IoT-Enabled Service Management Device IoT-Enabled for Improvization of Customer Service in a café

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Abstract — The Internet of Things (IoT) incorporates billions of devices across the world which provides the means through which end systems are able to share information with each other. Every internet-enabled device is a participant in transferring a plethora of data and also capable of making use of data it receives. In this paper, the focus is specifically on how services in a café or restaurant can be improvised by the use of IoT-enabled devices made up of microcontrollers, Bluetooth modules, motors, sensors and screens.These devices could facilitate customers to engage in hassle-free ordering along with fluidic customer service. The manpower required to manage the customers could be reduced as the ordering of food is done completely by the use of these devices. Along with service quality, this device is focused on all round customer satisfaction by acting as an entertainment centre which allows customers to engage in some inbuilt games and light entertainment.

Index Terms — Internet of Things, Microcontroller, Customer service, Communication.

1 Introduction

THERE is an evolution in the methods on how customers communicate with their supplier and on how the suppliers meet the ever-growing needs of the customers. Customers in Urban areas have the convenience of their home and order food, clothes, shoes, electronics and even medicines delivered directly to their home if the supplier provides door-delivery service.

In this fast-paced world, a typical customer feels that waiting in queue for the customer's turn has become a major inconvenience especially if the customer in front takes longer than the usual to be serviced. Every customer has a tolerance threshold beyond which the customer would either leave the queue or express his displeasure.

In such a scenario, the application of the IoT paradigm to this urban context is of particular interest, as it responds to the demands of the customers and pushes shops to adopt improvised methods of service. Change is inevitable. Progression is a choice[1]. An urban IoT may bring a number of benefits in the management and optimization of traditional servicing protocols in a shop.

The IoT is not a concept; it is a network, the true technology-enabled Network of all networks [2]. It is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet [3]. Thus, the main device and the touch sensors, which will be discussed further in this paper, makes use of microcontrollers, Bluetooth modules and sensors to improve services.

The objective of this paper is to put forth an idea on how services can be improvised by the use of IoT. Section 2 details about the construction of the device and the technical aspects of it. Section 3 depicts how this device would function in the real world. Section 4 explains how the device could be used for entertainment purposes. Section 6 gives details on how payment is to be done and section 7 explains the benefits this device would provide. Finally, section 8 concludes the paper.

2 Construction of an IOT Device

2.1 Main Focus

The aim is to eliminate the necessity for customers to wait in a line to place their orders and also to remove the paradigm where a waiter comes over to the cutomers' table to take their order. The IoT is removing mundane repetitive tasks or creating things that just weren't possible before, enabling more people to do more rewarding tasks and leaving the machines to do the

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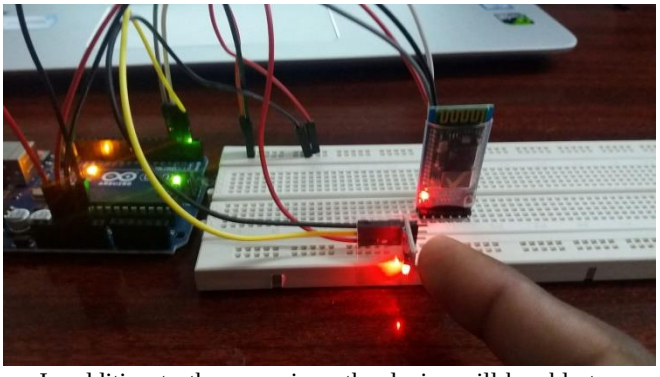
repetitive jobs.[4] This can be accomplished by placing multiple IoT-enabled devices within the shop, on the table or in strategic places through which customers will be able to place their order and a waiter will only play the part of bringing over the order and to facilitate the payment of the order which is further discussed in section 6.

The device has a touch screen which would provide the interface with which customers can interact. This device would be running the application of the store which allows the customers to place their orders. The benefit of using an application to place orders as compared to telling your order to the cashier or the waiter is that the customers can browse through the menu at their leisure, select the desired item and know the exact cost of the item or the total cost of all the items the customer has selected. After the customer places the order, the customer has to keep the cash/card ready before a server brings the food over along with some change, if it is a cash transaction, or the card reader machine, which is very light-weight and portable, along with the bill. Each device within a shop is connected to a device in the workstation of the shop through which orders can be received and necessary services can be rendered.



In addition to these services, the device will be able to provide the customer with some light-entertainment as well. The device would have a library of videos from which the customer can indulge in. Also, some games which support single player mode or also multiplayer mode through which a group of customers can play among each other.

2.2 Touch Sensor to recognize customer

When a customer arrives at the shop and sits in front of a table, the device should turn its screen towards the customer and allow him to interact with the device and place his order. The turning of the device is discussed in section 2.3. First, a signal needs to be sent to the main device to let it know that a customer has arrived at the table and wishes to place his order.

Fig(i)

This is achieved by the use of TTP223 capacitive touch Arduino module connected to an Arduino Uno board programmed to receive the signal from the module if it is touched. Now, when the customer places his finger on the touch module, the touch is sensed and converted into a signal which is then sent from the Arduino Uno to another Arduino Uno connected with the main device (discussed in section 2.3) via HC-05 Bluetooth module.

The placement of such a touch module can get complicated as a signal is sent to the main device that a customer has arrived but the main device doesn't know to where the screen must be turned in order to face the customer. This problem is tackled by assigning each seat to a unique touch sensor (ex. If there are four seats, there will be four touch sensors placed on the table accordingly). Now, the main device would be receiving a signal that a customer has arrived and also where the screen should be turned.

After placing the first order, if the customer wishes to place another order, all he has to do is touch the sensor again and the session would continue along with the addition of the cost of the new item selected with the previously ordered item.

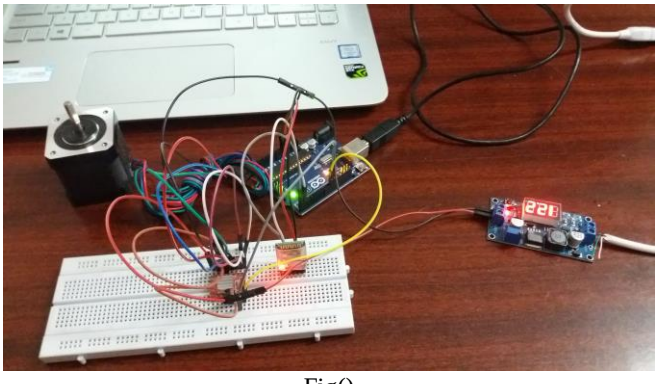
2.2.1 Concealment of the touch sensor

The TTP223 touch sensor will be able to sense touch through certain materials, such as wood, with minimal thickness. This enables the sensor to be hidden under the table at a certain fixed position and the customers are intuitively directed to touch this portion of the table surface with a subtle "tap here" indication.

2.3 Testing of other methods to recognize customer

In an attempt to further simplify the solution of turning the screen to face the customer in the exact position the customer is in, a combination of sensors, GY-271 HMC5883L Triple Axis Compass Magnetometer sensor along with a HX711 weight sensor connected to an Arduino microcontroller which transmits data via HC-05 Bluetooth module, is put into each chair. The idea is to sense the direction in which the chair is facing in accordance with the main device, in which the rotatable screen will be having a magnetometer sensor, and to rotate the screen until the screen and chair are pointed in the same direction. The weight sensor would give the '*go*' signal to the Arduino to start transmitting the magnetometer sensor data to the main device as the weight sensor would detect the weight change when a customer sits on it. There were a few faults with this design which was analyzed through a Proof of Concept which urged an alternate design to employed. Device design and hardware failure is very high, it is important for us to quickly verify and validate by doing a Proof of Concept (PoC)[5].

The faults detected were: (i) Accommodating multiple customers within the same table would become a hassle, and (ii) If a customer wishes to place another order, the customer would have to get up and sit down again to initiate his second round of order.

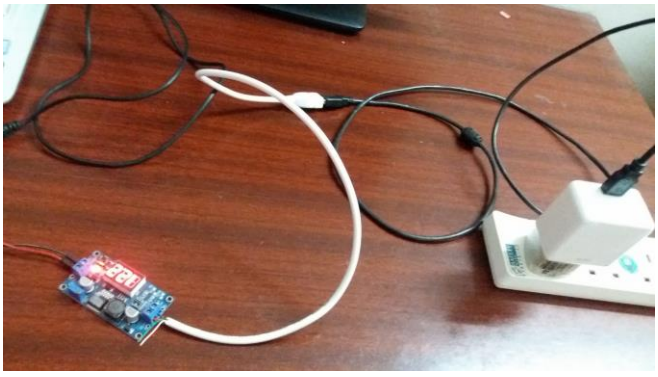


Fig()

2.3 The Main Device

This is the device that has the capability to rotate the top part of its body which contains the screen towards the customers while it enables them to interact with the screen and place orders and view some entertainment content as well. The rotation of the device is achieved by the use of a Nema-17 Stepper Motor. This was chosen as it uses high torque to turn and hold precise positions which is otherwise known as the step. The stepper motor is connected to an Arduino which receives the signal from the touch sensor via its own HC-05 Bluetooth module and calculates the precise position to which the screen should be moved.

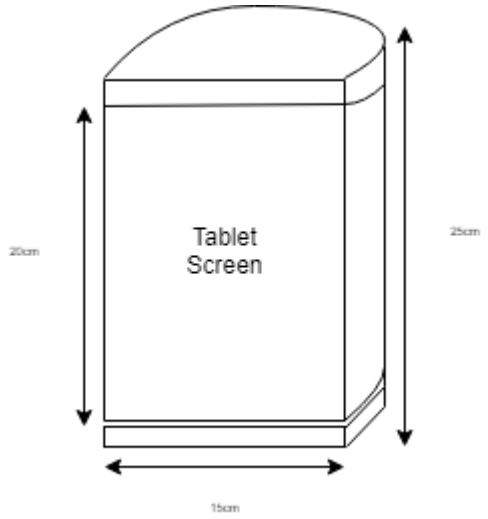
However, the stepper motor operates in 12v and fitting a battery of that size into this machine is impossible. So, a contraption as shown in Fig (ii) is assembled. This contraption is made up of a 5v-12v step-up boost converter which takes in a continuous 5v supply and provides a 12v output to power the stepper motor.



Now, the most important part is the screen through which the customer can view the menu and place the order. This is achieved by fixing a tablet computer, which would constantly be running the shop's dedicated application, on to the rotating part of the device. The connection for the Nema-17 Stepper motor is given through A4988 motor driver which helps in the proper functioning of the motor by retransmitting the step signals coming from the microcontroller. The rotating shaft of the stepper motor is attached to the rotatable frame of the main device, enabling it to turn in the desired direction.

Designing such a device with minimal compromise in the use of componants was a challenge. The art challenges the technology, and the technology inspires the art[6]. Fig shows the design of the main device. The bottom part of the device will be fixed to the centre of the table. The top part of the device is rotatable and incorporates a tablet through which the customers will be able to make their orders with the help of a tailor-made application of the shop. The back and the sides are curved.

This device is nothing more than a communication tool. Communications tools don't get socially interesting until they get technologically boring[7].



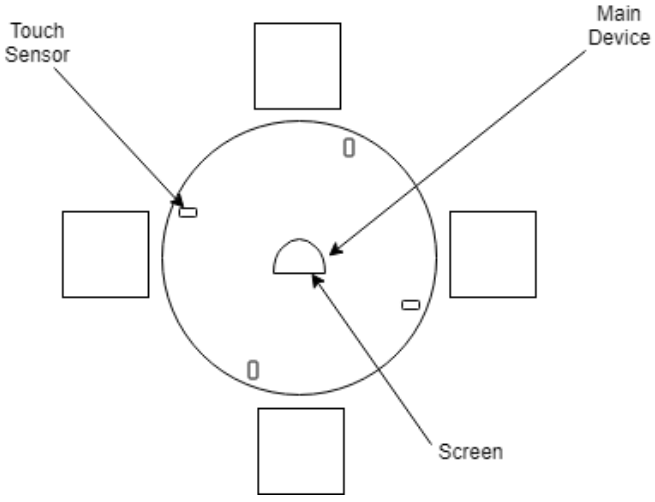
Fig() The Main Device

3 An example with the device

For example, let's consider a scenario in a coffee shop. Two friends, A and B, walk into the shop, wanting to get a cup of coffee and a cookie each. They find an unoccupied table and sit at it. Both A and B touch the sensor, and the Main Device adds them into a processing queue in the order in which the signal arrives from the sensor. Lets assume B's touch sensor signal arrives first, A is then put into the processing queue, and the main device, from its default position, rotates the top part which has the screen towards B. B chooses a tall glass of iced coffee with a scoop of vanilla ice cream in it and completes his order, forgetting to select a cookie for himself. The main device having completed B's order sends it to the kitchen where the order is received and servicing begins. The screen is then rotated towards A where he places his order for a cup of espresso and a chocolate chip cookie and completes his order by choosing to pay by credit card. When A is ordering his cookie, B gets reminded that he had wanted one as well and touches the sensor again which sends a signal to the main device and is queued until A completes his order. After A completes his order, the screen turns towards B and allows him to continue his order and the cost of both the items are now added and he chooses to pay by cash.

The waiter then brings the ordered items of both A and B and also brings a credit card transaction machine along with some change so that A can complete his credit card transaction via the credit card machine and B can pay by cash. The payment strategies are further discussed in section 6 if any change is required to be given; the waiter would have it ready.

In the case where B wants to change his initial order from a tall glass of iced coffee with a scoop of vanilla ice cream to something else, B will be able to do so only if the status of service for that order is still "Order received". If the status of service for that order has proceeded on to "Preparation has begun", B will not be able to change his initial order. This is further explained in section 5.



Fig()

4 Entertainment Centre

After all the orders have been placed, a customer can indulge in some light entertainment by selecting a video to watch from the collection of videos from the inbuilt video library in the application. If it is a party of two, for example, the customers could challenge each other to a game of tic-tac-toe.Lets consider two friends, A and B. They both can register their participation in the game by tapping on their individual touch sensors. After that, the main device arbitrarily rotates the screen towards either one of the friends who begins the game by putting a '*X*' and turns towards the other friend who continues by putting a '*O*'. This game continues until one of the two friends win or the game can be declared as a draw.

5 Service Status

As data can be received and transmitted in real-time by the use of such an IoT device, a customer can monitor the current status of their order. This is what new technology does; it creates new opportunities to do a job that customers want done[8]. There are four different statuses: (i)Order received (ii)Preparation has begun (iii)Almost done (iii)Bringing it over.

A small portion of the screen can be dedicated to always display any one of this status in real-time. If there is an unusual delay in getting the order ready, the operator in the work station of the shop can send a pop-up notification on the screen. This is more of a courteous act rather than a service being rendered. Courtesy is the one coin you can never have too much of or be stingy with[9]. Through this, anticipation of the customers can be removed as the customers will be kept in the loop of what's currently happening.

6 Payment Strategies

Majority of the customers would like to make their payment by cash or card. These two methods are explained with a scenario in section 3. In the application, before the order is finalized, there are two checkboxes which are titled cash and card respectively. The customer must check either one of the methods of payment before completing the order.

If the customer checks the box titled cash, the waiter would then bring some cash in small denominations so that change can be provided to the customer. If the customer checks the box titled card, credit or debit, the waiter would bring a payment machine through which transaction could be done. These payment machines are light-weight and very portable.

7 Results and Benefits

The main purpose of this device is to eliminate the need for-waiting in line and to encourage more fluidic customer service. Customer service is of paramount importance. Customer Service is everything and anything that touches a customer – directly or indirectly. Customer service means servicing customers, and it's so much more than just solving problems or addressing complaints. Customer service is part of a holistic customer experience that is capable of providing a critical competitive advantage in today's increasingly cluttered and commoditized marketplace[10]. Apart from that, we have focused on the removal of the classic who-ordered-what confusion when the waiter brings the orders to the table. With the help of a dedicated application working hand-in-hand with the touch sensors, the application will be able to transmit the order to the workstation in the shop along with the association of each order with the appropriate customer. For example, if customer B touches the sensor to place his order, the position where the customer is sitting at the table is recorded as well. This helps the waiter to deliver the food appropriately.

The requirement of manpower to run the shop would be reduced by the use of this device as the only function of the waiters would be to bring the order and facilitate easy payment strategies as discussed in section 6.

8 Conclusion

Building a device capable of improving quality of service by adhering to the basic principles of IoT has been the main aim of this paper. IoT is changing and transforming everything from business to life. Imaginations are boundless and opportunities are infinite. Everything is being wired up or connected wirelessly - architecture, energy efficient sensing, secure networks, quality of service, new protocols, participatory sensing, data mining, GIS-based visualization, cloud computing, and international activities. It means that powerful information will be at our fingertips [11].

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