stages is taken into consideration as well as the interaction of the user in the system. This section also includes the connection of each components by doing a circuit plan of the whole system. At the last part of this section the overall design of the machine is shown.

a. Gathering of Information for Design Consideration

This study consists three different design consideration first is the design of its Graphical User Interface, second is the factor considered in creating the initial Graphical User Interface, lastly is the design of the vending machine itself. Stated below are the gathered factors to be considered in order to create the design of Automated Rice Vending Machine.

Table 1. Design Consideration of the Graphical User Interface

The design of the Graphical User Interface (GUI) of the machine was based on the observations of the researchers. The existing GUI of different machines were observed to see what design is needed for it to become user friendly. The color scheme of the existing GUI was researched to see what color is pleasing to the eyes of the users. The font family was considered to design the GUI, it should be readable to the user of the machine.

Design Consideration	Result	Reason
Color	Green	Based on the study green is a versatile color and inviting a customers a pleasing feeling.
Font Family	San Serif	According to Jacob Palme, based on a study, the font family that is most readable to the user in the screen is San Serif.
Simple	Avoid unnecessary elements	Too many elements will make the GUI unclear to the user

Table 1 shows the results obtained by the researchers. Based on the study the color that is pleasing to the eyes of the user is color green. The font family in the GUI will be San Serif because according to Jacob Palme it is the most readable font. The design of the GUI will be simple to make it clearer to the user.

Table 2. Factors Considered in Graphical User Interface

The researchers consider two different factors in creating the GUI. The type of rice to be displayed is based on the most in demand rice in the market, to know, the researchers will conduct an interview. The price of the rice will be based on the selling price of the in demand type of rice plus the operating cost.

Question	Result
What is the most in demand rice today?	Angelica
What is the selling price of the most in demand rice?	Php42.00 – Php45.00 per kilo

Based on the interview that the researchers conducted the most in demand rice is Angelica and its selling price is 42 to 45 pesos per kilo.

Table 3. Design Consideration of the Vending Machine Chassis

The design of the Automated Rice Vending Machine was based on the interview that was conducted at the store who sells rice in a traditional way. The

existing size of the rice chassis in that store will be considered in designing the rice chassis of this machine. The total weight of rice that can be placed inside the chassis, in kilograms, will also be asked to the interviewee to know the maximum weight of rice that the machine can offer as well as the average weight of rice they can sell in a day. The materials used in the existing chassis will also be taken as consideration in designing in order to create a durable machine.

Question	**Result**
What is the dimension of your chassis?	24 in x 9.5 in x 20 in
How much is the capacity of your chassis?	50kg
What is the average weight of rice sold in a day?	10kg – 15kg
What material did you use in your chassis?	Fiberglass

Based on the interview conducted by the researchers the rice chassis has 61cm x 24cm x 51cm, length, width, and height respectively. The maximum weight of rice that can be placed inside is 50kg and the average weight sold in a day is 10kg to 15kg. To make the chassis durable and long lasting they used Fiberglass as the material.

b. System Block Diagram

The Figure below shows the connection of how the vending machine system works. The user will be the initiator or the one who will decide if he/she wants to order. The LCD along with the Raspberry Pi will determine if the user or customer will buy, basically it will act as a switch. If the Raspberry Pi read that the user will buy, the LCD will display or command the user to insert bill.

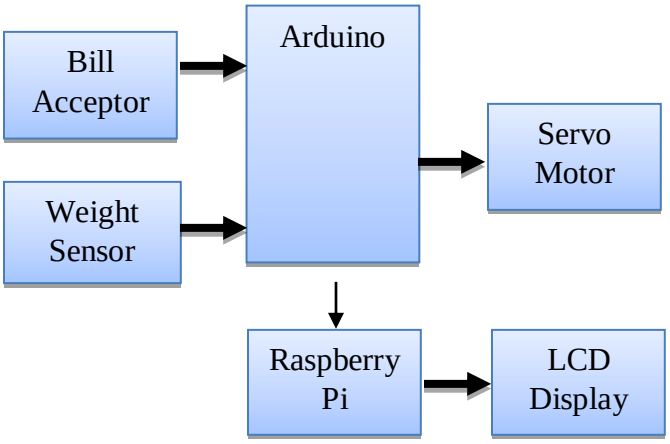


Figure 3. System Block Diagram

The bill will be accepted by the acceptor then the Microcontroller will compute its total amount as well as its equivalent weight according to the price per kilo. The computed money and weight will be displayed on the LCD. Then the accurate amount of rice will be dispensed depending on what the Microcontroller computed. To dispense an accurate amount of rice the servo motor and the weight sensor will be used. The Raspberry Pi will then save the log of the time of transaction, the amount and the equivalent weight.

c. System Flow Chart

This section discussed the step by step process of the system. The flow of the program in the system's three states is presented with the full details and description that supports to understand more the system's functionality.

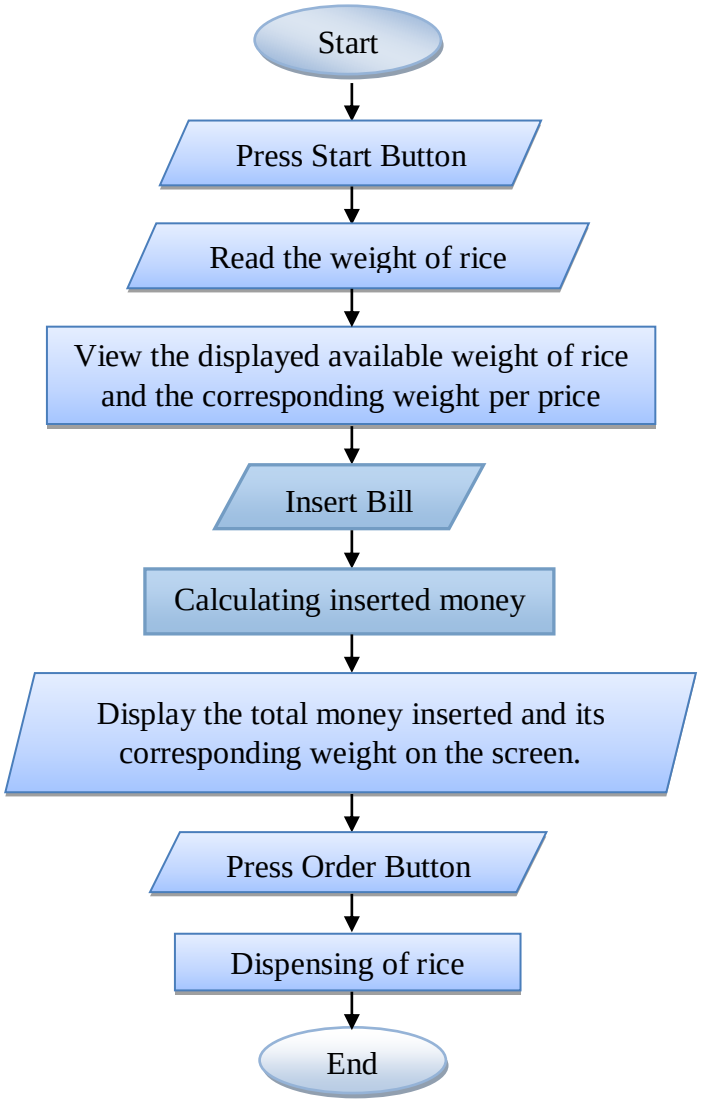


Figure 4. Flow Chart of the Order Page

Figure 4 shows the flow chart of the order page. It requires the weight sensor to read the weight of available rice first before ordering. The user is

required to view or read the displayed price range in the screen before ordering. After that microcontroller will compute the total amount of bill inserted and display it to the monitor as well as its corresponding weight. Lastly, when the insertion of bill is done the user will press the order button to dispense the amount of rice his/her ordered.

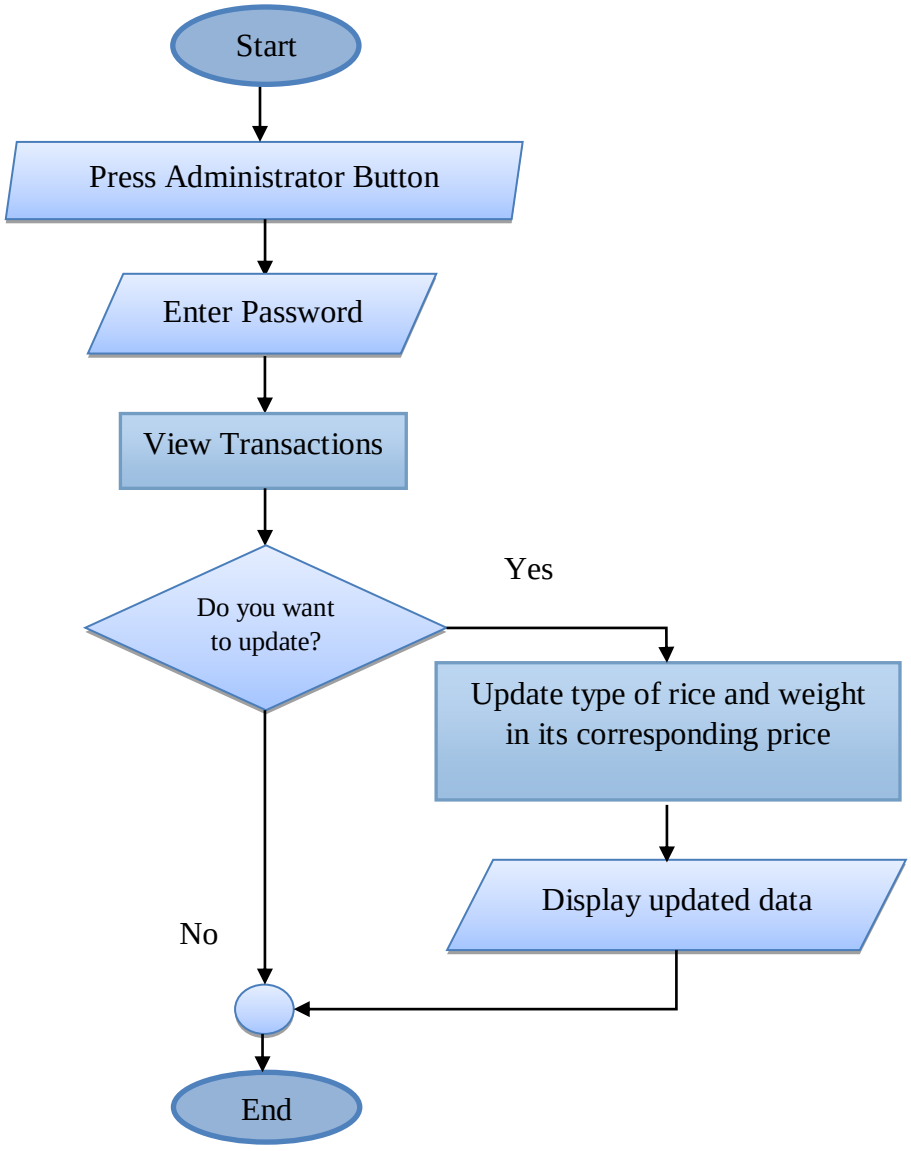


Figure 5. Flow Chart of the Administrator Page

The Figure 5 shows the flow chart of the Administrator page. The admin of the system will be asked to enter his/her username and password in order to view the machine's transactions. If the admin wants to update or change the type of available rice and its weight per price he/she will press the update button otherwise the process in the Administrator page was finished.

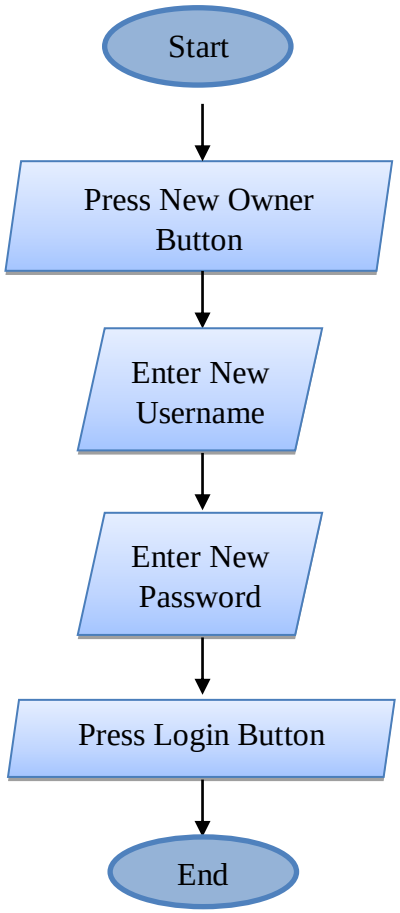


Figure 6. Flow Chart of the New Owner Page

Figure above shows the flow chart of the New Owner Page. The new owner of the machine will be required first to enter his/her new username and password. If done, he/she can now press the login button to end the process.

d. Use Case Diagram

This diagram will show how the buyer and the administrator will interact system.

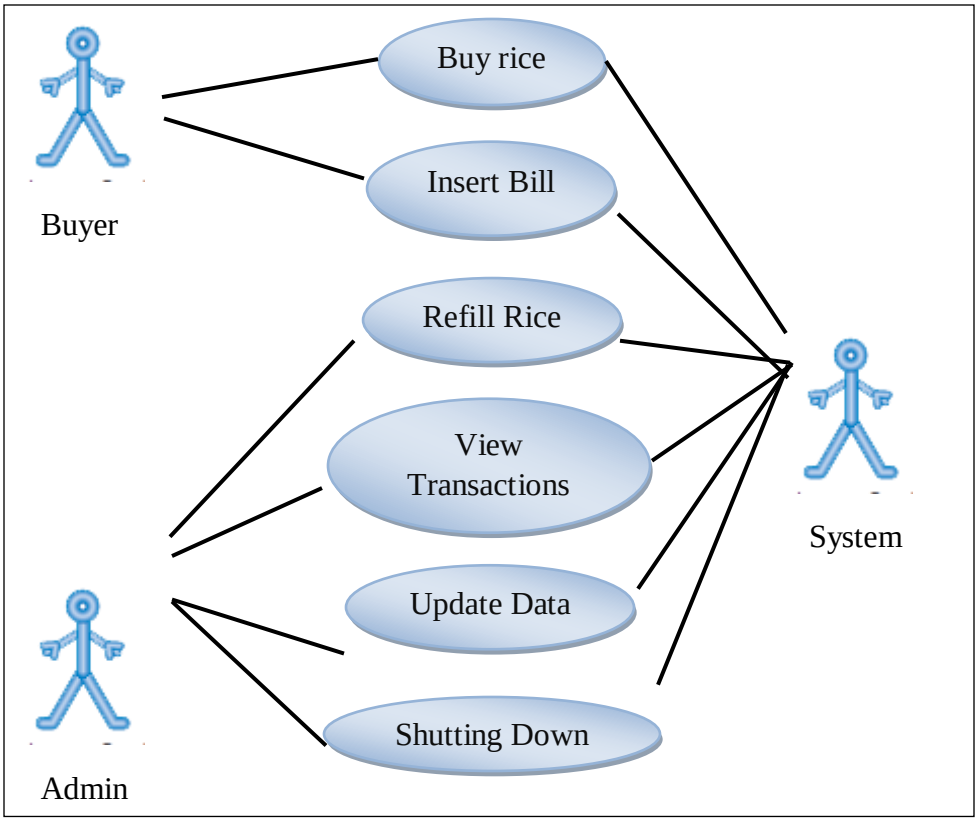


Figure 7. Use Case Diagram of the System

Figure above shows the use case diagram of the system. Buyers can use the system to buy rice and provide payment on the system through inserting bill. On the other hand, the admin has the access in every transactions done by the users and has the control on when to shut down the vending machine. Refilling of rice is also done by the admin or the owner of the machine. The system validates if the one using the machine is the admin through requesting password.

e. Circuit Plan

Table 4. Pin Assignment

The table below shows the pin assignments of each components in the Arduino Mega 2560. Components that will be connected in the microcontroller are Raspberry Pi 3, Bill Acceptor, Weight Sensor, and Servo Motor.

Materials	Pin Assignment in Arduino Mega 2560
Raspberry Pi	USB Port
Bill Acceptor	PWM 2, VIN, GND, GND
Weight Sensor	PWN 5, PWM 6, 5V, GND
Servo Motor	PWM 3, 5V, GND

The pin assignments of the components mentioned above are based on the number of its wire and how each will function. In order to configure the two microcontrollers the Arduino must be connected to Raspberry Pi via USB cable. The specific pin number where bill acceptor, weight sensor, and servo motor was also stated above. The weight sensor and servo motor is connected to 5V pin to provide power while bill acceptor on the other hand will be connected to VIN to supply 12V power.

Schematic Diagram

The figure below shows how the bill acceptor will be connected at the user interface.

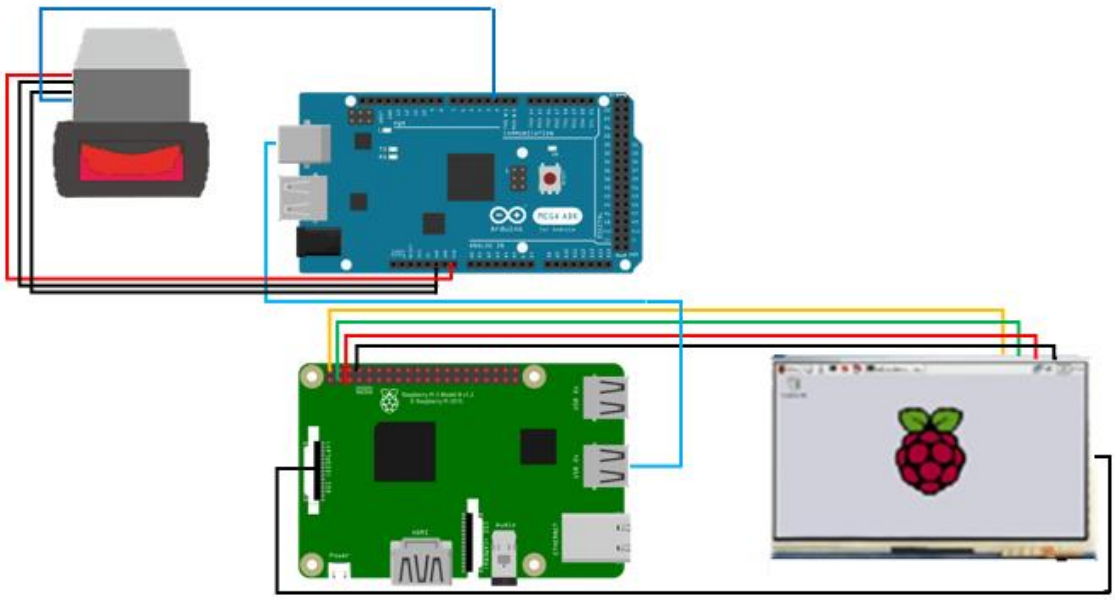


Figure 8. Bill Acceptor and User Interface Connection

Figure above shows four different components that will be used to connect the bill acceptor at the user interface to work in conjunction. First the bill acceptor is connected in the microcontroller because it is the one who will control it to operate. Then the microcontroller is connected in Raspberry Pi that is connected in a LCD display. Raspberry Pi will contain the code for the GUI of the system that will show in the LCD. Bill acceptor and User Interface needs to work in conjunction because bill acceptor will serve as the input where the buyer will insert the payment and the User Interface will be the output that display the total amount of money inserted by the buyer.

The figure below shows the schematic diagram of the whole system of the machine. It shows how the main parts of the vending machine will be wired together.

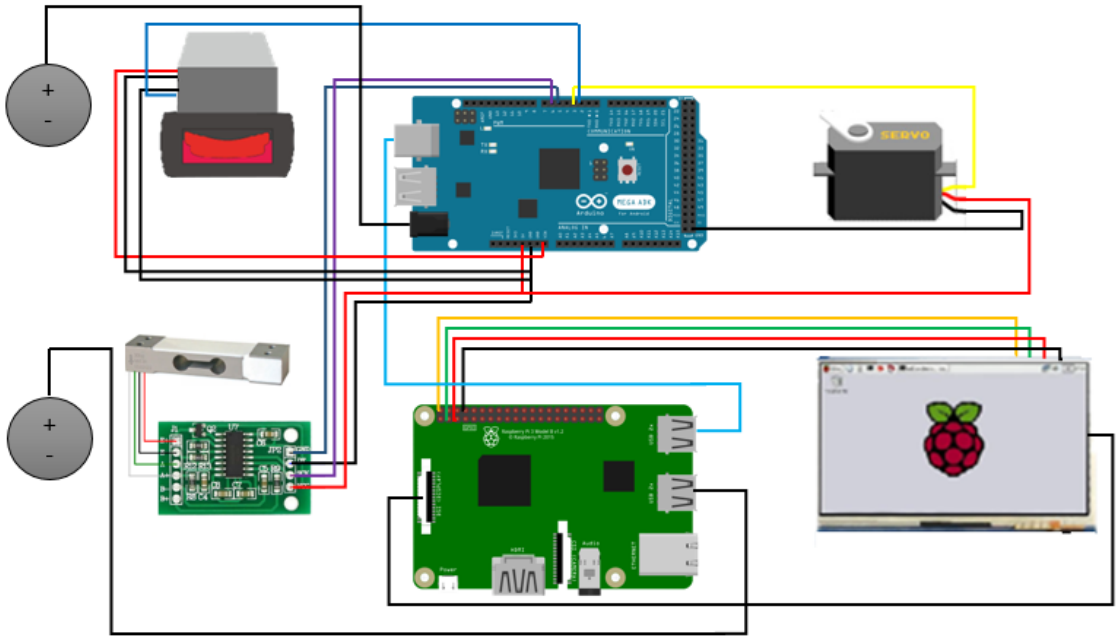


Figure 9. Schematic Diagram of the Whole System

The center of the schematic diagram shows the brain of the machine which is the the microcontroller unit, all of the components that will be used are connected to it. The main components that were connected to the microcontroller are LCD display, Raspberry Pi, logic converter, bill acceptor, servo motors and weight sensors.

f. Physical Design

The figure below is the representation of the Automated Rice Vending Machine prototype would look like from outside. There are several factors that

the researcher were considered in designing the chassis. Also show below are the different view of the machine.

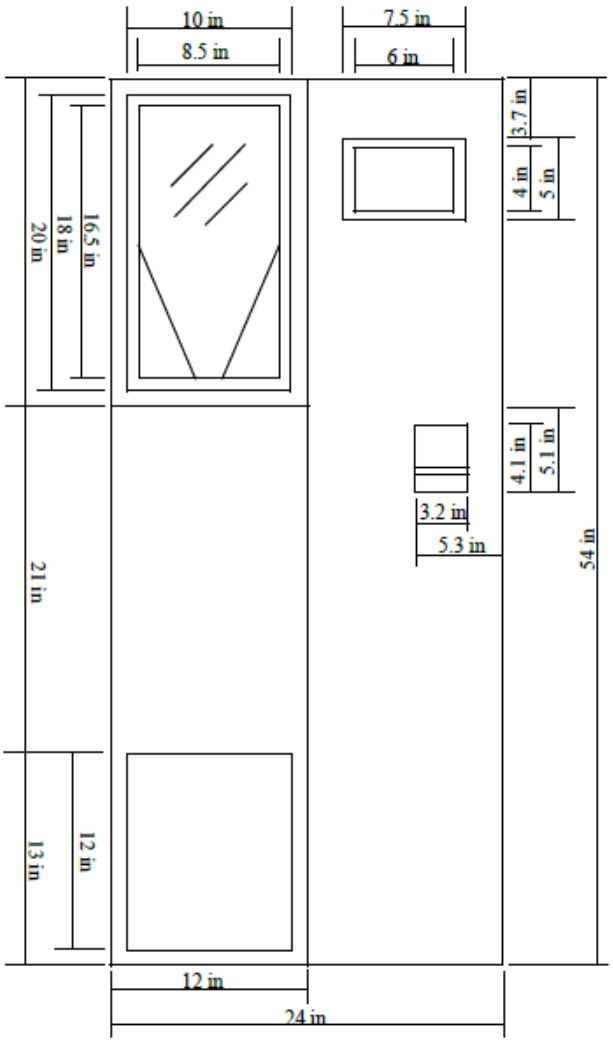


Figure 10. Front View Design of the Chassis

Figure 10 shows the front view of the planned design for the chassis. The unit of measurement used in the chassis dimension was also show. The dimension includes the length, width, and height of the prototype. The result of the interview was considered for the length and width of the chassis as well as the components

to be placed inside. Compared to the existing size of chassis our design is a little bit smaller because we also considered the amount of rice sold in a day and with that we adjusted the size according to the amount of rice. Meanwhile the average height of the Filipinos are considered for the height of the chassis. According to Inquirer. NET Filipino males have an average height of 64inches while the Filipino females have an average height of 59 inches. The researchers subtracted 5inches from the average height of the female for the chassis to become more convenient for all kind of users such as teenagers.

Include in the physical design of the vending machine are the LCD display and bill acceptor that was placed at the right part of the machine. The upper left side of the machine was design using a fibre glass and a transparent glass material for the rice grain to be seen. The lower left side of the machine was designed hallow because that is the place where the ordered rice will be dispensed. The other part of the machine was design using a stainless sheet for it to be durable and long lasting. The overall design of this machine was based on the other existing vending machines that are available in the market.

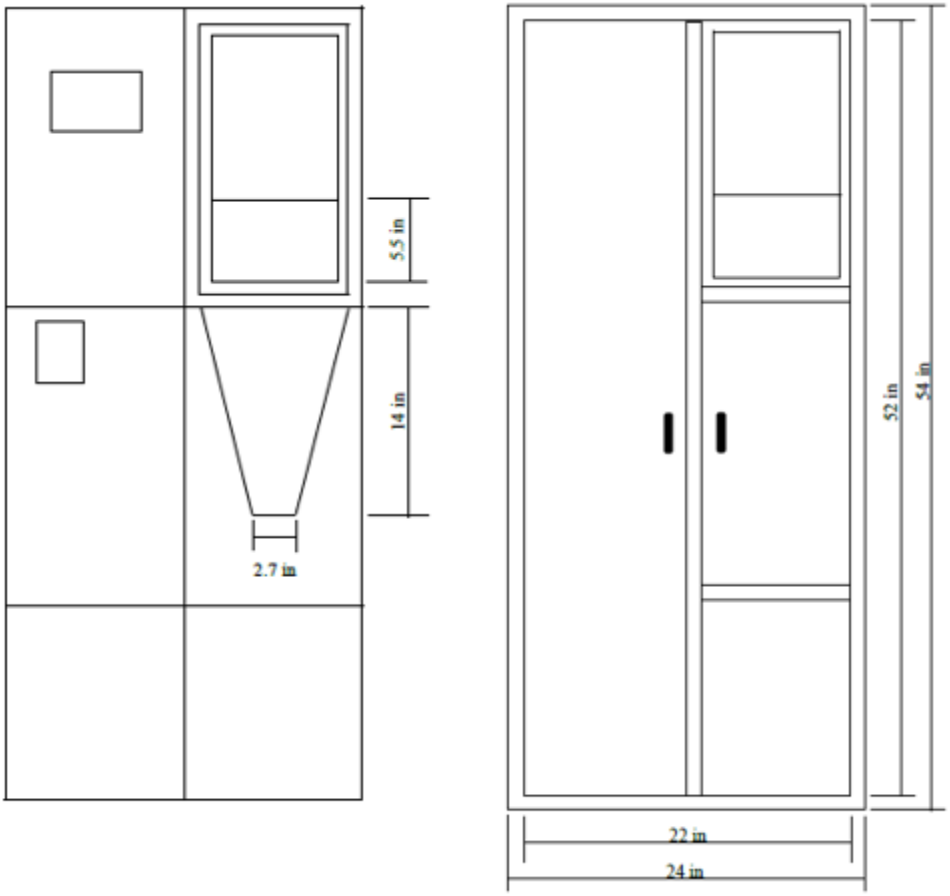


Figure 11. Internal and External Back View Design

The internal back view of the machine was shown on the left side of the Figure 11 while the external back view of the machine was shown at the right side. Inside the chassis a funnel was placed in order to dispense the rice easier to the container provided by the customer. There are also two layer platform inside the chassis where the components and the money will be placed. The researchers designed a full door at the left side for an easy access of the administrator to the components and the money there is also a small door on the right side for cleaning purposes. Two doors has a lock for security purposes and only the administrator can open it.

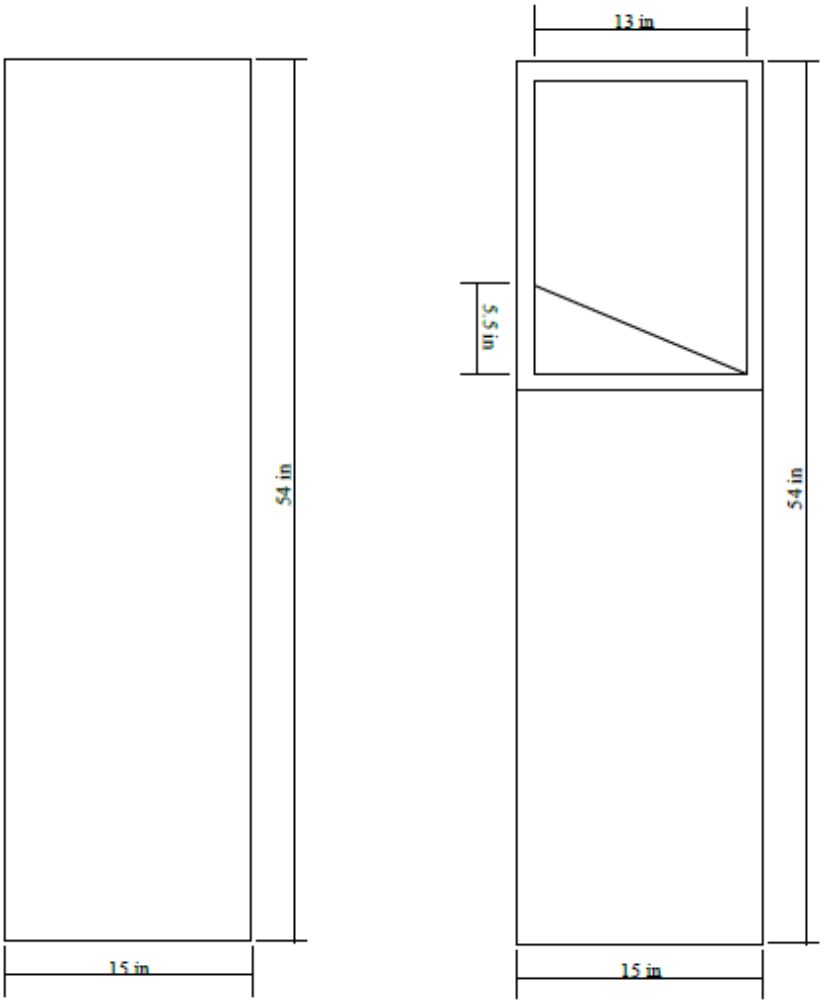


Figure 12. Left and Right Side View of the Chassis

The left side of the chassis was shown at the left part in figure 12 while the right side of the chassis was shown at the right part. The left side and lower right side of the chassis was designed to be covered by the stainless sheet to make it more secure. Meanwhile the upper right side of the chassis was designed to be transparent for the amount of available rice to be seen. Also shown above is the inclined part of the rice

chassis. The researchers designed the rice chassis to be inclined for the rice to slide down smoothly and to dispense most of the rice inside.

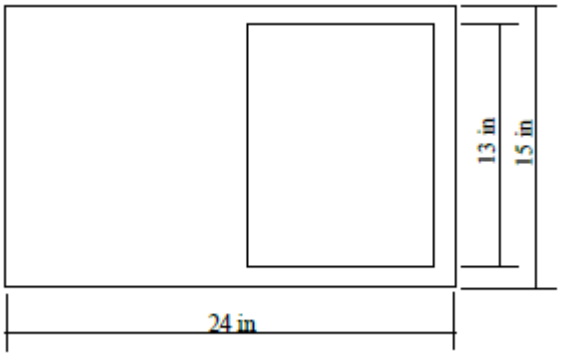


Figure 13. Top View of the Chassis

The top part of the chassis was divided into two and its right side was designed to have a door. The door will serve as a passageway for the administrator to refill rice when it runs out. The administrator can also open it to clean the rice chassis.

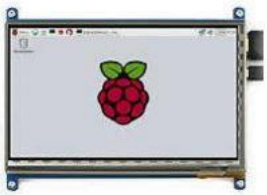
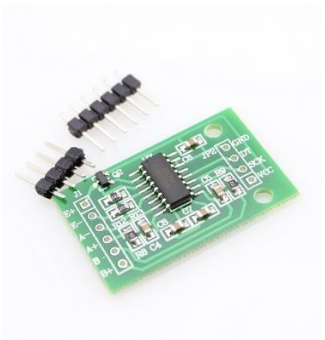
B. Materials Used

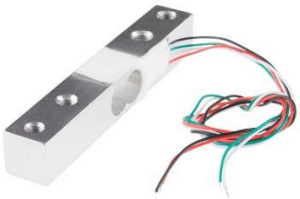
This study consist of two materials: first is the hardware materials and second is the software materials. Some of the materials specified below are used in the previous researches regarding vending machines and will be used as the basis of the materials in this study.

Table 5. Hardware Implementation

The selection of hardware materials used in the system are gathered through the previous research and internet. Its functionality is based on how it will be used in this study.

Name	Specification	Function/Description
Arduino Mega 2560 	The Arduino Mega 2560 consists of 14 PWM inputs. This is where the connections from the bill acceptor and other components will be placed.	This micro-controller, Arduino Mega 2560 serves as the brain and the center of the machine. It controls all the component, accepts input from the LCD Touch screen then analyse it and understand it before producing output and tells the servo motor to move to disperse rice.
Raspberry Pi 3 	The Raspberry Pi 3 consist of 4 USB 2.0 Ports. These ports is where the Arduino will be connected. The Raspberry Pi also has a micro SD port for loading and storing data and a DSI Display port for connecting a touchscreen display.	It will serve as the control processing unit of the device. This gives power to the LCD Touchscreen, process and executes the data from the input devices such as the Arduino

 **7” Liquid Crystal Display**	The researchers used a 7 inch or 164.9x124.27mm LCD screen with an 800x480 (pixels) of resolution.	It displays the details about the rice including: its price, its kind, its availability and receive inputs from the buyer. The database of the transactions can be opened and save here.
Bill Acceptor 	The researchers used a BV20 bill acceptor. This type of bill acceptor is programmed to accept Philippine Peso Bill. It accepts Php20, Php50, and Php100. It sends an appropriate electric signal via its output connection.	The bill acceptor accepts bills from the buyer then identify and compute the bill inserted. It is the most important component of the vending machine as it used in the payment process.
HX-711 Weight Sensor 	The researchers uses HX-711 weight sensor amplifier is used to get measurable data out from a *load cell*. It consist of an amplifier and a precision 24-bit analog-to-digital convertor designed for *weigh* scale and industrial control applications to interface directly with a bridge *sensor*.	It is the most fragile and the most delicate part of the vending machine to determine the exact weight to be dispense depending on the payment of the buyer.
20kg Load Cell	The researchers uses a 20kg load cell. A load cell is a transducer that is used to	It is used to measure the weight of available rice and the weight of rice to be dispensed. This material

	convert a force into electrical signal. The most common use of this sensor is in weighing machine. Every weighing machine which shows weight has a load cell as sensing element.	will be connected to the HX-711 weight sensor.
Standard Servo-TowerPro SG-5010 (180° Rotation) 	The Servo Motor SG-5010 is a workhorse standard servo with a range of 180 degrees that can be used in many applications and is one of the best values for a general purpose servo. Servo motors can be commanded to go to a specific position and so are the usual go-to motor when accurate positioning is needed.	It will be the component in charge of dispersing the rice. It will accept inputs from the microcontroller received from the LCD then produce output by dispersing the equivalent weight of the money inserted computed by the microcontroller.
Micro SD Card 	The Micro SD card has 16GB storage capacity with a speed class of 10.	It is a type of removable flash memory card that is used to store necessary files and data of the Raspberry Pi.
 **Universal PCB**	Universal PCB is a board the already has a hole where the components can easily be soldered.	The Universal PCB is used to add more pins in Arduino 2560 and to mount the HX-711 weight sensor.

 **Power Supply**	The power supply has 12 output voltage.	This power supply is intended to power Arduino 2560.

The table above discuss the major components of the vending machine: Raspberry Pi 3 with Touch Screen Display that will serve as the display and will accept the inputs of the buyer, the BV20 Bill Acceptor that will accept payment of the buyer and will identify how much bill is inserted, Arduino Mega 2560 that will serve as the brain of the machine and tells the other components what to do according to the inputs of the buyer, HX-711 Weight Sensor as well as the 20kg Load Cell will be the deciding factor of the precise dispersion of the rice depending on the weight computed by the microcontroller, and the Standard Servo-Tower SG-5010 will be the one that will act to disperse rice. In order to function the machine properly the said components must be completed.

Table 6. Software Implementation

The tabular list of platforms and languages below will be used in the software part of this study. The software platforms and languages are identified with the help of other researches and the previous study of the researchers.

Name	Compatibility	Function/Description
Arduino IDE 	Arduino senses the environment by receiving inputs from many sensors, and affects its surroundings by controlling lights, motors, and other actuators. You can tell your Arduino what to do by writing code in the Arduino programming language and using the Arduino development environment.	The only official platform used in programming the the Arduino board. It is used for input and output as well as controlling of sensors and other devices connected.
Python 	Python is often used as a support language for software developers, for build control and management, testing, and in many other ways.	It is a programming software which is widely used to programming Raspberry Pi 3.
C Language	C is a powerful general-purpose programming language. It is fast, portable and available in all platforms.	It is the language in which will be used in programming the microcontrollers.
NOOBS 	Noobs is a way to make setting up a Raspberry Pi for the first time much, much easier. Its compatibility on Raspberry Pi is proven to be more efficient.	It is the OS used for the Raspberry Pi to run and construct GUI.

Table above list three programming software platforms that will be used to produce the proper operating system of the machine, it includes the Arduino Platform, the Python, and the XAMPP. To program the micro-controllers C Language will be used. The functionality of each was based on how it will be used in the system of the machine.

Structure/Organization

This section discussed how the Automated Rice Vending machine was developed. In able to develop the machine the researcher are guided by the knowledge acquired in planning conducted beforehand. The programming/coding the GUI of the system, interfacing, testing and evaluated are presented in this section.

Programming/Coding of Graphical User Interface

This section present the codes used in development of the system's GUI. Discussion on how codes are developed and how they worked were presented in this part.

The operation of the Automated Rice Vending Machine was controlled by a user-friendly GUI. The researchers used Thonny Programming IDE in an Ubuntu Operating System upon developing the GUI of the system. Ubuntu OS was used instead of Windows OS because Raspberry Pi 3 runs only on Raspbian which is a Linux based Debian.

```
def main_account_screen():
    def shutdown():
        call("sudo poweroff",shell=True)

global main_screen
    main_screen = Tk()
    main_screen.title("Welcome Page")
    main_screen.frame
    main_screen.attributes("-fullscreen",True)
    main_screen.geometry("800x480")
    main_screen.resizable(False,False))

    label=Label  (main_screen,text="Automated  Rice  Vending  Machine",bg="chartreuse3",
fg="yellow", font="Sans-serif 30 bold", width=50, pady=10).pack()
    label0 = Label (main_screen, background="chartreuse3", width="150", height=7)
    label0.place(relx=0, rely= 0.85)
    button_admin  =  Button(main_screen,  text  =  "Administrator",  bg="chartreuse3",
font="Sans-serif 20 ", width=15,pady=10, command=login)
    button_admin.place(relx=0.35, rely=0.2)
    button_new_admin  =  Button(main_screen,  text  =  "New  Owner",bg="chartreuse3",
font="Sans-serif 20 ", width=15, pady=10, command=register)
    button_new_admin.place(relx=0.35, rely=0.4)
    button_start  =  Button(main_screen,  text  =  "Start",  bg="chartreuse3",  font="Sans-
serif 20 ", width=15, pady=10, command=Customer)
    button_start.place(relx=0.35, rely=0.6)
    button_shutdown  =  Button(main_screen,image  =  photo,width=60,  height=65,bg="black",
command=shutdown)
    button_shutdown.place(relx=0.0, rely=0.85)
```

Figure 14. Welcome Page Sample Code

The figure above shows a part of the Welcome Page code which is most likely the home page of the system. This is the first page that will be visible to the administrator's eye once he/she start the system. The Welcome Page has three different buttons that functions differently. The syntax *Button()* was used to create, add text inside, and design a button while the syntax *button_name.place()* was used to position each button. Additionally, the Welcome Page features a shutdown button. Once the button was click by the user the system will shut down because the command *shutdown* will call its function that was define in the code to shut down the system.

Figure 15. Equivalent Welcome Page

The figure above shows the equivalent Welcome Page in the application from the code in Figure 14. The page features three buttons namely: Administrator, New Owner, and Start that gives access to its designation page of the system's GUI. The page also features the title of the research, which is Automated Rice Vending Machine and a shutdown button at the bottom left of the interface. The background of this is a picture of rice grain as representation to the product that our machine will offer. This background is used in other pages of the machine.

```
def register():

username_entry  =  Entry(register_screen,  textvariable=username,bg="linen",font="Sans-
serif 15 ",relief=GROOVE)
    username_entry.place(relx=0.45, rely=0.31)
password_entry      =      Entry(register_screen,      textvariable=password,bg="linen",
show='*',font="Sans-serif 15 ",relief=GROOVE)
    password_entry.place(relx=0.45, rely=0.51)
buttonreg = Button(register_screen, text="Register", width=10, bg="gray", fg="black",
font="Sans-serif 20 ",relief=GROOVE, command = register_user)
    buttonreg.place(relx=0.4, rely=0.87)

def register_user():

    username_info = username.get()
    password_info = password.get()


Label(register_screen,   text="Registration   Success",   fg="green",   font="Sans-serif
```

Figure 16. New Owner Page Sample Code

The New Owner Page is where the administrator can register his/her username and password. The sample code of this page was shown in Figure 16. To allow administrator enter his/her username and password the syntax *usermame_entry and password_entry*. After entering the details Register button must be clicked to call its function that was defined as *register_user*. Then a pop-up message will show saying "Registration Succes". The username and password will be then save to the *username_info* and *password_info*.

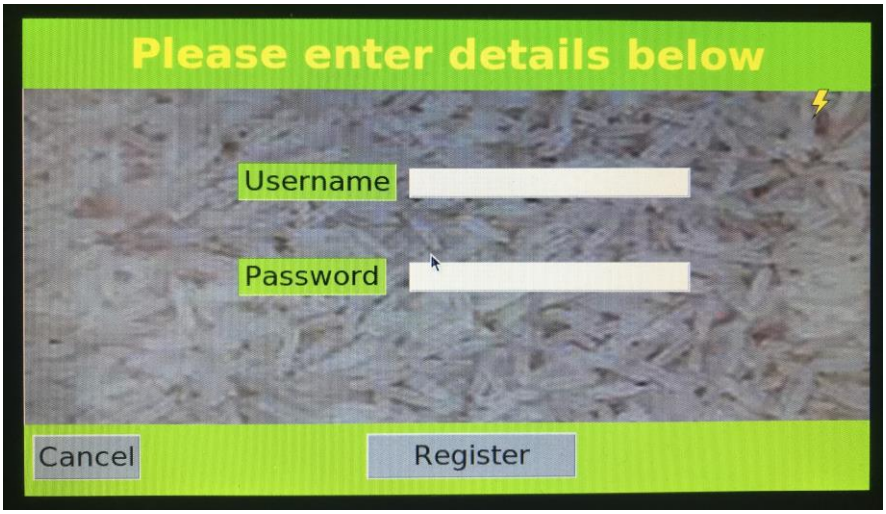


Figure 17. Equivalent New Owner Page

The figure above shows the equivalent New Owner Page in the application from code in Figure 16. The page features two entry boxes labeled as Username and Password respectively for the owner to type his/her account details. To save the entered details the Register button below must be clicked. After being registered the owner may now click the cancel button to bring him/her back to the previous page which is the Welcome Page.

```
def login():
    global login_screen
    login_screen = Toplevel()
    login_screen.title("Login")

    username_login_entry                    =                    Entry(login_screen,
textvariable=username_verify,bg="linen",font="Sans-serif 15 ",relief=GROOVE)
    password_login_entry                    =                    Entry(login_screen,
textvariable=password_verify,bg="linen", show='*',font="Sans-serif 15 ",relief=GROOVE)
   button   =   Button(login_screen,   text="Login",   bg="gray",      font="Sans-serif
20",relief=GROOVE, command = login_verify)
ef login_verify():

    username1 = username_verify.get()
    password1 = password_verify.get()
    username_login_entry.delete(0, END)
    password_login_entry.delete(0, END)

    list_of_files = os.listdir()
    if username1 in list_of_files:
        file1 = open(username1, "r")
        verify = file1.read().splitlines()
        if password1 in verify:
            login_screen.destroy()
            admin_items()
        else:
            password_not_recognised()
    else:
        user_not_found()

def password_not_recognised():
        Label(password_not_recog_screen, text="Invalid Password ").pack()

def user_not_found():
        Label(user_not_found_screen, text="User Not Found").pack()
```

Figure 18. Login Page in Administrator Button Sample Code

The Login page is where the administrator login his/her account. After creating and registering account in New Owner Page, the next step is for the administrator to enter the details and click the Login button to access the main Administrator page. Once the Login button was clicked the command *login_verify* will call its function. With the use of *if-else* function the system can verify if the entered detailed was correct. If the entered username was wrong it will call the function *user_not_found* and display a message "User Not Found" but when the entered password was wrong it will call the function *password_not_recognized* and display a message "Invalid Password" otherwise it will proceed to the Administrator Page.

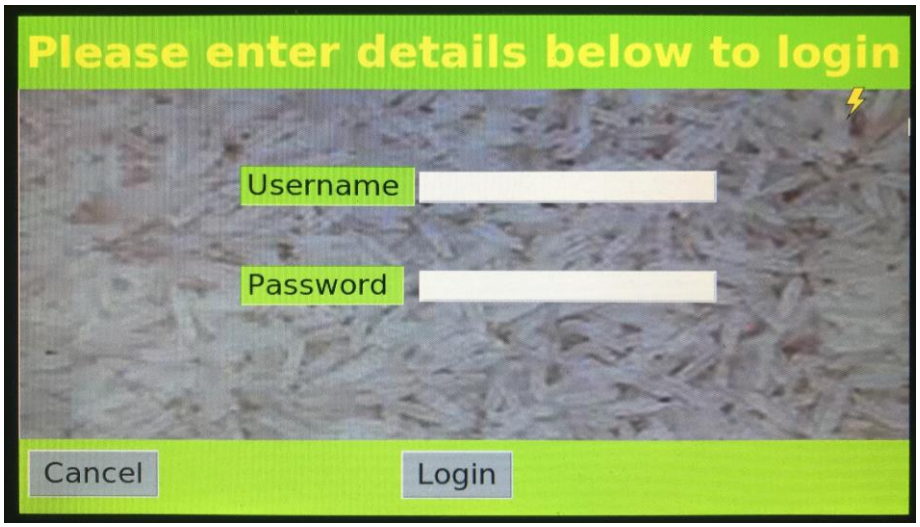


Figure 19. Equivalent Login Page

The figure above shows the equivalent Login Page in the application from code in Figure 18. Just like New Owner Page, Login Page features two entry boxes labeled as Username and Password respectively for the administrator to type his/her saved account details. To access the Administrator Page the Login button must be clicked while the cancel button is for the system to go back in Welcome Page.

```
#main function:
       gui.title("Administrator Page")

       tb0= Label (gui, text=l[0],bg= "chartreuse3",fg="yellow", font="sans-serif 40
bold", width=10,relief=GROOVE)

        transaclabel = Label(gui, text="Transactions)
        tbprice = Label (gui, text="PRICE)
        tb1 = Label (gui, text=l[1)
        tb2 = Label (gui, text=l[2)
        tb3 = Label (gui, text=l[3)

        tbweight = Label (gui, text="WEIGHT”)
        tb6 = Label (gui, text="1 KG”)
        tb7 = Label (gui, text="1 1/2 KG”)
        tb8 = Label (gui, text="2 KG”)

        button0 = Button(gui, text="View Sales Report ", command=transaction_list)
        button1 = Button(gui, text="Edit", command=edit)
        button1 = Button(gui, text="Exit", command=exit_edit)
```

Figure 20. Administrator Page Sample Code

Figure 20 shows a part of the Administrator Page code. This page is where the owner of the machine can access the Edit Page, where he/she can set the price of rice according to the given weight, and the Transactions Page, where he/she can see the sales details of the vending machine. In the sample code variable 0, 1, 2, and 3 are declared, these variable are the ones that can be change by the owner. *tb0* for the name of the available rice and *tb1, tb2, and tb3* for the price of 1kg, 1 and 1/2kg, and 2kg. This page features three different buttons that has different purposes. Those buttons has individual command that will be called once it was clicked.

Figure 21. Equivalent Administrator Page

The equivalent interface of Figure 20 is shown in the figure above. Administrator Page has three buttons namely Edit, View Sales Report, and Exit. At the right side of the interface the set name of the available rice and its corresponding price per weight at the right can be seen. The Edit button at the bottom of the interface is to access the Edit Page where the admin can change the name of the rice and its price. The View Sales Report

Button placed at the left side of the interface is for the admin to see the transactions made by the customers. An Exit button is also available for the administrator to return in the Welcome Page.

```
def edit():
        def edit_val(tbl_get, def_value):
                if tbl_get == None:
                        val = def_value
                else:
                        val = tbl_get

                return val

def goback():
                f = open("price.txt", "w+")
                val0 = edit_val(tb0.get(), "Angelica")
                val1 = edit_val(tb1.get(), "P50.00")
                val2 = edit_val(tb2.get(), "P80.00")
                val3 = edit_val(tb3.get(), "P100.00")

                f.write("%s\n%s\n%s\n%s"%(val0,val1,val2,val3))
                f.close()
                gui.destroy()
                save_interrupt()
#main function:
        global gui
        gui = Toplevel()
        gui.title("Edit Page")
tb0= Entry (gui, textvariable=l[0])

tbweight = Label (gui,text="PRICE”)
tb1 = Entry (gui, textvariable=l[1)
 tb2 = Entry (gui, textvariable=l[2])
tb3 = Entry (gui, textvariable=l[3])
 tbprice = Label (gui, text="WEIGHT”)
 tb6 = Label (gui, text="1 KG")
tb7 = Label (gui, text="1 1/2 KG”)
tb8 = Label (gui, text="2 KG")
button1 = Button(gui, text="SAVE”, command = goback)
button2 = Button(gui, text="Back”, command = gui.destroy)
```

Figure 22. Edit Page Sample Code

The Edit Page is where the changing of name of the available rice and its price takes places. *Entry* syntax was used to have a entry box where the administrator can type the changes. As mentioned earlier it will be save in the variables *tb0, tb1, tb2,* and *tb3.* To save the changes made a button will be click for the system to call the function in *goback.* In tha said function values will be save as *val0, val1, val2,* and *val3.*

Figure 23. Equivalent Edit Page

The Edit Page shows four entry boxes, one for the name of the rice and three for the prices of 1kg, 1 and 1/2 kg, and 2kg. This page also feature two buttons that was place at the lower part of the interface. The Back button will return the system to the Administrator Page and existing details will not change. The Save button is for saving the changes that the administrator made. The changes can be seen only when the administrator login again.

Programming/Coding of the System's Function

This section present the codes used in development of the system's function. Discussion on how codes are developed and how they worked were presented in this part.

The operation of the Automated Rice Vending Machine was controlled with the use of bill acceptor. The researchers used Arduino IDE upon coding the system's function because it is the platform that can be used in programming the Arduino Mega.

```
void countPulses() {
  int val = digitalRead(2);
  if (val == LOW) {
    pulses++;
    displayMe = true;
  }
  if (val == HIGH){
    displayMe = false;
    prnt1();
```

Figure 13. Code for Computing the Total Bill Inserted

. The figure above shows the code for computing the total bill inserted by using *pulses* that will increment depending on the pulses per bill set in the bill acceptor. To compute its equivalent weight the total *pulses* were divided to the *price* set by the owner of the machine. Meanwhile, the available weight of rice was computed by subtracting the *initial weight* before dispensing that was read by the weight sensor to the dispensed *weight*.

```
void rotate(){

  Servo1.write(0);
  delay(1000);
  Servo1.write(90);
```

Figure 14. Code for Controlling the Servo Motor

The figure above shows the code for controlling the rotation of the servo motor. This code will be activated if and only if the order button in GUI were pressed by the customer. The syntax *Servo1.write() w*as used to set the angle of motor initially is was set at 0 degree with *1000ms* delay.

Assembly

The material's connection with other materials was shown in this section. Presented and discussed here are the process of how they are connected and communicate with each other for the development of the system.

a. Microcontroller Configuration

The researchers configured to connect two microcontrollers used in the system the Raspberry Pi and the Arduino Mega. Microcontrollers are configured by the use of Serial Communication which is responsible for sending and receiving data between two microcontrollers or devices. The first step in configuration is for Raspberry Pi only, in its terminal the command ls /dev/tty* was typed without connection to the Adruino Mega. After its execution two microcontroller was needed to be connected with each other using cables and connecting wires.

Figure 15. Cable Connection of Arduino and Raspberry Pi

The figure above shows the connection of two microcontrollers that was used in the system. A USB Cable was used to connect the Arduino Mega to the RasPi and four connecting wires were used for the connection of LCD Touchscreen and RasPi. The port where the Arduino Mega was connected was needed to be recognized by the RasPi first. To be recognized the command ls /dev/tty* was needed to be retyped in the terminal of the RasPi. After the execution of the code a new port name is then recognized, that port name will be used in the Serial Communication code.

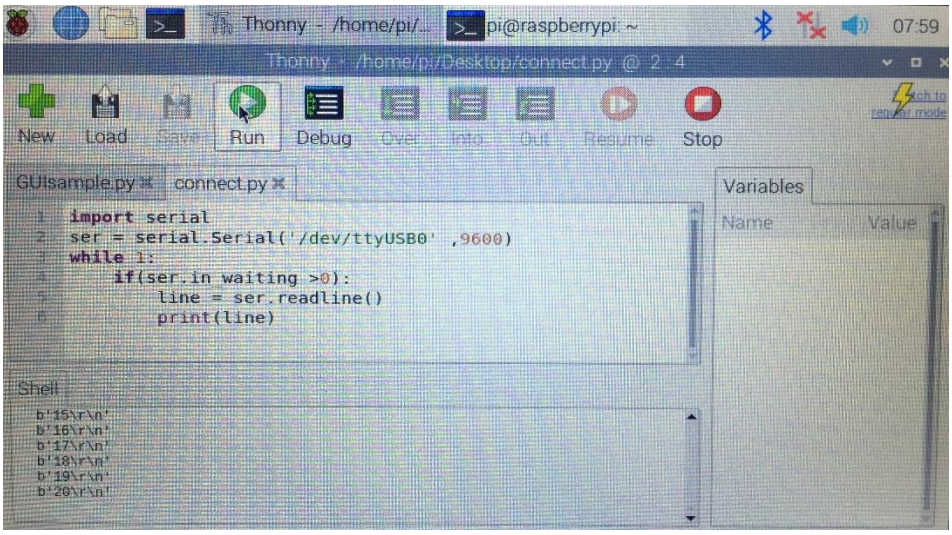


Figure 16. Serial Communication Code

The figure above shows the code used for the Serial Communication of the Raspi and Adruino. The code used was downloaded in the internet by the researchers. The coding was done by the use of Thonny which is a Python IDE.

The first line of the code is to import a module named serial. The /dev/ttyUSB0 in the second line was the name of the newly recognized port by the RasPi which is for the Arduino. The 9600 on the other hand was the baud rate or the unit transmission speed equal to the number of times a signal changes state per second. The configuration is correct once the Raspberry Pi received data from the Arduino which was shown in the bottom part of the figure.

b. Bill Acceptor and Arduino

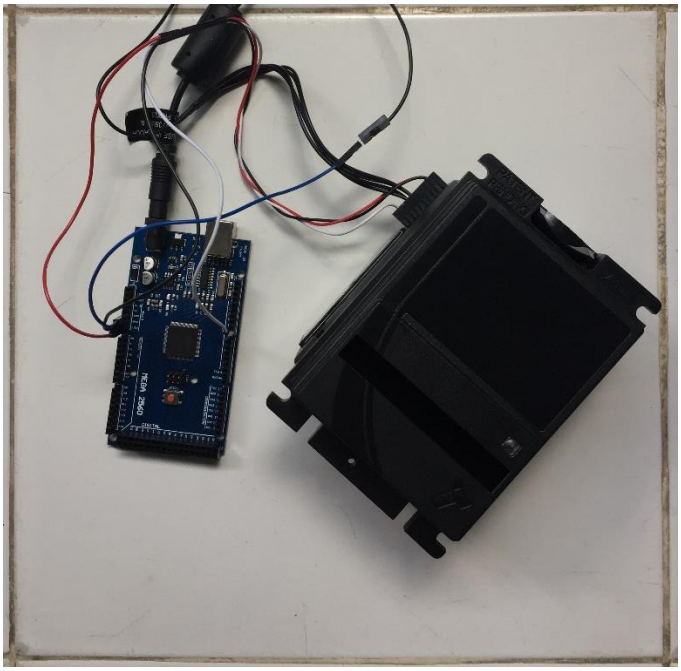


Figure 17. Connection of Coin Acceptor and Arduino

The figure above shows the connection of bill acceptor and Arduino microcontroller. The bill acceptor is configured to accept bills amounting 20, 50, and 100 pesos only. The Arduino is responsible for sending the total amount of money inserted inside the bill acceptor to the Raspberry Pi because it is the one who computes the bill. The researchers code the connection of the two materials with the help of internet. In the code that the researchers used, the Arduino recognized the amount of bill inserted according to the number of pulses set for each type of bill in bill acceptor and its equivalent weight according to the weight per price set by the system's admin. Each bill gives its own specific number of

pulse which the Arduino recognize and compute. The total value computed will then sent to Raspberry Pi.

c. Servo Motor, Bill Acceptor and Arduino

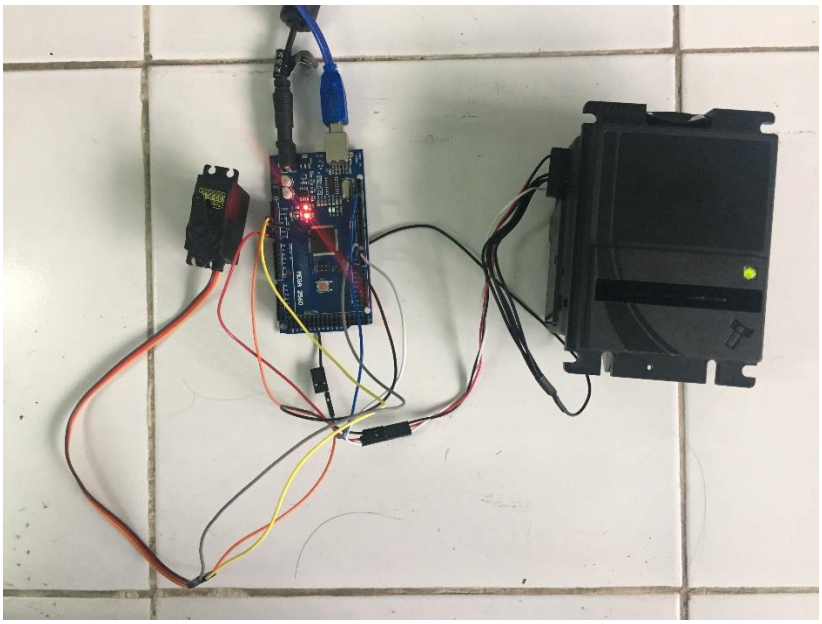


Figure 18. Connection of Servo Motor, Bill Acceptor and Arduino

The figure above shows how the servo motor, bill acceptor, and Arduino microcontoller are connected to each other. The servo motor was programmed by the researchers after the bill acceptor. When the insertion of bill was done, the order button will be pressed by the customer. The order button in the GUI will send the signal set by the researcher from the Raspberry Pi to the Arduino. After that the servo motor will be activated and will dispense the equivalent amount of rice computed by the Arduino.

Testing

Acceptability of Money

No. of Trial	Bill Inserted	Remarks (Accepted or Rejected)
1	20 pesos	Accepted
2	50 pesos	Accepted
3	100 pesos	Accepted
4	200 pesos	Rejected
5	500 pesos	Rejected
6	1,000 pesos	Rejected
7	Paper	Rejected
8	Play Money	Rejected

Functionality of the Whole System (initial price per kilo)

No. of Trial	Displayed Amount of Available Rice	Displayed Total Amount of Bill Inserted	Expected Weight to be Dispensed	Actual Weight Dispensed	Recorded Weight Dispensed	Percentage Difference	Remarks
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Functionality of the Whole System (modified price per kilo)

No. of Trial	Displayed Amount of Available Rice	Displayed Total Amount of Bill Inserted	Expected Weight to be Dispensed	Actual Weight Dispensed	Recorded Weight Dispensed	Percentage Difference	Remarks
1							
2							
3							

4							
5							
6							
7							
8							
9							
10							

Evaluation

In this section tables are presented to evaluate the speed of the system compared with traditional way of selling rice. Also, the capability of the proposed study was evaluated to determine if it is acceptable or not.

The researchers evaluated the speed of the system depending on the time it takes the bill acceptor computes the total amount of bill inserted as well as the time it takes to dispense its equivalent weight of rice. The researchers inserted three different amounts and recorded the time it took for each transaction.

Time Response of the Machine Before and During Dispensing the Rice

No. of Trial	Bill Inserted	Response Time (sec)	Amount Dispensed	Response Time (sec)	Total Response Time (sec)

Total Response Time Comparison between Manual and Automated Selling of Rice

No. of Transaction	Weight of Rice	Total Response Time for Manual Selling (sec)	Total Response Time for Automated Selling (sec)
1	1kg		
2	1.5kg		
3	2kg		

Amount of rice dispensed satisfied by the amount of bill inserted

No. of Transaction	Bill Inserted	1kg amounting 50 pesos	1.5kg amounting 80 pesos	2kg amounting 100pesos
1	20 pesos	0	0	0
2	40 pesos	0	0	0
3	50 pesos	1kg	0	0
4	60 pesos	0	0	0
5	70 pesos	0	0	0
6	80 pesos	0	1.5kg	0
7	90 pesos	0	0	0
8	100 pesos	0	0	2kg

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