Smart Shopping Mall during Pandemic Situation

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This Article is about an application for booking time for shopping in any registered shopping center during any pandemic situation. It will control number of people at the shopping center at each time, which will prevent virus from spreading between societies.

Abstract:

These days the world is facing a global pandemic (Coronavirus- COVID 19). This virus caused many deaths in all parts of the world. Also, led to weakness in the economy due to the closure of some global and local markets. Worldwide actions and measures been taken to limit the spread of this virus. Among these measures, the prevention of gatherings and the prevention of mixing between people. We all know the importance of shopping centers, which are often crowded and mixed. This helps the spread of the virus especially those symptoms differ from one person to another. In order to reduce gathering in the markets and shopping centers, the idea of creating a website and a mobile phone program aimed at organizing shopping in malls.

The aim of this article is to give you an overview about Smart Shopping Mall application. The application aims to be able to book an appointment in a shopping center. A certain number of customers is determined at one time and for each center according to its capacity. For that, the time cannot reserved if the number is complete, and the customer must choose another time or book an appointment in another center. After booking, the customer keeps a special number or a special code from the system (barcode) to confirm the reservation. All booking information will be send to the barcode reader. At the barcode reader, Arduino Microcontroller will be install and all information and booking details will be send by network. Barcode reader will be place at the entrance of the mall with a security man and will read the customer's code to verify the identity and the time of reservation by help of Arduino sensor to allow him to enter the center. This program will contribute to regulating the movement of people in the markets and reducing crowding.

Keywords: Health care, Phone application, Booking Time For shopping, Confirmation barcode, Barcode reader.

Introduction:

The idea of this project started after the emergence of COVID-19 pandemic around the world. This pandemic has caused the complete closure of some projects and facilities. Among these facilities, shopping centers. It was necessary to find a solution to the crowding of people in shopping centers. Nowadays, most people use modern and electronic technologies in most areas of life, especially with the emergence of this pandemic. Recently people have started shopping through e-shopping programs (online Shopping) in order to preserve their safety and health, to reduce crowding and to reduce the spread of this virus. However, sometimes, it takes people to go to the mall to choose the most suitable one for them. In order to organize the number of people in the shopping centers, it was necessary to find a program that would fulfill this purpose. These days, many programs organize the reservation of hotels, restaurants, lounges, cinemas and many more. So that reservations to be made in advance without the need to go and wait for long hours, which we always face when we go to some shopping centers. Moreover, do not forget that some people live in places very far from the city and take hours to reach these centers to buy their needs and daily necessities. This program will help them to ensure that there is no congestion or delay during their shopping so that they can return to their areas as soon as possible.

The idea of designing a shopping program came from the centers, similar to these programs that help organize reservations and make it easier for people to find what suits them. There is also a program concerned with organizing the reservation of football stadiums in one of the countries. However, the difference in this program is that barcode be send to the user after confirming the reservation directly via e-mail. Upon reaching the center according to the reserved time, barcode is recognize and read by barcode Reader device. We hope that this program will be approve even after the end of the pandemic, which in turn will contribute to limiting the spread of many diseases and seasonal viruses due to the regulation of the number of shoppers. Currently, work on this program is underway and it is expect to be ready for trial use in June 2021.

Literature Review:

During my planning, I could not find any application, which is similar to my idea. I found some applications, which used for booking different things like film in cinema, medical appointment, car parking and bus ticket.

First application is Cinema Station application, which able you to see all movies and book film at different Cinemas with selected time. Ticket will be generate for the customer in the application.

Second application, Medical Patient appointments. It will help you to search for hospitals or clinics or even specified doctor and choose an appointment to visit him.

Third application is Smart Parking System. This is use to check the availability of car parking and you can book parking for your car before you arrive to that place.

Last application is Smart E-Ticketing System that is used to book bus ticket. This will avoid crowding in bus station.
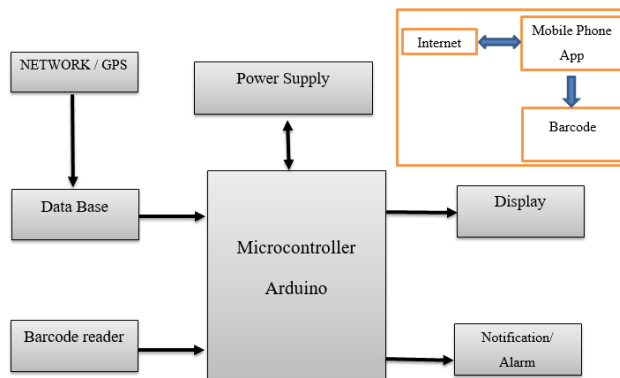
Design and Analysis

System Block Diagram

Figure 1 System Block Diagram

The principle operation of the system as follows:

Mobile phone Application: at the beginning, the user should have Internet to access this application. It will required registration to have an account for the user with his/her details. After registration, the user can sign in and start to use the App. Then, the user will choose the mall and will book the time for shopping. At the end, user will have barcode to confirm his/her booking. This barcode will be show for the security at the entrance of the booked mall. Barcode Reader will be place at the entrance to read the Barcode and confirm the booking.

Data Base: It will contain all the information about malls and markets in Oman. The user can choose the nearest mall or any mall around Oman.

Barcode Reader: it will be available at the entrance of all registered malls to read customer Barcode and booking details.

Microcontroller: Arduino Microcontroller will be use at this project. It is useful for this project because it is easy to program. It will be program and should be able to verify the barcode of the customer. Barcode will be save at Arduino Sensor with all details to give output and will be display for the mall Admin or security.

Display: After Reading the information from the Barcode Reader by using Arduino Microcontroller, it will be display at the Display screen. This will show Booking information including customer Name, Time, Date and Booking duration.

Notification/Alarm: Customer will receive notification at his Mobile App to remind him/her about the booking time. Alarm will be send two hours before the booking time.
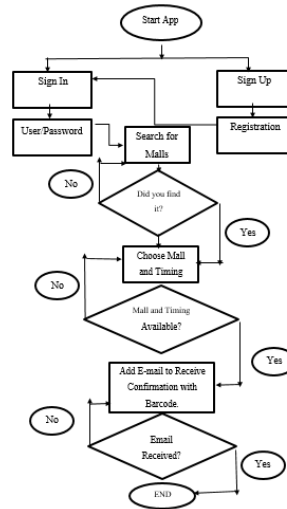
System Flow Chart

Figure2. System Flow Chart

Requirement Analysis

Handheld Barcode Scanner/Reader

As we see from the previous block diagram that we are using barcode scanner to read customer barcode. The main specifications of the recommended handheld scanner are show at the Table 5.2.1.1. This scanner should be connect to power supply of (100-240 V AC) and (50-60Hz). The operating current is (140 mA) with tolerance of (15 mA). The scanner can operate at temperature from (-20 – 50 C) (Handheld 2D Barcode Scanner, 2021).

Arduino Microcontroller Board

In this project, we are going to use Arduino Board that based or related on 8-bit ATmega328 Microcontroller. It is consisting of other different components like voltage regulator, crystal oscillator, serial communication, etc. These are use for supporting the Microcontroller. It has 14 digital pins (Input/Output). Six pins used as PWM outputs and six pins are analogue input pins. In addition, it has one USB connection, ICP header, reset button and power barrel jack. Operating voltage of Arduino is 5V and recommended input voltage is (7-12) V. considering that, input voltage limits is from (6-20) V. It is using (40 mA) as DC current on input/output pins (Arduino, 2021).
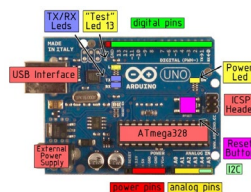

Figure 3. Arduino Microcontroller (Arduino, 2021)

Display

Display will be use at the output to show customer-booking details. No restricted specifications required for Display. You can use any type of display to connect to Microcontroller.

Initial Conditions

It is necessary to have power supply to switch it on. In addition, you have to program Arduino Microcontroller before connect it to the project. Open source Arduino Software (IDE) is using to program Arduino. You need to download and install the program from the website (https://www.arduino.cc/en/software) and then write your code. After writing the code, you can upload it to the board. Simple textual data can be send to or from Arduino board through serial monitor, which is included at the software. Online courses are available to learn how to program Arduino Microcontroller (ANON, 2021).

Input and Output Parameters

There are many pins on Arduino Microcontroller. The following are power pins:

- ✓ VIN. The Input voltage which is applied to Arduino board is 5V whenever using external power source from USB connector or other source of Regulated power. Even if you are supplying voltage power via power jack, you need to access it via VIN pin.
- ✓ 5V. the use of this pin is, to provide power for Microcontroller & all components on the board. This can be done from VIN or via on board regulator.
- ✓ 3V3. This is generated by on-board regulator. 50mA is maximum current draw.
- ✓ GND. It is a ground pin.

The Atmega328 has flash memory of 32 KB, used to store data. It uses 0.5 KB for boot loader. In addition, it includes1 KB of EEPROM and 3 KB of SRAM. Arduino has 14 pins, which can used as inputs and outputs. These pins have an internal pull up resistor (By default, they are disconnected) of (20-50 Ohms). Some other pins have the following functions (ANON, 2021):

- ✓ Serial: 0 (RX) and 1 (TX). This used for transmitting and Receiving TTL serial data. These connected to Atmega8U2 USB to serial chip of TTL.
- ✓ External Interrupts: 2 and 3. These pins used for trigging an interrupt on a rising or falling edge, a low value or a change in value.
- ✓ PWM: (3, 5, 6,9,10 and 11). Used for providing 8-bits PWM output.
- ✓ SPI: 10 (SS), 11(MOSI), 12(MISO), 13(SCK). These pins used to support SPI communication, which provided through underlying hardware.
- ✓ LED: 13. This is a built-in LED, which connected to pin 13. If the pin is High value, LED will switch on. If the pin is LOW value, LED will be off.

Arduino Uno has six analogue pins as an input. Each one is providing 10 bits of resolution. By default, they are measuring from Ground to 5V. AREF pin and analogue reference function can used to change upper end of pins range. Some other pins at Arduino Board have specialized functions as follows:

- ✓ I^2C : 4(SDA) and 5(SCL). Use wire library from Arduino datasheet to support I^2C communications.
- ✓ AREF. It is reference voltage for analogue input.
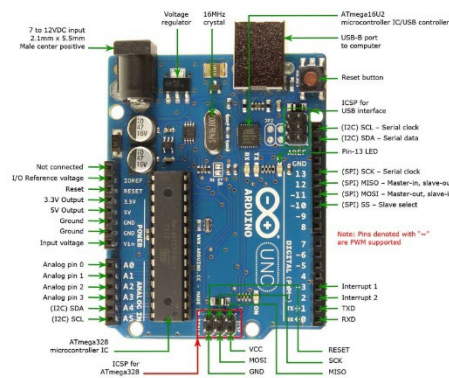- ✓ Reset. Used to Reset Arduino Microcontroller.

Figure 4. Arduino Pin Details (ANON, 2021).

Relations

As we see from Above System Block Diagram (figure 5.1), Barcode Reader will be connected to Arduino Board. The output from Barcode Reader will be 5V DC. This Voltage (5V DC), will be directly as an input for Arduino Board. Arduino data sheet shows that, the operating voltage must be 5V DC. In this case, Arduino will operate and work correctly. That signal will be transmit to the output Display.

System Design:

During the designing stage of this project, it is necessary to check Arduino operation. We will do simulation of analogue input for Arduino Board. There are two ways to do Analogue Input test.

First Method, we will need Arduino Board, Potentiometer and built-in LED on pin 13. We will use 3 wires to connect them to Arduino board. First wire, connect ground pin of the Arduino to outer pin of potentiometer. Second wire, from outer pin of potentiometer to 5V pin of the Arduino. Last wire, from middle pin of potentiometer to analogue pin 0 of Arduino. For this method, we can use board's built-in LED, which will be attach to pin No.13 of Arduino Board. For using additional LED, we have to connect the larger leg of LED (positive or anode leg) to digital pin No.13 in series with resistor of 220 ohms. Moreover, connect shorter leg (negative or cathode leg) to Ground pin, which is next to pin No.13 as shown at figure 5, and figure 6.
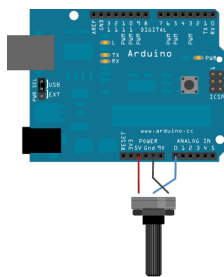

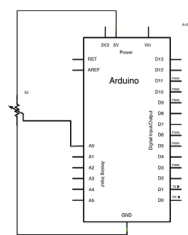Figure5. Potentiometer Analogue Input (ANON, 2021)   Figure 6 Potentiometer Analogue Input Schematic Diagram (ANON, 2021)

Other method is by using photo resistor. This circuit consist of Arduino Board, 10K ohm photo resistor and 10K ohm resistor, 220-ohm resistor and red LED. In this circuit, we will use a resistor divider for allowing high impedance Input (analogue) for measuring voltage. These inputs will not draw any current. By using ohm's law, voltage that measured at other end of that resistor connected to 5V and always will be 5V, regardless the value of the resistor. We need voltage divider to have the voltage proportional to photo resistor (ANON, 2021).
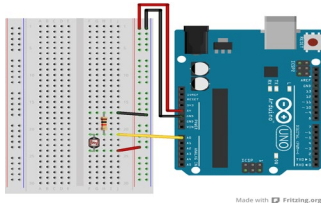
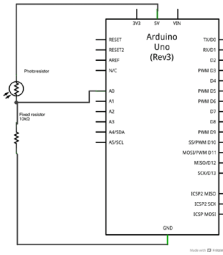Figure 7 Photo resistor Analogue Input (ANON, 2021)   Figure8. Photo resistor Analogue Input Schematic Diagram (ANON, 2021).

This circuit will use fixed resistor, variable resistor and measurement test point, which is at the middle of resistors. Output voltage will be measure by using this formula:

$$V_{out} = V_{in} \left(\frac{R_2}{R_1 + R_2} \right)$$

- VIN= 5 V.
- R2= 10 K ohms.
- R1= Photo resistor (Range from 1 M ohms (in darkness) to 10 K ohms (in daylight)) and less than 1 K ohms in sunlight or bright light.

As we see if R1 (photo resistor) increased, Vout will decrease. Vout is inversely proportional to R1 (photo resistor). Let us take an example to prove this relation. Assume that: Vin = 5V, R2= 10K ohms and R1= 20K ohms then Vout will be (ANON, 2021):

$$V_{out} = 5 \left(\frac{10K}{20K + 10K} \right)$$

$$V_{out} = 1.6667 \, V$$

Now we will increase the value of R1. R1= 50K:

$$V_{out} = 5 \left(\frac{10K}{50K + 10K} \right)$$

$$V_{out} = 0.833 \, V$$

System Test Plan

Identifying test Points:

Each Project need to be test during the implementation or after completing all connections and necessary programing. For my project, I will mention Test Points the required to make sure that the project is working correctly. First, we have to make sure that database of malls information updated and completely uploaded to the application. Then, security of the application must be included and updated since privacy of the customer personal information and details are important. For, Arduino, we have to make sure that the programming is correct and to be tested and simulated at each stage. This be done during the programming stage by Run the program to make sure it is working perfectly. After Programming Arduino, we have to do a test that signal from barcode Reader can be read and recognize by Arduino Board. Each barcode reader come with some reference barcodes used for testing and programming it.

Developing Test Plan

After implementation, three tests points to be consider as a reference In case of any sudden failure on the system. First, Make sure that barcode reader is correct and securely connected to Arduino Board (To check the connection point). Second test point; check the connection between Arduino and Display. Finally, check the programming of the Arduino Microcontroller if the coding is correct or not. Sometimes, these three testing steps will not show or indicate the failure of the system. There is possibility that, Arduino Board is faulty and need to be replace.

Implementation of the project:

At this section, I will explain the process of the project implementation. First, I have to create phone application (Android). I already visited too many websites to see how I could create Android phone application. After creating the application, I will start to build up hardware circuit which is contains Barcode reader, Arduino and Display.

Conclusion:

The idea of this project came after the world was affect by a pandemic COVID-19. It has become imperative for everyone to take the necessary precautions, follow prevention methods, and not mix with people in markets and public places, with the necessity to wear a facemask and hand gloves. Usually people crowd in the malls to buy their needs of food, drink, clothing, etc. From here came the idea of creating an application in mobile phones to regulate the shopping movement and prevent congestion by booking an appointment in advance at a specific shopping center. Not to exceed the permissible number. The calculation of the number of shoppers each time depends on the size of the center.

This application is very important in these exceptional circumstances. The project was study in all respects and a plan was make to complete it on time and determine the most appropriate methodology to be follow during the completion of the project. Now, there is no application completely similar to the idea of this application, As we know that each project has expected risks during completion, a plan has been developed to avoid potential risks.

This application works by using cellular data and by using GPS to determine the location and show the nearest shopping center to your location. After opening the application, the user can choose the appropriate shopping center and timing. After booking, a special barcode will be send to the user, which is the reservation information. Inside the center, there is a barcode reader to read the barcode of the user and allow him to enter and shop according to the reservation data.

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