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ARDUINO BASED RESTAURANT MENU ORDERING SYSTEM

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Abstract

The role of restaurants, canteens, other forms of eatery and food service outlets are becoming very big part of most economies at different levels. However improvement in customer experience while making orders plays a very critical role in having a smooth and efficient menu ordering process. This article presents a novel hybrid approach that tackles the challenges associated with menu ordering especially in the post-covid era; both from software and hardware perspectives. First, a web-application - powered by ReactJS and GraphQL, which enables order request anywhere at any time was developed. In addition, is the implementation of hardware with mobility feature on trips to the restaurant using two Arduino microcontrollers (transmitter and receiver). The result allows the user to browse through a catalogue, check-in and out on a Thin-Film-Transistor (TFT) liquid-crystal display (LCD) and deliver a seamless experience to the customer.

Key words: Transmitter, restaurants, software, microcontroller, restaurant

1. Introduction

The improvements in Information and Communication Technology (ICT) have resulted in the increased number of industries that transfer information via the internet [1]. The restaurant or fast food industry is one of such industries in which a menu ordering system is commonly adopted. A restaurant menu ordering system is a system that allows customers to place orders without necessarily having people manually take those orders. A restaurant menu ordering system replaces the conventional way of placing orders in restaurants which requires a lot of manpower and mostly inefficient. The traditional method by which orders are made is dependent on a lot of manpower to handle customer reservations, order placing on tables, food ordering, and other activities involved. Therefore, improving customer experience requires a distinct and innovative technological advancement. One of such systems is a digital multi-touch menu cards in which orders are taken from customers according to their menu requirements [2]. In the digital meal ordering system, orders are placed digitally through a touch screen device, sent to the database for cash point notification after which orders are being sent to the tables for service. Similarly, online food ordering systems have also been explored, which provides a menu on the web and allows users to easily order their food based on their respective preferences using personal devices. One important feature of an online food ordering system provides is a tracking feature through which customers can track their already placed orders [3]. Systems of this nature has witnessed improvements on mobile devices such as smartphones for both android and IOS devices.

The use of Personal Digital Assistants (PDAs) has also been established to have some challenges. Some of these are small screen sizes, susceptibility to health hazards, training of manpower and ineffectiveness during peak periods. This study has identified some of these challenges with the aim of reducing the customer turnaround time and ensure maximum efficiency.

This research designed and constructed a smart restaurant menu ordering system which do not require restaurant waiters to take orders as obtainable in existing restaurants ordering system. The output of this work also allows tracking of orders through menus implemented using Arduino. In addition is the upload feature of orders placed to a database accessible in real-time. One of the uniqueness of this design is the ability of customers to seamlessly monitor the turnaround time for their orders to be delivered. The significance of this study cannot be overemphasized, especially with the potential to change food ordering narratives globally. The capacity of this system is not limited to restaurants; but applicable to hotels, bars, guest houses and many other forms of business processes where ordering is involved.

2. Review of Literature

Most restaurants in large cities often experience large influx of customers, however the advent of post-covid effect has created much awareness for remote ordering of most commodities including food items. This method is gradually eliminating congestions in public places. This section will explore relevant concepts, previous literatures and their methodologies, strengths as well as gaps with respect to food ordering in restaurants.

Jakhete et al [4] proposed a smart restaurant menu ordering system using android tablets provided by the restaurant. This approach enables customers to place their orders on the android tablets and forward each order to the kitchen through Wi-Fi. An in-depth explanation of the technical operations of the application is required to be pre-loaded into an android smartphone or tablet which contains the menu items and details. Menu details are loaded to an ARM LPC2148 microcontroller connected to the android device over Wi-Fi. The output of this work is limited to premise of the restaurant, hence orders cannot be placed remotely [4].

A touchscreen-based menu ordering system was projected by Banker et al [2]. This intelligent system employed the use of a Liquid Crystal Display (LCD) screen with a graphical user interface (GUI) that has been programmed using embedded c language. The study uses ATmega1280 Arduino microcontroller, and an RF module for communication. Their work do not require any special training which makes it easy to deploy. The work ensures fast communication between the customer and the kitchen officials in making the order ready. However the system implementation lacks modularity in structure such that failure in a section leads to total system breakdown [2]. Chavan et al [5] purported a customizable online food ordering system. In this food ordering system, online ordering is possible with seamless delivery to the customer and payment features included. This study display in detail the process of food ordering via the internet and particularly highlights payment method (PayPal). The strength of this study was more on the payment platform but cannot accommodate non-android users. [5]

Koubai et al [6] also developed a system using internet of things (IOT) concept. The authors designed interconnection of devices and gadgets over the internet. The system provides varieties of tools used for services in an integrated manner including refrigerators, ovens, grills, etc., Orders related to individual devices could be placed and reservations will be handled over the internet, thus making data transfer seamless. However, performance is slow and could not work in locations without internet.

The system also sidelines customers who don't have access to the internet or who do not have the technical know-how on its operations [6].

In Cotta et al [7], a handheld device system with two modules was introduced (sender and receiver). These two modules use Bluetooth technology for communication which is an improvement on the conventional approach. One major drawback this system is the limited range of the Bluetooth technology [7]. A framework for smart restaurant management and ordering system that aims to reduce order mix-ups was proposed Liyanage et al [8]. The authors introduced a futuristic approach that makes use of machine learning, data mining, artificial intelligence, business intelligence and predictive analysis. By combining all the technologies, a unique dining experience was created for the customers base on choices. If deployed, the system will include a mobile application that will enable customers to view menu in 3D imagery [8]. However, no record of deployment found yet.

Baranwal et al [9] formulated a framework to handily oversee online menu where food items could be updated according to the accessibility of food and costs. The proposed framework is created with an open source programming and implicit information modules. The information module in the proposed can showcase consumption issues like obesity, overindulging and others [9]. Esenowo et al [10] research focused on Intelligent Automated Eatery House System, an investigative approach was explored. The gadget was designed in two sections using Proteus. The authors achieved a seamless back office workers involvement in the entire ordering process and the output was demonstrated, the outcome during the activity of the gadget shows that the pressure of putting in a request in the diner was decreased, payment was simple through credit/debit card reader, although no method for

observing both the staff and the client exchange was included their findings [10]

The research by Sowndarya et al [11] achieved a marginal effort for setting orders for food in guest houses and cafés. A touch screen driven interfaces was recorded as a progression in the field of innovation. This structure is easy to understand and guarantees the great nature of administration and consumer loyalty. Similar proposals were presented in [12-13]. Correspondingly, In Rathore et al [14], a significant improvement on the visual experience of menus using an electronic menu card was achieved. The new methodology is unique compared to the regular food requesting framework recorded by previous authors. The system accommodates remote notification using ESP01 module as a specialized gadget. UART correspondence with a transmitter and receiver was programmed for timely arrival of messages and customer requests. Several attempts has been made to replace the regular method of placing orders in restaurants especially in a high demand environment. The reviewed literatures, revealed common gaps encountered with different proposals of restaurant food ordering system ranging from cost to constant internet connections. Hence a hybrid system is required.

3. Methodology

In this work a rare combination of effective methodology to replace the conventional menu ordering system in an efficient manner is designed and implemented using two main systems. The first being an online platform where customers can place orders and possibly track them while the second is a menu ordering system using Arduino which can be used to place orders in the restaurant. A web application where customers can view the available food items and drinks, make reservations, place their orders, and track the orders is designed. This application is developed with utmost user experience such that the user gets a comfortable feeling when using the application.

The front-end development tools used in this research are HTML & CSS, JavaScript, ReactJS, AngularJS, VueJS. The methodology encapsulates programming of the basic functionalities of the application like routing, button clicking etc. The back-end development uses a server-side database with information system and management capability, storing and retrieving ordering information with NodeJS. Postman was used to test the routes on completion and ensure proper functionality. The entire system flow is illustrated in Figures 1a and 1b. The menu ordering system uses a smart approach such that customers place orders using the TFT LCD touch screen display as illustrated in the flow diagram. The RF Transmitter section and an RF Receiver section uses ArduinoUno microcontroller for data processing, 433MHz RF Transmitter and Receiver formed major components used in this methodology.

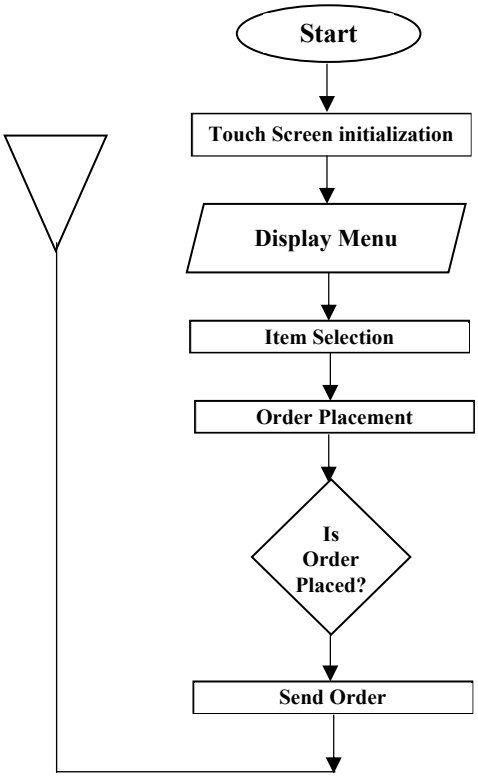

Fig. 1a: Flow chart for the transmitter module

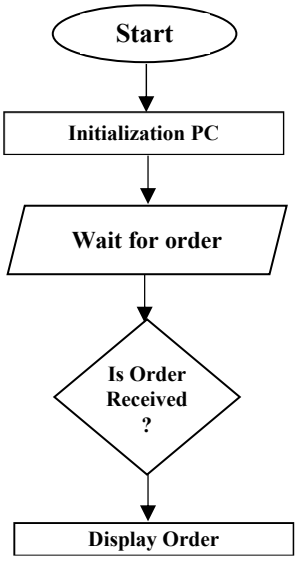

Fig. 1b: Flow chart for the receiver module

Components Specifications

In this research, the transmitter subsection is a combination of a microcontroller, RF Transmitter, and

an LCD. The main purpose of this section is to facilitation customer request through the menu as appeared on the display.

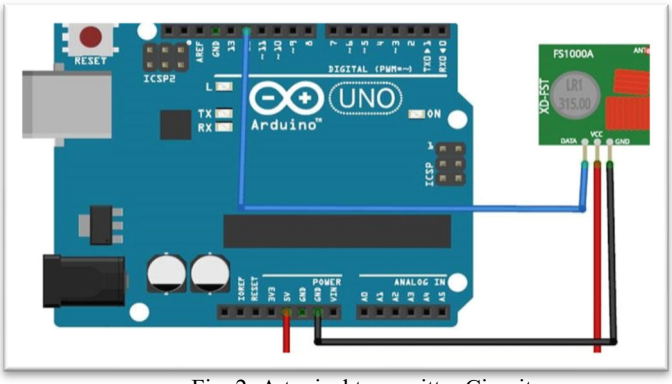

Fig. 2: A typical transmitter Circuit
Source: Ashish Choudhary [15]

The RF transmitter module is linked with the pin transferring the data, this is also linked with the digital pin 12 of Arduino. Both GND and VCC pins are linked with the 5V and GND pin of the microcontroller. The second module of the design in this research is the receiver, which display data using the 16 * 2 LCD Module. The data pin of this section is connected to the digital pin 11 or the Arduino. The GND pin and VCC are linked with 5volts. For improved efficiency, a buzzer, SCL and SDA of the I2C module are linked to the analogue pins A5 and A4.

4. Overall Construction

A combination of hardware and software subsystems as indicated in the flow (Figure 1a and 1b) are implemented. The web application of the Hybrid restaurant menu ordering system is tested against varieties of requirements through user sign-in and orders of food items, adding to cart and checkout request. Tracking of order placements and modification is also an added feature. The different feature of the system deployment include;

Authentication

The system is built on Auth0 to validate access in two different ways (User name and password) as well as integration with external services such as Google, Apple or GitHub accounts. User details received from the authentication process are also being displayed in the user/profile section. Sensitive content are optional and customizable to be revealed or hidden when users logged in or out.

Content Fetching

A content management system (CMS) is used for fetching the content. This in addition uses the graph query language (GraphQL) service to query food items and other complementary data from the backend. This information are subsequently displayed for user access and onward processing. New food items can be added to the CMS and are reflected in real time. One of the uniqueness of the method employed in this research authentication approach is the use of GraphQL. With this framework, network requests are made with queries rather than Application Programming Interface (API).

Online Ordering

The web application enables users shop for food items and add multiple of them to the cart. The cart helps users to check out all items they are interested in seamlessly without having to check out individual item one after the other. This deployment enables addition of individual food items to the cart, modifying the number of units required for each food item, checking out the cart and payment

Similarly, orders can be tracked based on the turnaround time in minutes or days.

Physical device implementation

This physical device is an additional module which presents the novelty of this research in a rare combination manner of two major subsystems for users to select food items from the TFT display at the transmitting end forwarded by the RF transmitter module to the receiving end. The information is received by the RF receiving module with details of results achieved presented in the following sections.

Item Selection at the Input

Selectin of items on the TFT display is achieved using the touch pen through the transmitter of the setup. This selection is forwarded transmitted via radio frequency to the receiver for display on LCD. The maximum range of connection for the RF modules is close to 100 meters if connected with appropriate antenna power. The transmission speed of up to 10kpbs was used for the evaluation of this research. [16]. Figures 3-5 presents an illustration of the transmitter connection for various functionality in this project.

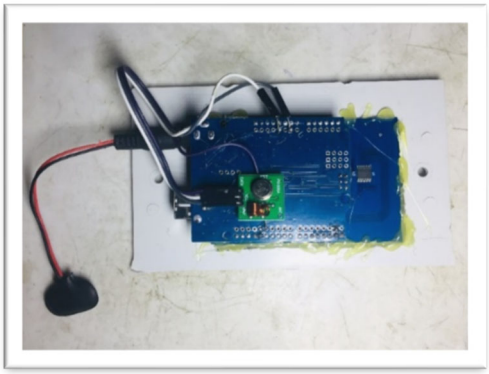

Fig. 3: Transmitter Connection-Internal View

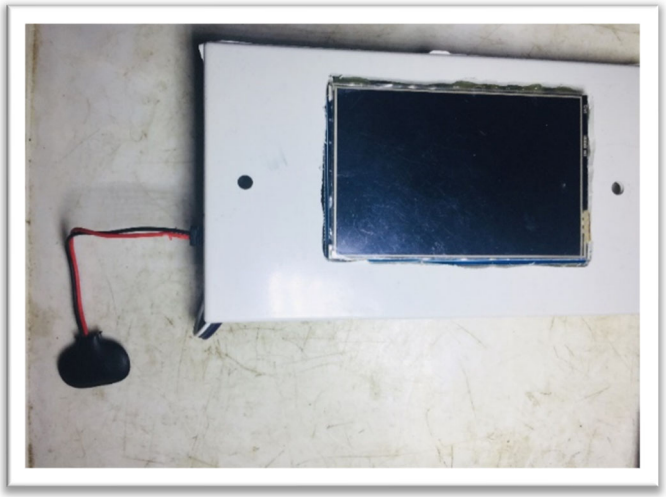

Fig.4: Transmitter connection – Front View

Fig. 5: LCD indicating Item selection on the transmitte

Output values and display of items

The item selected from the input (transmitting end) is sent over radio frequency and received at the output for display on the 16 x 2 LCD. A buzzer is also activated to acknowledge the receipt of the input. Figures 6-8 depicts concluding connections of the results.

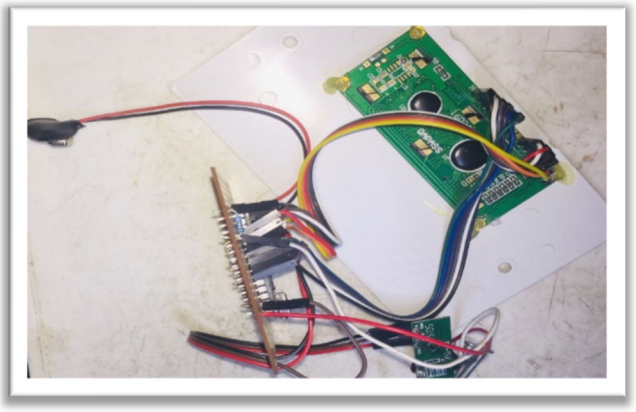

Fig. 6: Rearview of the Receiver connection

Fig. 7: Receiver connection with the LCD

5. CONCLUSION

In this research, a novel hybrid restaurant menu ordering system involving both the software and hardware solutions was implemented and tested successfully. The result of this work addresses the challenge encountered my customers while trying to get food items especially during peak periods in populous environments. The web application handled remote user request for food items with a very high flexibility and varieties of functionalities. The implementation using Arduino on the other hand is a unique addition and improvement of work done by previous researchers in similar areas. A unique and efficient method of order placement is achieved using with the combination of transmitter and receivers driven microcontrollers minimizing man power and maximizing turnaround time. The combination of these two implementations is a great enhancement of existing systems from the output of the functional prototype. The result of this research will form a significant economic addition for restaurants and other businesses to tackle extensively the bottlenecks that come with the prevalent manual process of ordering food in everyday restaurants. In future a mobile

applicable could be deployed with replication of the web application features.

Fig. 8: Overview of the completed prototype

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