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Development of an Intelligent Automated Eatery House System

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ABSTRACT The development of an intelligent automated eatery house system is the focus of this research work. The challenges faced by the fast food restaurant operators (eatery) basically were service dissatisfaction which includes: delay in the presentation of the ordered food, physical presentation of money after eating to the waiters, argument in term of wrong presentation of food against the customer wishes. A traditional eatery outfit has a counter where customer can place their order and then make the payment, thus the needs for an employee to take the order and processing the payment. Labour rates are increasingly high nowadays and it is difficult to find the number of workforces in the middle of the hard-economic situation, hence to solve this problem the design of an Intelligent Automated Eatery House System becomes necessary. The experiment approach was adopted using electronic components. The device was put together in two parts: the transmitting and the receiving modules. The schematic design was developed and simulated using Proteus whereas the hardware was implemented using the printed circuit board. The result from this design brings better applications of technology to the daily operations of the eatery outfits. The self-service fast food restaurant is developed and equipped with a user-friendly touch screen system and software design develops to complete the process at the backend. The functionality of the design was proven, the result during the operation of the device shows that the stress of placing an order in the eatery was reduce, processing and payment making was easy through credit/debit card reader, it also provides the means of monitoring both the staff and the customer transaction by the eatery owners. The discrepancy between the chef and waiter during account reconciliation was negligibly absence. A sizable number of employees were kept at counter thereby reducing the cost of labour. The portability of the device to replace food menu also make the design unique; reduction of queues at the counter due to the speed of execution and number of optimum screens to accommodate the maximum output. It is only the system administrator that has the rights to enter the menu with their current prevailing prices, this solve the problem of price manipulation, were a secured system password to change the menu contents by adding or deleting an item or changing its price is solely with the administrator. The system renders 24 hours for 365 days, because the machine will not be sick or go on vacation. Further design should consider a means of placing order from a distance like home or workplace.

Keywords: Eatery, Smart, Arduino, Ordering, Automated

I Introduction

Background Information on Intelligent Eatery

An Eatery is simply a place where foods, drinks are prepared and served. These include restaurant or cafeteria. These are commercially established outfit where food, drinks and other eatables items are served. A restaurant or an eatery is a business ensemble which prepares and serves food and drinks to customers in exchange for money. Meals are generally served and eaten depending on the individual demand, the price for the services are presented in a menu. Each waiter is assigned to a group of tables, after taking orders for a table the waiters enter the order (a list of dishes and drinks ordered by the diner or group of diners) into the system. An intelligent and automated eatery house system is an integrated smart eating outfit with computerized accessories that accelerates the order and service with fewer waiters with prompt attention (Bhargave *et al* , 2013)**.** Also, as a smart system the robot can be made to function as human (humanoid) in some cases.

Figure 1: Picture of an Eatery Set-up

A smart Eatery is a restaurant management and billing system that makes it easy for one to manage a Restaurant or hotel. In this case, software is specially developed to serve the hotel or restaurant industrially. This helps in making the management of the outfit easy. The billing system can be handled easily for both take away items and immediate consumption services.

The smart concept reduces the manually working hours by managing the invoice, food movements and the daily sales etc. This has ultimately increased the productivity which makes it possible for one to run the restaurant in a profitable manner. The features of this Smart Eatery system include the following: firstly, it has a Counter service capability which includes: Kitchen order ticketing, Sales accounting for each item, Reports on daily sales, End of day sales calculation, Employee allocation and management; secondly, it has Customer Remote Service and Monitoring system which include: Customer analysis reports, Customer sales history, Order management and Invoice generation based on the orders placed, and lastly, it has a Back-Office Management system which includes: Purchase entry,

Stock Management, Closing stock reports. An Intelligent Eatery outfits business be it small, medium or large will bring the business to the next level to achieve the level of productivity and sales.

Problem Statement

Many at times, some of the customers eat in a restaurant without making payment for the services rendered. This may be as a result of inability of the eatery servers to provide a means of knowing which of the table was served; which waiter was in-charge, especially when the customers are many. Most of the time the customers complain of not feeling satisfied on the services offered especially when it comes to time management. There are many reasons leading to this feeling of dissatisfaction. This includes attending to customers late as against when the order was taken by the waiter and meals served. This issue of being late to attend to customers could be solved with help of the advancement in the smart technologies. The waiters are not good time managers as such delay the customers in their traditional eatery business. The need to Automate systems are increasing as day passes by. Applications such as homes and industries find automation as a means of reducing man power with the increasing efficiency. This research project considers the design of an automated menu for ordering meals in the restaurants.

Objectives

The purpose of this research design is to develop an intelligent and automated Eatery system through the following objectives:

i. To develop a system that will relate the customer's demands to the chef in the kitchen without the waiter coming to take order.
ii. To develop a system that will intelligently monitor the eatery house, recognizing each of the table and the number of customers on it.
iii. To develop a smart means of making payment with feedback system after eating.
iv. To design a smart system that can serve a large number of people at the same time (Robot)

Justification of the Study

These designs find its application in Hotels where the management of guest and their time is relatively paramount. In student cafeteria where it is difficult to serve many students at a time, the advent of this design will witness a shift from their traditional line-up policy thereby making the cafeteria less rowdy. The restaurant operators which is referred to as the eatery outfit owner will no more run at a loss because measures have been put in place to monitor the effective operation of the firm intelligently.

Scope of the Study

This research will cover the design of an intelligent eatery outfit, modelling, simulation and implementation. The purpose of this research is to demonstrate the extent to which high-level systems concept is used to describe the functionality of this system. This study lays out a framework for a new system to be developed and brought to the market for maximum use.

II Literature Review

The efficient restaurant's ordering and billing system was developed to replace the paper and bill board system. The design was easy to implement in restaurants management and give a technical touch which help automatize the working of Restaurant. Its design was demonstrated as in figure 2

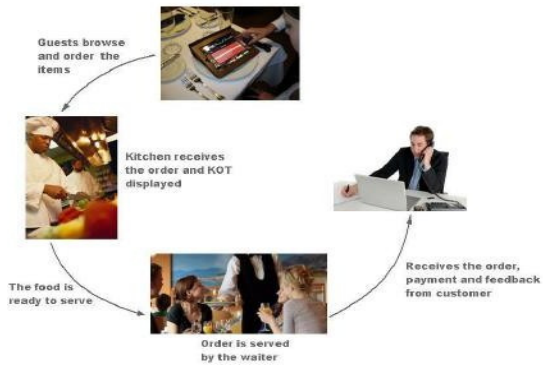

Figure 2: The architecture of automated Restaurant system

From figure 2, as the customer enters the restaurant, the tablet on the table helps him to place order from the digital menu gadget. When the order is confirmed, there will be a display as a feedback to the customer while the display screen in the kitchen also shows the same status.

Figure 3: The networked Service technology system

After the chef has completed preparing the items, the system will notify the customer. Similarly, when the customer has finished eating the food, the bill will be directly displayed on his gadget as well as managers system (Bhargave et al , 2013). An android application forms the basis of this research design. Where mobile app was used to create a smart environment for the ordering to strive. A Similar view will be adopted for this design (Gandhewar and Sheikh, 2010).

In another development, the flourishing growth on wireless technology and Mobile devices create a great impact on our lives to complement on some early efforts made to combine and utilize both of these technologies in advancement of

hospitality industry. This research work aims to automate the food ordering process in restaurant and also improve the dining experience of customers. In this paper, discussion on the design & implementation of automated food ordering system with real time customer feedback for restaurants. This system implements wireless data access to servers. The android application on user's mobile will have all the menu details. The order details from customer's mobile are wirelessly updated in central database and subsequently sent to kitchen and cashier respectively. The restaurant owner can manage the menu modifications easily. The wireless application on mobile devices provide a means of convenience, improving efficiency and accuracy for restaurants by saving time, reducing human errors and real-time customer feedback. This system successfully overcomes the drawbacks in earlier PDA based food ordering system and is less expensive and more effective than the multi-touchable restaurant management systems (Tanpure et al, 2013).

Furthermore, the researcher developed a low-cost Home Automation System with wireless remote control. This design was put in place to help offer support in other to meet the needs of elderly and disabled persons at home to control its device. This intelligent management home concept has greatly improved the standard of living at home. The design uses a wireless Bluetooth technology to provide a remote access from smart phone as it controls mechanism (Ramlee *et al*., 2013). The design provides an electrical switching which makes its control system safer with low voltage activating technique. At every switching status, the system synchronizes with the control system mechanism as such every user interface indicates the real time existing switches status. The system was able to control electrical appliances and devices at home with a relatively low cost as designed. It's also facilitates a user- friendly interface and offer ease means of installation (Professor and Scholar, 2016); (Hashim and Ali, 2013).

According to Hashim and Ali (2013). stresses that the development of a smart ordering system with Bluetooth configuration to be use in the restaurant to replace a conventional paper ordering system that has price tag.

In another development a newly introduced design scheme with a Touch screen-based Menu ordering system applied to middle and small hotel were proposed. The development of this Menu ordering was based on the software-hardware platform on ARM11 (Raspberry pi Board), using Zig Bee short-range radio communication technologies. Its advantages were that of high performance-cost ratio, low power, high reliability and friendly user interface. It also introduces two sections one is hand held device section and other is main section and both sections consist of Zigbee transceivers. At first, order is taken and saved in memory and this information is forwarded to the second stage via Zigbee wireless communication. Whereas, the main section will receive the information from the first section and displays that data on screen. According to that order which is in display, service is provided. A 3.2-inch Touch screen LCD is used to select the menu and transmit the data, a PC is used to receive and display data and record for billing (Kumar and Amarnath, 2015).

The developed smart system proves itself effective and efficient with guarantee of being user friendly for both the customers and operators with LCD display modules (Hashim and Ali, 2013)

Touch screen-based design took stage in automated menu system design for restaurants application and the speech recognition module and a colour graphical LCD to provide a user-friendly environment and also form part of the new**est** innovation. With this design, there is no need of a person to take the order from the customer's table. The menu will be displayed automatically on the customer's table and it can directly order the choice with the help of either touch screen sensor or speech recognition module. The user can also request the order even through speech commands using speech recognition module. Touch screens provide fast access to all types of digital media, with no text-bound interface getting in the way. Using a touch interface, it can effectively increase operator accuracy, reduce training time, and improve overall operational efficiencies. Transmission of data is through Zig-bee which is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power, wireless sensor networks (Meeravali *et al*, 2013).

It is no newer that automation has played a very vital role in every field of human life and this paper contains the proposal of a fully automated menu ordering system in which the paper-based menu is replaced by a user-friendly Touchscreen based menu card. The system has PIC microcontroller which is interfaced with the input and output modules. The input module is the touchscreen sensor which is placed on GLCD (Graphical Liquid Crystal Display) to have a graphic image display, which takes the input from the user and provides the same information to the microcontroller. The output module is a Zigbee module which is used for communication between system at the table and system for receiving section. Microcontroller also displays the menu items on the GLCD. At the receiving end the selected items will be displayed on the LCD and by using the conveyer belt the received order will send to the particular table (Prema, 2017).

A Design of E-menu card in Smart Restaurant using Arduino was formulated as way of researching into the smart restaurant to attempt solving the problems being faced by customers and the owners of restaurant. The problems are shortage of manpower, employee theft at the cashier, mistakes in taking orders, mistakes in delivering order, mistakes in Billing, impatient customers queuing outside, mix ups in matching credit cards to the respective customers. The design smart restaurant was able to solve the problems at minimum cost and minimum power. These problems can easily get sorted out by increasing the use of automation in taking and receiving orders using electronic menu and solve billing issues by using RFID tag. This designed smart restaurant provides orders system that favours both the eateries operators and customers since the customers can easily order from e-menu available at table. The design was wholly controlled and powered by ATMEGA328P: Arduino Uno (Sharma, 2016).

With the advent of technological development, food industries have also had good prospects. Especially now that many the restaurants are automated and simplified in its operation. That is the reason why the touch screen-based ordering system is one of the solutions to avoid the time delay. Traditionally the waiter takes the order from the customer then places the order to the kitchen and then the billing is done if this process saves the time then it is highly appreciable, for this purposed design, a digital menu ordering system using AVR –microcontroller is

developed using 8 bit AVR microcontroller, touch screen, Graphic LCD display, USART for serial communication and LCD display for displaying the result. Advance touch-screen based menu ordering system allows the user or customer to select any items by their choice which are in menu display & that order will be transferred to the manager's desk as well as chef side for further processing &that ordered item will be given to that customer. As design it's provide each table with a microcontroller-based order placement unit. The unit has a touch screen to browse through the menu. The menu items, their cost and information shall be displayed on the touch screen (Soitkar *et al*, 2014).

The validation of the smart menu was issues of popular demonstration as another researcher deigned an Automated Food Ordering System with Real-Time Customer Feedback.

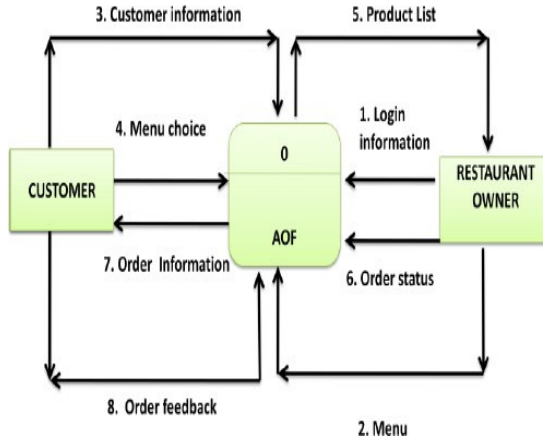

Figure 4: The block representation of an Automated Food Ordering System with Real-Time Customer Feedback.

This research was as the result continuous growth in wireless and Mobile technology. Some early efforts have been made to combine and utilize both of these technologies in advancement of hospitality industry. This research work aims to automate the food ordering process in restaurant and also improve the dining experience of customers. In this paper we discuss about the design & implementation of automated food ordering system with real time customer feedback (AOS-RTF) for restaurants. This system, implements wireless data access to servers. The android application on user's mobile will have all the menu details. The order details from customer's mobile are wirelessly updated in central database and subsequently sent to kitchen and cashier respectively. The restaurant owner can manage the menu modifications easily. The wireless application on mobile devices provide a means of convenience, improving efficiency and accuracy for restaurants by saving time, reducing human errors and real-time customer feedback. This system successfully over comes the drawbacks in earlier PDA based food ordering system and is less

expensive and more effective than the multi-touchable restaurant management systems (Tanpure *et al*, 2013).

Soitkar *et al* (2014). developed an Information System for Fast Food Restaurants application and this provide the possibility of automation with a single system as a small cafe (or a restaurant), and the whole network of institutions with graphical interface with support of touch screens; also has operative multi-use's access and managements of orders with flexible and ability to extend in the future. It uses object- oriented programming language and the implementation of a data warehouse as a relational database. To reduce costs, the owners of restaurants buy single touch screen computers with slow CPU performance. For the design of information system, the unified Modelling Language UML is used. The paper describes the purpose of each class and association with other Researcher idea varies from time to time here, an automated food ordering system using Cypress's Programmable System on Chip (PSoC) was proposed and implemented. This system is based on wireless communication technology for transferring data between various modules. The system includes the food ordering instrument and the receiving section. The system uses Cypress's ARM based PSoC5 as the controlling chip of the food ordering instrument. It uses a matrix type keyboard to realize data input that includes choice of food, quantity of dishes etc. It uses Nokia 5110 graphical LCD to display. Through the Cypress's

> CyFi wireless module, the receiving section receives the data that is transmitted by the food ordering instrument. The system uses PSoC5LP as the controlling chip of the receiving section. This microcontroller unit is connected to a PC which acts as the user interface, through which the owner or admin can save the data that is transmitted, into the storage database. In the case of small to medium restaurants, the automated food ordering system can provide more flexibility to the customers, improve management efficiency and reduce labour costs and therefore, this system has many application prospects (Indu and Das, 2017).
>
> A Comparative approach between the conventional food initiative management and the wireless self-service ordering management system in restaurant administration were the basis of this research. The researcher designs a self-service ordering system with software and implement it with hardware also. In this design a touch screen displays system was develop where the choice and prices of the food for customers to input their orders directly by touching the screen. The system as automated provides the data received, stored, displayed, and analysed for the eatery operator at convenience **(**Oleynik *et al.*, 2015).

Limitations of Study

In comparing this approach with the traditional were of operation and eatery in Nigeria, it provides the conventional food initiative management and the wireless self-service ordering management system in restaurant administration as the basis of this research required. These self-service ordering systems with software is capable of being implemented with hardware also. In this design a touch screen displays system was developing where the choice and prices of the food for customers to input their orders directly by touching the screen. The system as automated

provides the data received, stored, displayed, and analysed for the eatery operator at convenience. From the literature so far gathered, a new approach is deduced to develop this design.

III Materials and Methods

A. Materials

Software Tools:

1. Proteus
2. Arduino IDE
3. Android Studio

Hardware Tools: The following materials were used to achieve this design:

i. Arduino Uno with ATMega 328P
ii. Liquid Crystal Display
iii. Crystal Oscillator
iv. Capacitors
v. Resistor
vi. Human Machine Interface (HMI)/Key Pad/Touch Panel
vii. Bluetooth/ ZIGBEE
viii. Polypropylene,

B. Method

The method adopted for this design is represented in a block in figure 5 below

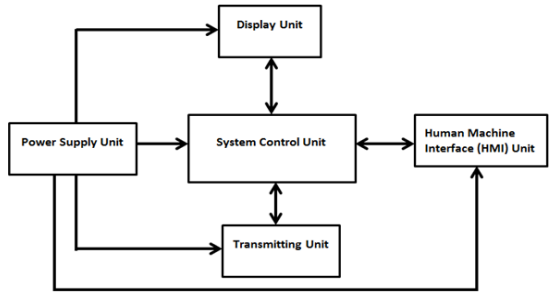

Figure 5: Block diagram of the Transmitting system of an intelligent and automated Eatery system

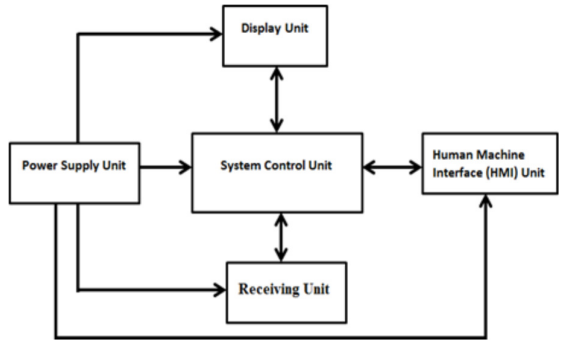

Figure 6: Block diagram of the Receiving system of an intelligent and automated Eatery system

C. Flow Chart

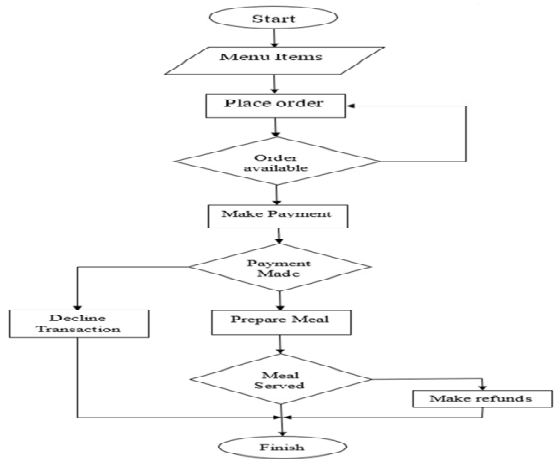

Figure 6: Flow chat of the Eatery system

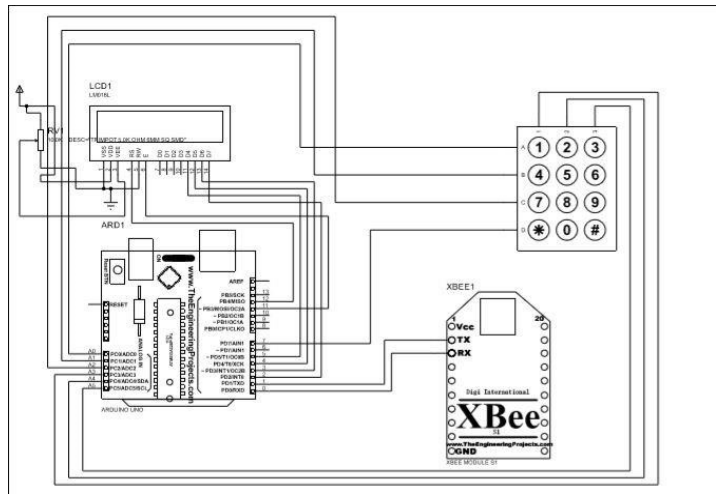

Figure 7: Schematic diagram of the Transmitting system of an intelligent and automated Eatery system

Transmitter units are used for ordering from the menu. A 4×3 keypad is used to select the items. Four rows of the keypad are connected to PORT C of the micro-controller, while the three columns are connected to PORT D.
The food varieties allocation to the Human Machine Interface [HMI] (keypad):

i. Number 1 is Ice Cream
ii. Number 2 is Garry and Okoro Soup
iii. Number 3 is Rice and stew with chicken
iv. Number 4 is Rice and Goat Meat Pepper soup
v. Number 5 is Fry Rice with Salad & Goat Meat
vi. Number 6 is Pounded Yam with white Soup
vii. Number 7 is Hamburger with yogurt
viii. Number 8 is Sharwama with Chapman
ix. Number 9 is Garri and Mellon soup
x. # Transmit (Placed) the order to the receiver
xi. * Make payment for the order
xii. 0 means Cancel and placed an equivalent order.

Zigbee transmitter is connected to the transmitter and receiver the pins of the microcontroller. The transmitter pin of the microcontroller is connected to the transmitter of the zigbee transmitter module. No need of connecting receive pin, as the module only transmits the data. Liquid Crystal Display is also connected in order to view the selected items. Here LCD is used in 4-bit mode.

D. Receiver units

The receiver units are in the kitchen where the order placed by the customer is received by the zigbee receiver. In this zigbee network a single receiver is used to

receive data from different transmitters. Thus, received data is decoded and is displayed on the Liquid Crystal Display.

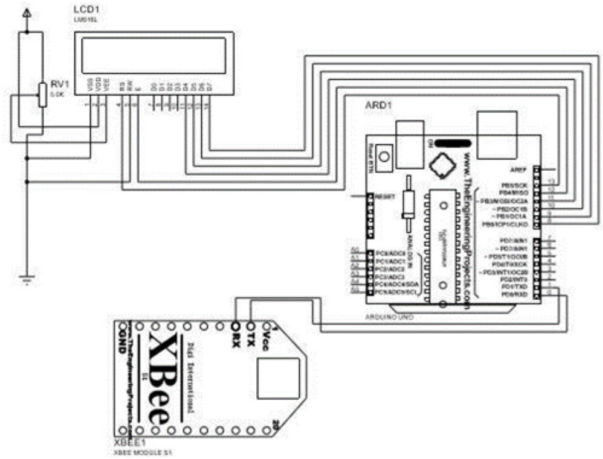

Figure 8: Schematic diagram of the Receiving system of an intelligent and automated Eatery system

E. Implementation

The intelligent and automated eatery system has in its design a transmitting and a receiving system. The schematic design was presented in the software (Proteus) and the programme was written and Compile in Arduino IDE. The programme was then embedded into the microcontroller in the schematic diagram and simulated. Similarly, the design was implemented using hardware components; the schematic design was first routed and printed Circuit board of the design as well as 3D view was produced.

F. Design of the Packaging

The design consideration for the device packaging included: operating environment, cost parameters, assembly method, and mechanical requirement. A plastic material, Polypropylene, was selected for the packaging design because its excellent properties of chemical resistance, lightweight, heat resistance, and low cost. The design of the design of the packaging was carried out using SolidWorks design package. Figure 9 and 10 shows the assembled package of the Transceiver and Display System, respectively.

Figure 9: Assembled View of the Transceiver Package

Figure 10: Assembled View of the Display System Package

G. Principle of Operation

This intelligent automated Eatery House System has its **MENU** displayed on the Liquid Crystal Display device. A unique number is tagged to particular food varieties, where the user should press the matching number of the selected item in the Human Machine Interface. Technically, the design project is coded with an assembling language to provide the interaction between the transmitting and the receiving devices. It is written in such a way that one can select 3 items at a time. In real time one can use EEPROM of the microcontroller to store the menu. Items are selected using keypad provided. For example, in order to select "1. Ice cream" press 1 one from the keypad. Similarly select your items and press '#'. Pressing '#' will transmit the order to the receiver.

IV Results

The handheld self-ordering device was the final product of the design, as shown on Figure 11. The functionality of the design was proven, the result during theoperation of the device shows that the stress of placing an order in the eatery was reduced, processing and payment making was easy through credit/debit card reader, it

also provided the means of monitoring both the staff and the customer transaction by the eatery owners.

Figure 11: The Designed Transceiver System

V Discussion

The portability of the device to replace food menu also make the design unique; reduce of queues at the counter due to the speed of execution and number of optimum screens to accommodate the maximum throughput. It is only the system administrator that has the rights to enter the menu with their current prevailing prices, this solves the problem of price manipulation, where a secured system password to change the menu contents by adding or deleting an item or changing its price is solely with the administrator. Figure 11 shows the design casing for the receiving and the sending device called transceiver, as supported by (Ramlee *et al*., 2013).

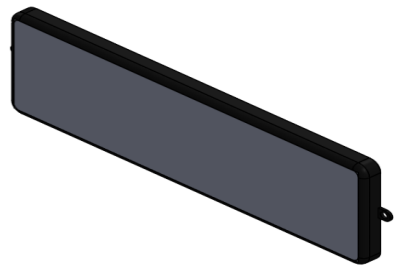

Figure 11: The Designed Display System

VI Conclusion

The development of an intelligent automated eatery house system in Nigeria has help in overcoming the challenges of delay in presenting the ordered food, physical presentation of money after eating to the waiters, argument in term of wrong presentation of food against the customer wishes were resolved. This will help in

replacing the traditional eatery where customer can place their order and then make the payment, thus the needs for an employee to take the order and processing the payment. The experiment approach was adopted using electronic components. The device was put together in two parts: the transmitting and the receiving modules. The schematic design was developed and simulated using proteus whereas the hardware was implemented using the printed circuit board. The result from this design brings better applications of technology to the daily operations of the eatery outfits. The self-service fast food restaurant is developed and equipped with a user-friendly touch screen system and software design develops to complete the process at the backend. The system renders 24 hours for 365 days, because the machine will not be sick or go on vacation. Further design should consider a means of placing order from a distance like home or workplace.

VII Recommendations

It is obvious at the initial adoption and use of this proposed device, some customers may find it difficult. The eatery operator should be on ground to educate them until they get acquainted with it. Further design should inculcate a real time monitoring system for chief Executive supervisory assessment of its operation, daily, weekly, monthly and yearly. The design be made to facilitate the placement of order at individual convenience from any location using suitable applications.

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