



## DEVELOPMENT OF AN AUTOMATIC QUEUE NUMBER WITH RESERVATION SYSTEM USING SHORT MESSAGE SERVICES

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### **ABSTRACT**

Queuing number for reservation system has been widely used especially related to service counter such as on banking service or government services. One of the most concerns is wastage of time for the long queue at ticket counter which cause service inefficiency regardless at government or private sector. Automatic queue number reservation system is a system that allows users to reserve a queue ticket or number efficiently which operate base on short message services (SMS) mobile. The automatic reservation function of the system has several multiple services which are based on user requirement. The purpose of this system is to reduce the waiting time for the customers, implement alternative for customer to select the preference time for the bank services also putting prioritize on advance booking customer thereby improve customer's satisfaction and increase the efficiency. This article presents the design of the automatic reservation system for the bank customers, build the reservation system devices, verify the product and system functionality and validate the results availability, real time and dependability. The basic components used in this project are Arduino Mega as controller, SIM900 GSM Shield module to send and receive SMS and Liquid-Crystal Display (LCD) used to display the reservation system.

**Keywords:** arduino, SIM900 GSM, queue management system, automatic reservation system, short message services (SMS).

### **1. INTRODUCTION**

The automatic queue number reservation system is adopted from the queue management system which used to manage queues of people who join in various locations and situations in a queue area to wait for service through mobile SMS queues [6]. Normally, the customer queue commonly existed in both government and private sector such as banks, hospital, pharmacies, post office, and ticket purchase counter.

Generally, bank customers have to visit bank for various reason hence queue ticket will be issued in a printed piece of paper and then customers will wait for the number to be called. Afterwards, they have to spend time at the waiting area until their number being called out from the service counter. Usual scenario happens whereby queue waiting is too long and customers decide to go for other activities outside and when they come back their queue number has over. Then customers will then have to take new ticket number for queuing and wait another round. This has cause much of the time being wasted just to get to the service. Besides that, this introduces non environment friendly as it uses paper to print the slip number.

A study by bank Financial Management in North America stated that the average time spent waiting in holding area has risen to 8 percent from 4 minutes 46 seconds to 5 minutes and 8 seconds [1]. Thus it can be seen the queue will be expected longer and tend to get crowded especially during the peak hour. Customer

dissatisfaction may incur due to the long waiting time and lack of information giving from the service provider [2].

The objective of this project is to improve the current existing manual ticketing counter system by developing a mobile SMS queue system which consist of advance booking function and alternatives for user to select the preference servicing time. Main objectives is to improve users waiting time at counter by knowing current ticket counting as well as to eliminate the usage of paper slip as ticket number.

Besides that, this system will allow customers to reserve the queue number by using their mobile SMS and also able to select type of services as they want. Once the reservation process has been confirmed and completed, a SMS queue number will be send to the bank customers mobile phone to replace the paper ticket. The queue number sequence will combine between the walk-in customers and SMS reserve customers. In this case, customers will have more convenient time to spent during the visit at bank as they have book the queue number upfront.

In addition, this system also provides customers options for the services they want. For instance, customers can select their preference timing for the specific purpose bank services during business working hour. The top priority will be given to the customers who have make an advance reservation through mobile SMS during the peak hour. To help to improve efficiency in time management customers were encouraged to use the systems by reducing



the actual waiting time for customers hence encouraging them adopt to the mobile queue function.

The scope of this project is to design and implement on the mobile SMS queue system only. The customer has to key in their mobile phone number to get the queue number or select specific services through mobile SMS. Another advantage for this project is that it introduce paperless services hence encourages environment friendly systems.

The first article titled “Arduino Based Paperless Queue Management System” was published by A. Z. Jidan *et al.* in 2016. The authors were using GUI, GSM and Arduino UNO to get the SMS queue number as well as provides SMS reminder functionality to remind the upcoming customers [2].

The second article titled “Countertop Ticket Eater” (DL 5000 Ticket Eater Manual) was published by Deltronic Labs from United States America in 1995 [3]. The function of this high speed and fully automated ticketing machine is to count and destroy the ticket then follow by issuing a receipt. This machine contains an external LED display and resettable electronic counter. The machine external LED display will display the current ticket number and it can be seen from several meters away. The machine has a resettable electronic counter to reset the counter number by pushing the button on the machine.

The third project that has been reviewed was “Easy Turn Multi-Counter”. This article was published by Bhupendra Kara from United Kingdom in 2004 [4]. This project was a Multi-Counter Queuing System that has been designed for all queue management need. Users need to get a ticket from a pre-printed ticket dispenser and wait for the queue number to be called from the service counter or provider. This machine consists of two LED display which display the current serving number and the counter number.

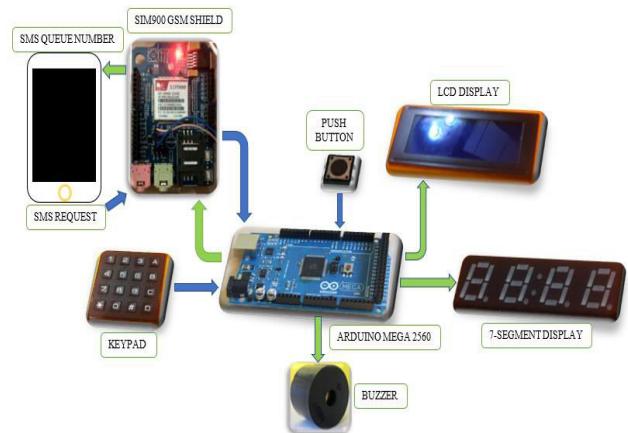
The fourth project was “Ticket Vending Machine (TVM). This article was published by Derek Tan from Malaysia in 2001 [5]. The function of this machine is to produce tickets once the user has completed the selection of the type and ticket’s quantity through the touch screen display interface then follows by payment method either pay by cash, credit/debit card or smartcard. The tickets will be printed and dispensed out to the customers. All the transactional data and audit history will be uploaded to System Manager on scheduled basis via local network link for accounting purposes.

## 2. METHODOLOGY

### 2.1 Introduction

The proposed SMS mobile queue system consists of two main functions. The first function is for normal reserve queue ticket whereby the ticket sequence number is combine from both walk-in customers and SMS reserve customers on the same day. The second function is advance for reserve function with desired time and particular service that customer request during normal working day and within business working hour.

### 2.2 Block diagram



**Figure-1.** Block diagram of Automatic Queue Number Reservation System using Mobile SMS.

### 2.3 Project flowchart

Figure-2 shows flowchart process of the whole system. The process starts with the user to select the desired transaction such as date and time with correct format. The format is set with “Type of transaction\_ Time in 24 Hour Formatted HH:MM DD/MM/YY”. For example, “BK CRT ACC\_12:30 15/09/18” which means the user wish to make a reservation at 12.30pm on 15th September 2018 to create a new banking account. Once Arduino receive the transaction, it will proceed to check whether the selected time slot have been reserved or not. If the selected time slot is available and have not being reserved, the GSM will send SMS for the queue number to the user’s mobile. On the other hand, GSM will send SMS to the user and request to change the reserve date or time.

The next function is when the user presents on the appointment day, before the user proceed to the counter they will have to key in their SMS queue number on the keypad. Once the queue number is keyed in, the system will perform check and verification. The queue number will only be called out provided all data are correct.

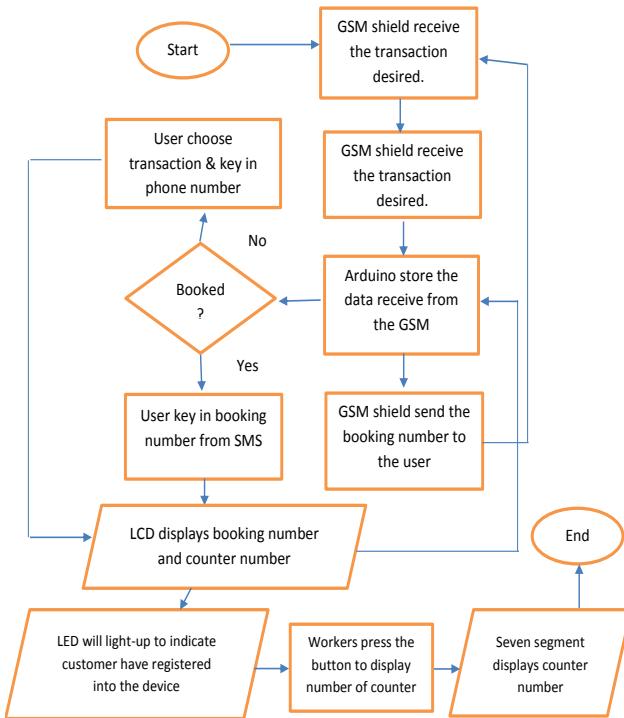
For those walk-in customers or SMS reserve customers, they need to select the transaction which in this case is either create new account or apply for a bank loan. Follow by key in their mobile phone number. A queue number will be send to their mobile via SMS.

The paperless queue ticket will help to reduce the usage of paper and printer at the same time encourage cost saving and eco-friendly environment. Thus, the queue number and counter number will be displayed on the LCD display. When the LED light up indicate the customer is registered successfully into the system then the service provider will proceed to press on the button to call for their queue number.

The walk-in customers queue number will be called out based on first come first serve basis. However, highest priority will be given to the SMS reserved customers as soon as the customers key in their SMS



queue number into the system. Meaning the current user has completed their transaction with the counter service provider, their number will be called out immediately and overtake those walk-in customers.



**Figure-2.** Flowchart of Automatic Queue Number Reservation System using Mobile SMS.

## 2.4 Project prototype

The Figure-3 shows the project prototype consists of keypad, LCD, GSM Antenna on the main device and the other portion consists of seven segment display, LEDs, buzzer and button for the counter to display the next counter number once it being pressed.

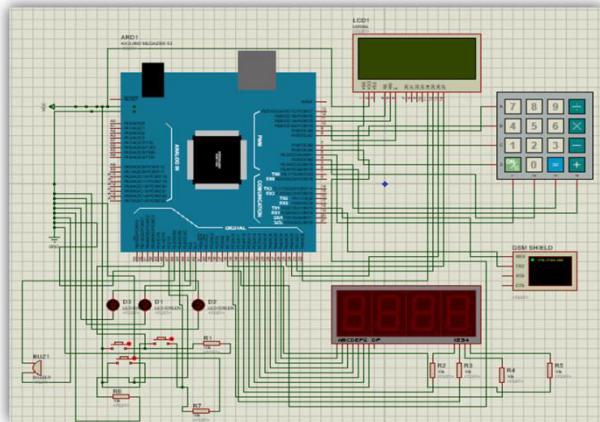


**Figure-3.** Project Prototype.

## 2.5 Schematic diagram

Figure-4 below shows the schematic diagram of the whole system. Basically, it summarizes all the

components used in the project which included Arduino Mega 2560, SIM900 GSM Shield, Liquid-Crystal Display (LCD 20X4), Matrix Keypad 4X4, Seven-Segment Display and Buzzer.



**Figure-4.** Schematic Diagram of the whole system.

## 2.6 Circuit operation

Based on Figure-4, the Pin 26-36 of Arduino Mega were reserved for the 7 segment. Buzzer, button and LEDs were placed at pin 42-48 to ensure clear separation between seven segment other input output. This was to avoid any conflict and confusion occur during hardware connection setup. For the keypad was set on pin 2-9. The LCD pin also has connected differently in simulation mode versus real mode setup. That is because of during simulation, LCD pin has connected in parallel whereas during hardware setup LCD connected with i2C module which is resulted reduce pin usage.

In Proteus, 7 pins were used but on hardware setup LCD connected with i2C module hence only 4 pins were being used. GSM Shield connection fairly simple whereby the RX and TX pin on the GSM module is connected to the TX and RX on Arduino Mega respectively. However, it may differs depending the GSM shield used. The rest will be explained in detail on the simulation part.

## 3. RESULTS AND DISCUSSIONS

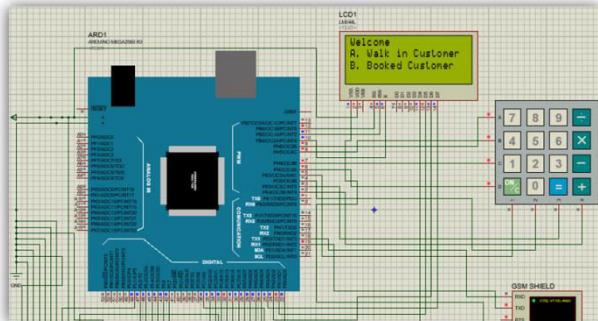
### 3.1 Software and simulation result

Figure-5 shows the initial simulation result when the program begins. The LCD will display an option for customer to select when they come to the bank. The customers must select whether they are a walk-in customer (new customer) or they have reserved the number thru reservation system.

Images of the star fruit used in this research has been shown earlier in Figure-3. This research has used a laptop powered by 1.40 GHz Intel i3-2367M CPU, 4.00 GB RAM, 64-bit Windows 7 Home Premium OS. The computation time to complete a simulation is about one hour. Table-1 shows the parameters used in this research compared to S. N. Nasroddin *et al.* (2014).

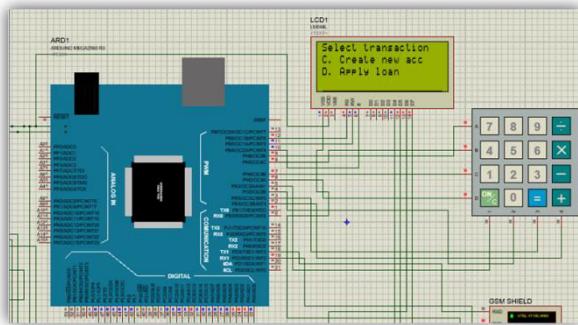


The left-hand side keypad represents the input for customer to key in. Although the 4-keypad button on the right-hand side shows a mathematical sign, but it was pre-defined in the code as an alphabet of 'A', 'B', 'C' and 'D'.



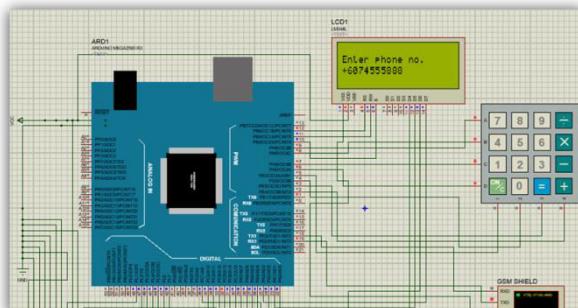
**Figure-5.** Simulation for walk-in user.

Figure-6 shows when the user chooses A (walk in customer) in previous option, they will be given an option to choose their desired transaction which is either to create a new account or apply for bank loan.



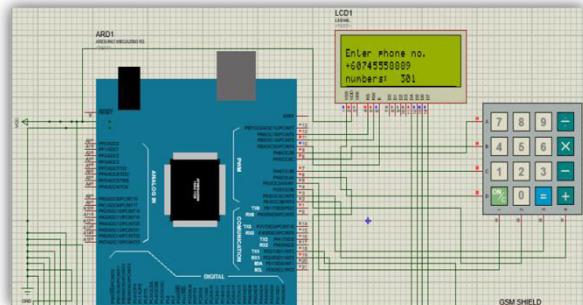
**Figure-6.** Simulation for transaction.

Figure-7 shows that when customers either chooses C or D, they will be asked and required to enter their mobile phone number. Since printer is not used in this project, it is replaced with the counter number which will be sent to the user's mobile phone. Unfortunately, there is a limitation for this system. It does not support latest phone number format which consists of 11 digits (10 digits for the old phone model).



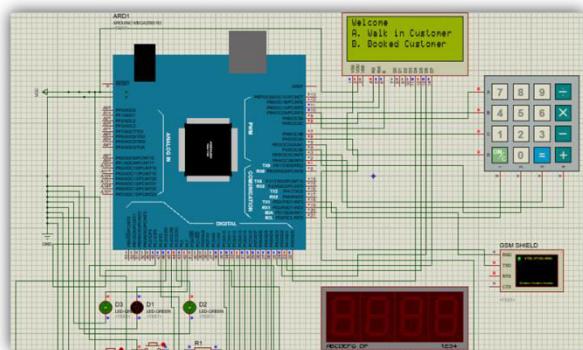
**Figure-7.** Simulation enter mobile phone number.

Figure-8 shows that after user keyed in their mobile phone number, the LCD will display their counter number as well as send the number to the user's mobile phone.



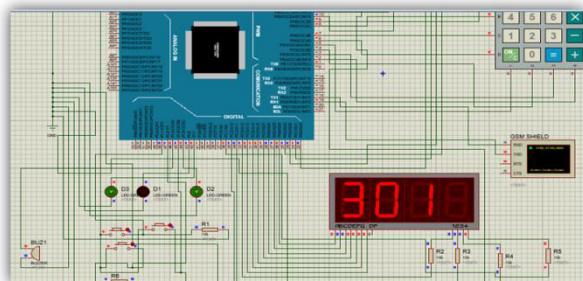
**Figure-8.** Simulation LCD display counter number.

Figure-9 shows that the program starts again to allow another customer to select an option. At the same time, LED 2 and 3 will be turned on which indicate that the walk-in customer is available or has registered in the system. It is to notify the counter to press the button in order to call out their number.



**Figure-9.** Simulation restarts.

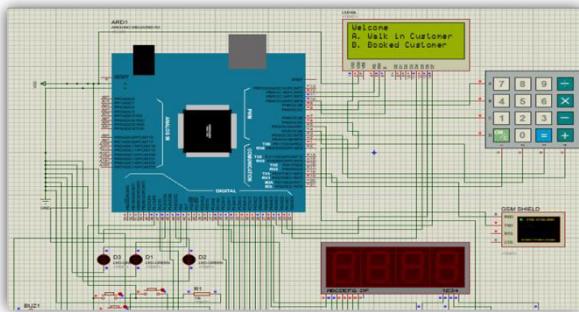
As soon as the button is pressed at the counter, the seven segment will display the number that have been registered, which in this case 301 has shown on Figure-10. Sound will be produced from the buzzer to indicate that button have been pressed. Notice that digit fourth did not light up in simulation using Proteus software.



**Figure-10.** Simulation seven segment.

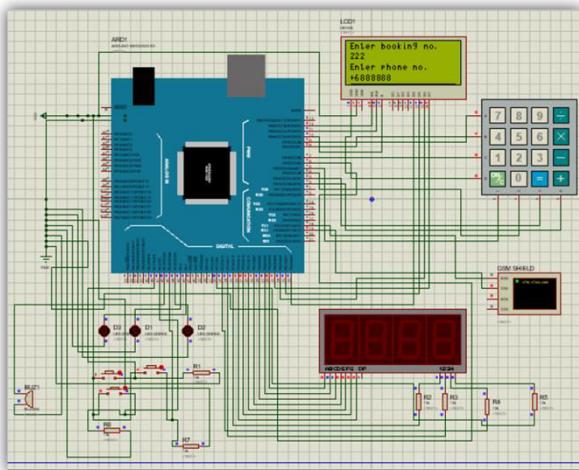


Figure-11 shows when there is no customer registered in the system, all the LEDs will turn off. Noticed that, the seven segment is not displaying anything because interrupt is not implemented in this project. However, if interrupt is implemented in this project, the seven segment shall display the current number which is 301.



**Figure-11.** Simulation LED off.

Figure-12 shows when the user chooses B, which is for SMS reserved user, they will need to key in their SMS queue number. Follow by enter the mobile phone number that they used to reserve the queue ticket as a verification purposes. Failing to do so will make the system to re-start.



**Figure-12.** Simulation for reserved user.

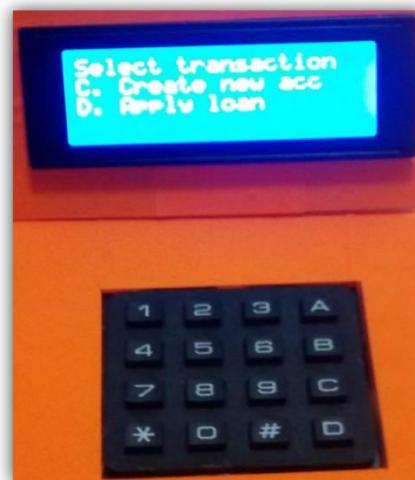
### 3.2 Hardware implementation result

Figure-13 shows when the customer comes to the bank, they will be given an option for them to select which is whether they are a walk-in customer or SMS reserved customer. User can choose the option by pressing on the keypad.



**Figure-13.** Initial Display LCD.

When the user select option ‘A’ in Figure-14, user will need to select their transaction which is either to create new account or apply loan on the bank loan.



**Figure-14.** LCD display option for walk-in customers.

Since the printer is not using in this project, the device system will prompt the user enter their mobile phone number as shown in Figure-15. Then, the queue number will forward to the user through SMS and the LCD will also display their counter number.

**Figure-15.** LCD Display counter number

Figure-16 shows that once the user has key in their phone number (for walk-in customers), they will receive their counter number and current counter number which are 301 and 0. Current counter number is 0 states that the user are the first person who registered into the system.

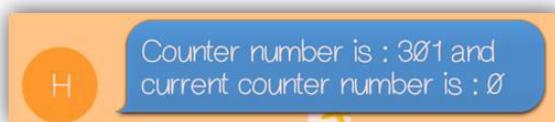
**Figure-16.** SMS received by the user.

Figure-17 shows that there are 2 more customers that have registered in the system which the info showing that the current counter number is 301 whereas the user counter number is 303. This is a useful feature and data provided to the customers so that the customers are aware about their number will be called out soon and avoid to miss the queue.

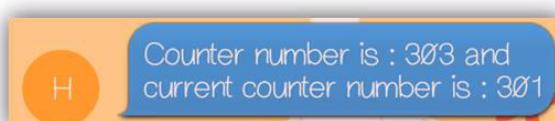
**Figure-17.** SMS received by consequent user.

Figure-18 shows the LED 1 and LED 3 was turned on. This indicate that customer have registered into the systems. This is to notify the counter service provider to press on the button so that the seven segment will display their number. Whereas the LED 2 did not turn on is because of there is no reservation being made by the user and no data will be registered into the systems.

**Figure-18.** LED 1 and 3 turn ON.

Figure-19 shows when the counter service provider has pressed the button, the seven segment will display the number on the seven segment where the right most (digit 4) is the counter number as well as the buzzer will produce sound to indicate that the number have been changed.

**Figure-19.** Seven segment display number.

Figure-20 shows that there are no registered being made by the customers and LEDs will turn off. Therefore, the counter service provider can prepare for the next transaction.

**Figure-20.** LED light turned off.

Figure-21 shows if the user wanted to make an appointment in advance, they will need to SMS to the bank using the defined format and if every steps flow are correct they will receive the advance queue number for the user to key in when they visit to the bank.

**Figure-21.** User sends SMS to device to make reservation.

Figure-22 shows when the user select 'B' they will be prompted to enter their advance reserve queue number and phone number for verification.

**Figure-22.** Booked user option.

Figure-23 shows when LED 2 turn on which indicates that booked user have registered into the system successfully and the service counter will be notify to prioritize the advance reserved customers.

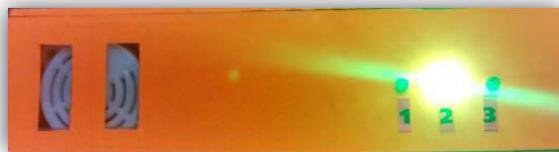
**Figure-23.** Booked LED turn ON.

Figure-24 shows when the counter service provider presses on the button, seven segment will display the prioritize reserved number and ignoring the current number. This significantly shows that this system will prioritize the SMS reserve customers.

**Figure-24.** Seven segment display the reserved number.

### 3.3 Discussion

There are some drawbacks for GSM and 7 segment in this project. Firstly, the system unable to receive multiple messages simultaneously. Message need to be send to the GSM before proceed with other project activities. Otherwise, the GSM message receive function will not work properly. Noticed that, in order to receive multiple messages simultaneously Arduino system need to be re-start and at the same time data stored in the Arduino have to be removed or cleared.

This issue was due to the data is stored in array data type however the GSM data stored in string data type.

The system is unable to receive multiple messages at the same time. But, when the GSM Shield sends SMS to user and restart the loop, the array position will be changed which cause the system unable to extract the required information due to the array position has changed. For example, the array position changed from 76 to 100 after SMS send to user. The author has tried to reset the array to 0 after every loop of function, but the GSM was failing to perform the data reset. Suspect the GSM can receive multiple messages simultaneously but different approach or method to extract is required also the information is still need to be validated.

Secondly, the 7-segment display unable to display the queue number and counter number continuously. That is because of this project did not used shift register or latching and resulted the 7-segment display will only display the number when the counter or push button being pressed. Once the button released, the display will turn off.

However, if the display is continuously turn on it will interrupt the 7-segment display and GSM shield would not operate properly due to continuously looping made in the 7 segment display.

In this project, the design of Automatic Queue Number Reservation System in Short Message Services (SMS) Mobile Operation Mode which is an improved version among of most current counters devices system available in the market today. Current counter devices available today was lack of booking function hence this features helps the users save times. This circuit design has been simulated from scratch before real hardware built on a real circuit. This is to avoid any human errors such as wiring connection so that can focus on the program coding which found is the harder part in this project.

This system will allow customer to reserve the appointment in advance using SMS in a defined format. The format is set to "BK\_Transaction\_Time\_Date". When they have successfully sent their SMS to the system, the system will reply back with their booking number. If they are sending the wrong format or time and date the system will reply back that they have sent an invalid format data. When user visit to the bank they will need to enter their SMS reserved number and the mobile phone number which they used for verification.

When this system implemented in bank, the device should able to do multiple tasks simultaneously. This included display the counter number and the queue number on seven segment, push button for the counter service provider to call for customers, walk-in customers to key in their details and so on. If users have been registered in the system (when they entered their details into the system), LED will turn ON to indicate that customers have arrived and registered. The systems also will be able to differentiate the SMS reserved or walk-in users. Even though the majority is the registered walk-in users, but the SMS reserved users will always be given the top priority which means their number will be called out immediately right after the current existing number. This is the main purpose of the project which is to prioritize SMS reserved users.



In order to integrate SMS function, GSM SIM900 used from SIMCOM which provide the same functionality as Arduino GSM Shield but cost lesser for the purpose of cost saving. However, the GSM Shield that used is storing the data in the array format which created more issues resulted the project unable to function properly. Nonetheless, still manageable to use the GSM to send and receive SMS which means there is still a room for an improvement for the code. The system is powered by 12V 2A adapter because the GSM requires certain amount of power to power up the devices or else the GSM unable to function properly.

Seven segment display that used to display the counter number and queue number will turn off when the button is released. This is to avoid the seven segment slowing down the whole systems as the loop to display seven segment is consuming longer system processing time.

Even though many problems and issues were surface out throughout the project, but all issues had been resolved with the guidance and assistant from the project supervisor. Although there are still some hiccups, believed that it can be improved by using different method and hardware to make this project become a perfect device in the future.

#### 4. CONCLUSIONS

This project successfully designed an Automatic Queue Number Reservation System in Short Message Services (SMS) Mobile Operation Mode. It has been implemented with Arduino and GSM to send and receive SMS and the functionality has been verified. This prototype has introduce paperless queue ticket hence encourage an environment friendly.

The concept and idea of integrating SMS function in booking devices is quite popular but are yet to be applied in the world today. This project can still be improved with implementation using interrupt to ensure smooth operation of the systems as well as features of the capability to book using a mobile application.

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