

## Dwell Time Management using Machine Learning in Airport

**Dr. C. Punitha Devi<sup>1</sup>, Dr. T. Vigneswari<sup>2</sup>, J. Jayalakshmi @ Madhumitha<sup>2</sup>, V. Sowmiya<sup>3</sup>,  
V. Bavithra<sup>4</sup>**

<sup>1,2</sup> Professor, Department of Information Technology, Sri Manakula Vinayagar Engineering College,  
Puducherry, India

<sup>2,3,4</sup> Student, Department of Information Technology, Sri Manakula Vinayagar Engineering College,  
Puducherry, India

c.punithadevi@gmail.com, vigneswarirt@gmail.com, jayaamadhu97@gmail.com<sup>2</sup>,  
sowmiya2710@gmail.com<sup>3</sup>, bavithra0505@gmail.com<sup>4</sup>

**Abstract** -IOT is a sort of “universal global neural network” in the cloud which connects various devices. The IOT is an intelligently connected devices and systems which be made up of smart machines interacting and communicating with other machines, environments, objects and infrastructures and the Radio Frequency Identification (RFID) and sensor network technologies will go up to meet this new challenge. As a result, a very large in size data are being generated, stored, and that data is being processed into useful actions that can “command and control” the things or devices to make our lives much easier and safer - and to reduce our influence on the environment. This paper provides an elaborated solution of past investigations on utilizing machine learning technique in indoor navigation frameworks for the IoT situations. We mean to explain about the indoor navigation technique along with the prediction of the likes and dislikes of the passenger to make their dwell time more efficient inside the airport.

**Keywords** – IoT, Machine learning, Indoor navigation system, Indoor positioning.

### 1. INTRODUCTION

#### 1.1 Internet of Things (IoT)

IOT is a promising technology to provide enormous applications in health, environment monitoring, transport systems, and other commercial areas [1]. The three important parts of IoT are Internet, objects and semantics oriented vision that significantly improve communication networks [2]. The IOT is a network that includes sensors, software, physical gadgets sharing storage and internet network that enable these things to gather record handle and trade interchange [3]. Iot can be applied in smart urban areas which plan to make open region increasingly usable. Indeed, it develops an urban area by integrating IoT technology and city infrastructure to smartly manage city's assets such as hospitals, shopping airports, libraries, transportation system and other public services [4]. Therefore, in the era of smart city, peoples' routine life and their related services, for example, shopping is shaping and reshaping significantly by the usage of accessible big data from various sources. Then again, Localisation is one of the significant services for the most real application where the announced occasion is trivial if its area is obscure [5]. In case of a shopping in the air terminal, real-time networks, distributed computing, area of products and clients, and furthermore the information caught from deployed smart objects in IoT frameworks give the enrich origin of information to improve and encourage social services for both

clients/guests of shopping air terminals and leaders. Be that as it may, the present information-driven system frameworks are for the most part depended on a solitary source or sound kind of information to offer services. This attitude deprived the developed existing systems of the most potential of big data analysis. In fact, apply better interaction between a shopping airport and its customers, providing customers with benefits such as personalized information, individualized special offers all in real-time. Coordinating the area of things, with heterogeneous information from the different origin of data and examining them is a location-based and real-time for forecast, customization, and proposal of services and products [6]. Therefore, a user-friendly, location-based and real-time smart shopping system connected when they enter the airport, which help customers through a website where they registered for the ticket. When they enter the airport, users will be guided and navigated through the shopping airport in an efficient manner. This research builds up a location-based framework to permit a store to interface straightforwardly and exclusively with its visitors furnishing them with customized data about establishments or activities of concern dependent on clients' conduct/area and their real experiences during their visit to the shopping airport. The principle commitments of this paper include the following:

- i. Location-based real time shopping system to provide an efficient IoT based advanced recommendation services for customers and managers by using four components, including location of everything component, data collection component, data filtering/analyzing component and machine learning component.
- ii. Accurate features of the registered user for the classification and analyzing the need of the person individually, which are stored by surveying in the previous shopping which is retrieved in the Cloud based system with full security.

## 1.2 Machine Learning

**Machine learning** is the study of company algorithm that improve consequently through an acquaintance. Applications run from data mining programs that find general principles in enormous informational collections, to data separating frameworks that consequently become familiar with clients' inclinations [35]. The Face recognition is a significant encapsulation of human-computer connection, which has been generally utilized to getting to control framework, observing framework and identity verification. Nonetheless, since face pictures vary with looks, ages, just as postures of individuals and brightening conditions, the face images of a similar example may be unique, which makes face acknowledgment troublesome. There are two primary prerequisites in face acknowledgment, the high acknowledgment rate and less preparing time. Right now, join Convolutional Neural Network and Support Vector Machine to recognise face pictures. CNN is utilized as a character extractor to procure astounding highlights automatically [38]. The facial recognition goes under the unsupervised machine learning is a machine learning system, where you don't have to oversee the model. Rather, it needs to permit the model to take a shot at its own to find data. It for the most part manages the unlabelled information. Unsupervised learning algorithm permits you to perform increasingly complex processing tasks compared to supervised learning. Although, unsupervised learning can be progressively capricious contrasted and other typical learning techniques [37].

This paper is organized as follows. Section 2 presents the system analysis what we have done. The next section includes the proposed work with its implementations. Section 4 tells about the module description of our project which includes the technical implementation of the system. And it follows the result and discussion in the section 5 and ended with the conclusion and future enhancements can be made to the system.

## 2. SYSTEM ANALYSIS

### 2.1 Problem Statement:

**Air travel is often associated with waiting – With the number of passengers increasing every year, airports are keen to find new ways to improve passenger flow. Especially during the dwell time, it contributes to passenger frustration if information on boarding are not notified. Thus, planning to make the passenger’s dwell time efficiently.**

Whenever a passenger enters into an airport, their credentials at check in Kiosks, Entry Gates, SHA, Immigration & customs and boarding gates to validate their journey are checked. Usually a passenger is instructed to come two hours before for a domestic travel and four hours before an international travel. This instruction is given to passengers as their validation process might take more time than usual due to long passenger queues at each check point. The time taken by passenger to stand in a queue at a particular touch point and gets its credentials validated is called dwell time of that touch point. The Automated system needs to prompt necessary alert messages as per escalation matrix for dynamic allocation of manpower and facilities for a particular check point. What we want: Hence, a mobile application-based dwell time data collection and analysis at touch points of airports including check-in counters, Monitoring Effective Utilization of Airport touch points, and Central data base record for each dwell time data collection. An external API integration to connect with existing Airport [39].

### 2.2 Existing system and its major drawbacks:

The use of self-service is not a new concept; banks have been using it for a long time now. The banking industry adopted the ATM concept for reducing costs and providing better services for the customers. The banks started installing ATM machines in the bank buildings first and where a cash dispensing machine was not linked to the account directly[37]. With the spread of internet connectivity the ATM machines have become a part of the urban landscape and available at parks, shopping malls or airports with many more services on offer than just cash dispensing [34]. The adoption of self-service is gaining importance in other industries for two main reasons, increased efficiency and reduced costs and labor. Self-service puts control into hands of the customers. Other industries like retail, finance, hotels, etc. are considering using of self-service kiosks. There exists a major drawback where the customer has to wait in long queue at the cash counter [17]. This takes a long time and makes the customer and shopkeeper reduce their energy. Also sometimes barcode gets faded, thus the scanning process becomes difficult for both the producer. The efficiency of barcode technique is less than the RFID technique [37]. The following tabulation represents the comparison of RFID and barcode usage from the above mentioned paper. The comparison is based on technology, automation, cost and durability of the both RFID and barcode is discussed in the Table 1.

PARAMETERS	RFID	Barcode
<b>Read range</b>	Passive-up to 40 feet. Active-up to 100's feet or more.	From inches to feet
<b>Read rate</b>	Depends on	Only one at a

	user	time
<b>Read/Write</b>	All tags are Read/Write	Read only
<b>Technology</b>	Radio frequency	Optical(laser)
<b>Automation</b>	No human involvement	Labour5 intensive
<b>Cost</b>	They are comparatively expensive	Barcode reader is cheaper
<b>Durability</b>	Can be damaged easily	More durable

**Tabulation 1: Comparison between RFID & Barcode [39].**

### 2.3 Analysis needed for the proposed system:

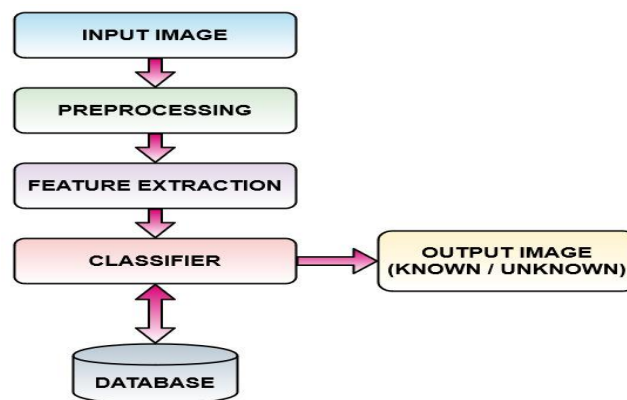
To recognize the face after the fare gate entry level of airport, we proposed **3-d facial recognition algorithm** and we used the dataset called Labeled Faces in the Wild. This dataset contains nearly 130000 images of 50000 people. These datasets are stored in the jpg format and it is coded in python language which is to be executed in the Anaconda Spyder. By using the following process in the entry level of airport, we classifies the person whether they are male or female, belongs to northern or southern states of India.

To perform the **recommendation passing process**, we planned to do a field work of taking surveys across the societies, about various things available inside the airport like food, books, clothing, likes and dislikes of the southern and northern teenagers, adult, aged people with various different scenarios from different forms of questionnaires for the students from B.E/B.TECH and parents of graduated students and from the IT companies and working employee on their view and their choice of spending time in the airport. The accuracy and the efficiency of all feedback forms are calculated automatically by pushing the training data sets and test data sets. Therefore, the proposed system forecasting / foretelling / classifying that the scope of Recommendation Passing Process will be done correctly [34].By using the above process, we endorse to the individual user to spend their precious time fairly. By the following recommendation, the user has to select the destination, and our system will navigate by showing the route map how to reach their wished destination.

### 3. PROPOSED WORK

We have proposed a system just to make the passenger feel better during their dwell time by making them recommend their own needs, and their likes and navigating them using the Wi-Fi connected provided in the airport. Initially our system is needed in online check-in, so that they are not supposed to check-in in the airport counter. They are several layers of security check made in airport like luggage checking is done first by giving a special tag or sticker. After that they will be separate checking for male and female where our system is starting to work by capturing the faces of the travellers using 3d facial algorithm [39] which is obtained to get the better accuracy in our system. Then each of the registered person is provided with the unique RFID card in the immigration check. By then the dwell time is being

calculated over the system. By the registered mobile number in our booking portal, if the registered face matches in the security check, there are provided with a link of our portal via SMS. By using that link, they are monitored by then they are recommended to follow the likes of the passenger.



**Figure 1: The overall flow diagram of the proposed system**

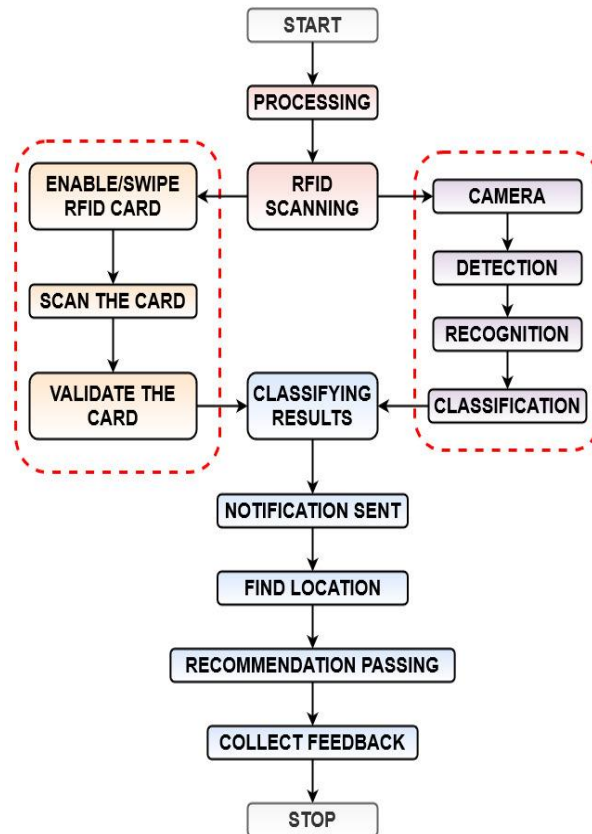
Our system is being trained with 13000 images of 5000 peoples stored in jpeg format, which acts as a sample datasets. By fetching those data recommendation passing and location tracking is done.

#### **i. Facial Detection & Recognition:**

In the current times, facial recognition has took a major role in research fields such as Multimodal Biometric Authentication System (MMBAS) and it is also a method of identifying or verifying an individual using their face. Facial recognition is a way of recognizing a human face through technology. A facial recognition system uses biometrics to map facial features from a photograph or video. It compares the information with a database of known faces to find a match. Face recognition can be used to find missing children and victims of human trafficking. As long as missing individuals are added to a database, law enforcement can become alerted as soon as they are recognized by face recognition—be it an airport, retail store or other public space.

Facial recognition system use computer algorithms to pick out specific, distinctive feature of a person's face. These details, such as distance between the eyes or shape of the chin, are then converted into a mathematical representation and compared to data on other faces collected in a face recognition database.

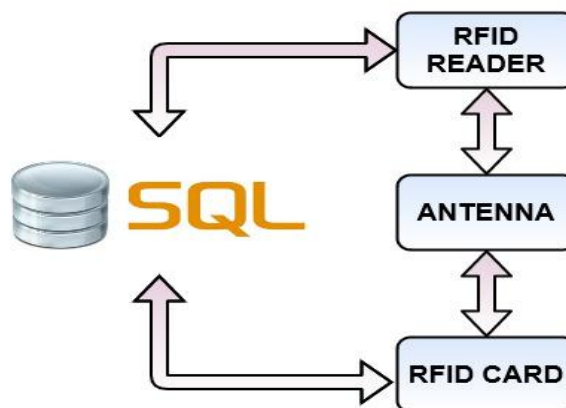
In our project the face is captured at the airport terminal, which acts as a real time data.



**Figure2: Process of Facial Recognition**

## ii. Rfid Card Scanning:

RFID or Radio Frequency Identification System is a technology based identification system which helps in identifying objects just through the tags attached to them, without requiring any light of sight between the tags and the tag reader. All that is needed is radio communication between the tag and the reader. In the normal existing system of airport managements also, RFID is used. An Intelligent RFID Reader and its Application in Airport Baggage Handling System. In civil aviation baggage handling application, the RFID tags are used to enhance the ability for baggage tracking, dispatching and conveyance, so as to improve the management efficiency and the users' satisfaction in figure 3.



**Figure 3: Process of RFID Recognition**



The areas of concern in the airport industry are these baggage management, security (passengers, personnel and baggage), and operations (check-in, boarding pass issue, operating costs, efficient utilization of human resources, and accurate billing).

### **Enabling the RFID Process:**

- The process starts when personnel enter the entrance/ terminal of the airport. As of now only the employees are given RFID enabled ID cards that validate the staff at the entrance through the RFID readers installed there.
- But in our system we propose a solution of providing RFID to the passengers or travellers and verify them at the entrance itself, which helps in reducing the security check time.

### **iii. Recommendation Passing & Location Tracking :**

Recommendation should be passed to the users according to their likes and dislikes. A recommendation engine or a recommender system is a tool that lets algorithm developers predict what a user may or may not like among a list of given items. Recommendation engines helps the users to discover the products or items that they may not come across otherwise. This makes recommendation engines a great part of web sites and services such as Facebook, YouTube, Amazon, and more.

This methodology we have tried to implement in our system of Persona based marketing using face and dwell time of the passenger. In our system we adopted Content based classification and Collaborative based classification which identifies the users whether North Indian or South Indian based upon ethnicity, and also based upon name, age and gender. And also new products could be recommended to the users depending upon the rating offered to that product/ shop by the previous users and also by finding similar users matching both their likes and dislikes and helps them to perform indoor navigation as shown in figure 4.



**Figure 4: Indoor mapping for the selected destination of the passenger**

The next section gives the detailed working of the system by explaining each module. Our project mainly consists of 3 major modules and each is described by its own working and real time diagrams in the following section.

#### 4. MODULE DESCRIPTION

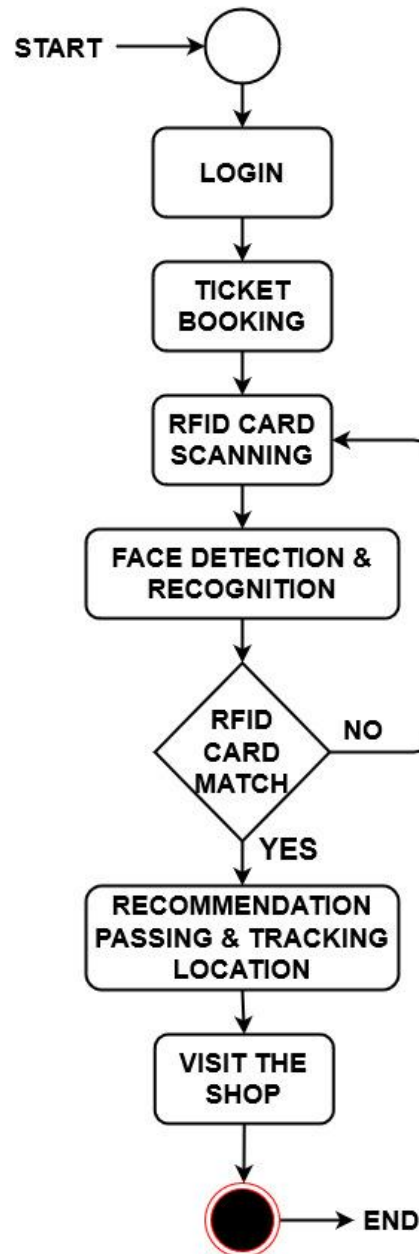
We haddone our project inthree major module, by which we are making work our idea. First module says about the ticket booking in which it is done in web based portal. Which is made using PHP language to collect their common data to get stored. It is being stored in Gsuite thus no fraudulence can be happened, and safely be provided with a backup option. Then the uploaded image in the Gsuite is being searched in our module 2 i.e., Facial Identification and RFID scanning. While the passenger enter into the level of security check, they are being captured and verified with the Gsuite data. After that, each of our registered passenger is provided with unique RFID card. After completing their emigration process, using their RFID their Dwell Time is being calculated.

$$\textit{Dwell Time} = \textit{Flight Timing} - \textit{Time of Entry to Airport}$$

After calculating their dwell time, our system will sent a SMS to the registered mobile number. By Facial Identification, it will classify that the passenger belongs to male or female, whether they are south Indian or north Indian. By this simple classification, our recommendation passing system starts working by showing their liked categories like food, clothes, costumes, books, etc.,. The passenger is allowed to choose any of those recommended shops, and by location tracking starts working. They are provided with the navigation map from the start point where they are and navigated till the desired destination of the passenger using the airport Wi-Fi. Later they are wished to shop the wished product in their desired shop and also they are meant to send the feedback of our product.

- I. MODULE 1:** Ticket Booking Form
- II. MODULE 2:** Facial Identification and RFID scanning
- III. MODULE 3:** Recommendation and Tracking





**Fig 5: Detailed activity diagram of our proposed work**

### **Module I: Ticket Booking Form**

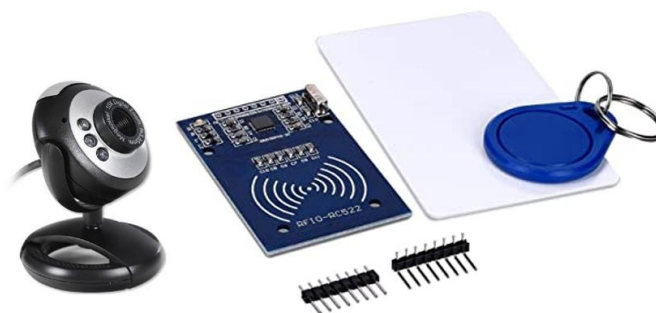
We have made our ticket booking form in such a way that it contains the general information like source and destination, Travel date, flight you wish to travel, business class or economy class, and personal information like full name, contact number, email ID, address, gender, hometown and your Passport size photo has to be uploaded. The passport size photo is fetched into the unique RFID card holder which is matched by the RFID reader.

After you finish booking your ticket (in hdairport), an RFID ticket will be dispatched to your address, and a confirmation mail is sent to your email. Your image will be trained in different angles and your photocopy will be stored in the database. Our booking portal is shown in figure 6.

**Figure 6: Booking the Flight Ticket in our Portal named Hdairport**  
(<http://www.secure2pay.in/hdairport/index/booking>)

## Module II: Facial Identification and RFID Scanning

When you enter the airport terminal your face will be captured by the USB web camera and it will be matched with the photo you uploaded while the process of ticket booking and as soon as you enter the security check, you need to swipe the RFID card, which contains all your details and it will be easy to identify the passenger and thus reduce the security check in time.



**Figure 7: USB Camera for Facial Recognition (left) and RFID reader with RFID Card (right)**

## Module III: Recommendation and Tracking

By calculating the dwell time of the passenger, our implemented system propose the recommendation based on the gender, from where they are, where they are travelling, the daily needs according to their age, and based on the native place. By the above mentioned features recommendation are passed for the passengers' registered contact number by the SMS. Using the Wi-Fi facility of the airport, the Indoor positioning systems are specifically designed to assist users to navigate in internal environment. These systems use Wi-Fi signal to assist in the movement proceeds. When Customer enters the current and destination location, then the direction is displayed on the customer device.

Based on the below recommendations passed to the user, they are allowed to select any one and by which they are provided with the additional information to the user. Then the system navigate the needed destination using the Wi-Fi GPS positioning of the mobile user inside the airport until their dwell time gets over. The recommendation starts after the process of getting tickets inside the airport as shown in figure 8 via SMS.

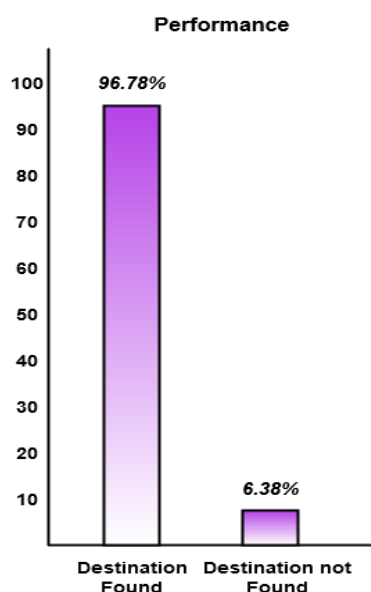


**Figure 8: Recommendation passing for the passengers**

## 5. RESULT AND DISCUSSION

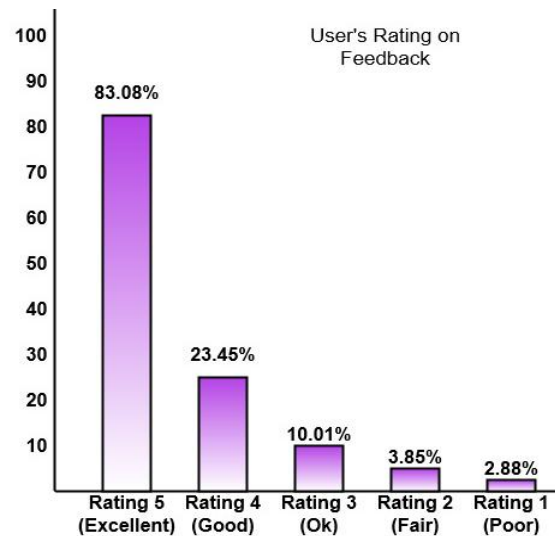
In this implementation, we wanted to scale the indoor building to do further analysis on the factors that can affect the localization process, such as the airport population, and the open areas, which will lower the system accuracy. Such issues were not addressed [35, 36, and 37].

Experiments were held at the airport, the reference points were taken first at various locations. With the object to examine indoor positioning performance, the mobile link will be created for each passenger and sent as a link to the registered number as SMS. Before positioning, the Wi-Fi map and the geomagnetic map were measured in a tested area. The special mapping utility application was used for this purpose. The purpose of the tests was to examine indoor positioning performance in public areas of big buildings in realistic place. Start is an important part of positioning process because the user can switch on his / her smartphone in any place inside a building. Automatic start allows to avoid entering the initial position manually where the initial position can be determined by the GPS receiver.



**Fig 9:Resultant performance done during testing of system.**

In this section three performance characteristics are considered. They are indoor positioning accuracy and availability. Estimation of the indoor positioning accuracy was provided by multiple repeating the same route and by comparing the indoor position estimation with the more accurate ground path.



**Figure 10: The feedback passed during testing period**

We have done two types of testing based on it the figure 9 and figure 10 is obtained. The figure 9 describes about the result based on location tracking done and figure 10 shows about the feedback form process after the destination is navigated during the testing phase of our system.

## 6.CONCLUSION

The usage of Dwell Time Management system as an airport navigator, in addition to helping the users to find shops, food courts and spending activities efficiently and effectively, were able to create awareness in using smart mobile devices for flexibility in almost every task among the shopping. We also implementing a new indoor navigation system to locate and help airport passengers to navigate inside. We present a method to visualize the airport in a web-based map. Then we developed a routing algorithm integrated with the map to get the shortest path to reach the destination. Thus it is performed by the best facial recognition technique reviewed prior for this project, and it is visibly done from our recommendation possible analysis report, that there is a better system which benefits the passengers dwell time in a better way by using persona based management of the overall process of the system. It can be worked only when the Ministry of Airport and Airport Authority of India is provided with the administration privileges to make this work. This can also be done in national and international airports.

The **future enhancement** of our system comprises of linking with the bank server which helps us to make the online payment when we reach a shop within the airport. This makes our mode of payment easier. In addition to this we are planning to connect our system with the Google server for the usage of the common people all over the world. Whenever a person is planning to have an air transport they have the ability to use our application can also be enhanced in future.

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