FlyPS – A PRICING AND QOS MODEL FOR PERVASIVE COMPUTING WITH AN AIRPORT ILLUSTRATION

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Abstract

Pervasive Computing is the future technology for every living being that enables all time computing without his/her interaction. i.e any time, any where. Customer Assistance and Passenger Support are the prime factors for Airways Agencies. The idea of this paper to address the issues when equip an Airport with Pervasive Sensor Networks. Customer Assistance FlyPS – Fly Pervasive Sensor Networks, the proposed QoS model for Airport assisting service designed for the customers/passengers. The issues related to the implementation of pervasive sensor network in the Airport and pricing them are focused in detail. Load balancing is a crucial factor accounted as a QoS parameter in this regard. A Quality of Service Model is suggested by analyzing the expected components of the Network. And an algorithm is given to determine the functionality of special equipment provided to the passengers. The pricing of the network is classified on the basis of services provided to/from the participants. And pricing to an individual passenger and Airways agency is also discussed.

The user will be directed to the place where he wants to go in a particular area. A pervasive server is maintained to connect the pervasive controllers. An 'on-body sensor' is used for the input to receive data from the passengers. The pervasive controller is used to forward the data sensed by it from the user controller. In an application scenario airport, directing software is used to interact with the user for effective use of the airport facilities. A load balancing algorithm controls the traffic/congestion. The quality is assigned with the accuracy of the data observed by the data observed by the pervasive controller. Load balancing is the process of improving the performance of a parallel and distributed system through a redistribution of load among the processors.

Key words: **Pervasive Computing, Airport Scenario, Load, Balancing, QoS**

1. Introduction

Pervasive computing is the idea that almost any device can be embedded with chips to connect the device to an infinite network of other devices. Nowadays the sensors have upgraded with the gesture based interaction. The natural movement of a human being is observed by the sensors as their input. The load balancing algorithm is used for decreasing the workload of a processor. In this paper, we are integrating the gesture interaction with pervasive computing which provides quality information through the load balancing algorithm. Suitable pricing model is applied for every process.

2. Related Work

The pervasive computing is implemented in various fields such as agriculture, health care, road traffic, etc. The health condition of the patient is observed by the doctor from anywhere. The main problem in the pervasive computing is privacy, safety and environmental implications. The user should get guidelines and others implications of the pervasive computing voluntarily [3]. The invisible computers are very difficult to develop. It is hard to hide computer processing as natural phenomena [6]. The Ubicomp systems are effective and usable but they are invisible. They should become visible. The user of the Ubicomp should be aware of the existence of the system and interact with that system using an interface [2]. The performance of the processors is improved through the load balancing algorithms. The performance of the load balancing algorithms is analyzed through various parameters. The dynamic load balancing algorithms are considered better than the static algorithms [5]. The research is focusing the next generation sensors, on-body sending systems, which interpret the complex human movements. There are some obstacles for the on-body sensors such as integration of the sensor into mobile device or clothing, reliable recognition, privacy, loss of control and handling errors [4]. The computers are becoming information appliances where the electronic appliances are performing their work based on the voice or the motion. When the technology offers new products, people will be in frustration [1].

The logic price function is set for each node and the assigning node assigns the traffic according to the logic price function. The analysis result proves the assigning node controls the load balance when the logic price function achieves the proposed criteria [7].

Gesture based interaction is the motion of the body which contains an information to interact with the device. In this interaction, the device may be any sensors which observes the motion from the user and acts according to the motion. The on-body sensors [7] can be divided into three categories:

- Motion sensors – track a user's body motions, position and orientation
- Wearable sensors – provide data about inner-body physiological processes ranging from muscle actions to cardiovascular activity to chewing and swallowing.
- Environmental sensors – provides information about the user's environment.

3. Pervasive Computing

Pervasive computing is the idea that almost any device can be embedded with chips to connect the device to an infinite network of other devices. The goal of pervasive computing, which combines current network technologies with wireless computing, voice recognition, Internet capability and artificial intelligence, is to create an environment where the connectivity of devices is embedded in such a way that the connectivity is unobtrusive and always available.

Pervasive computing provides convenient access to relevant information and applications through a new class of ubiquitous, intelligent appliances that have the ability to easily function when and where needed. Pervasive computing means 'Any time – Anywhere – Any device – Any network – Any data'.

Pervasive computing can be viewed in two forms: technology view, the computer anywhere embedded into any device. The device may be any movable or immovable thing and user view, an invisible computer which provides implicit interaction with the user's environment.

Pervasive Computing had problems in development of the battery technologies and user interfaces. Nowadays it became popular and wide spread.

4. An Airport Application Scenario:

The Airport is place where there are large number of passengers are at service by different Airways Agencies. The passenger is given service for moving from one place to another place through air. The identity of the passengers is to be checked before entering the flight. And the passengers should collect their boarding pass and their luggage that should be scanned. Every passenger should undergo the body scan. The passengers are to undergo these processes according to the departure time of the flight.

The FlyPS Network can be implemented in the airports where there are large numbers of passengers to undergo the above processes. The users will be the passengers and the air companies. The passengers will be fixed with the on-body sensors with their tickets. Also the user will be provided with the "FlyPS Object" for the airport assistance. If the user has the 3G mobile the software will be implemented automatically in their mobile and there is no need for the device. The pervasive sensors which are fixed in different parts of the airport will observe the identifier in the ticket. The pervasive sensors senses the ticket identity and the information will be send to the FlyPS Object. The information will be to collect the boarding pass, go for check-in process and the waiting time. The passengers who requests for the time of arrival of the flight, time of the departure, starting time of the check-in process, etc, will get the information to their FlyPS Object. The pervasive sensor sends the input to the pervasive server and the server will senses the sensor fixed in every flight to get the data.

If the user wants to go around the airport, the FlyPS Object or the direction software installed in the mobile will assist as like figure 1. The user can view the airport map in that device and can move around the airport based on his need.

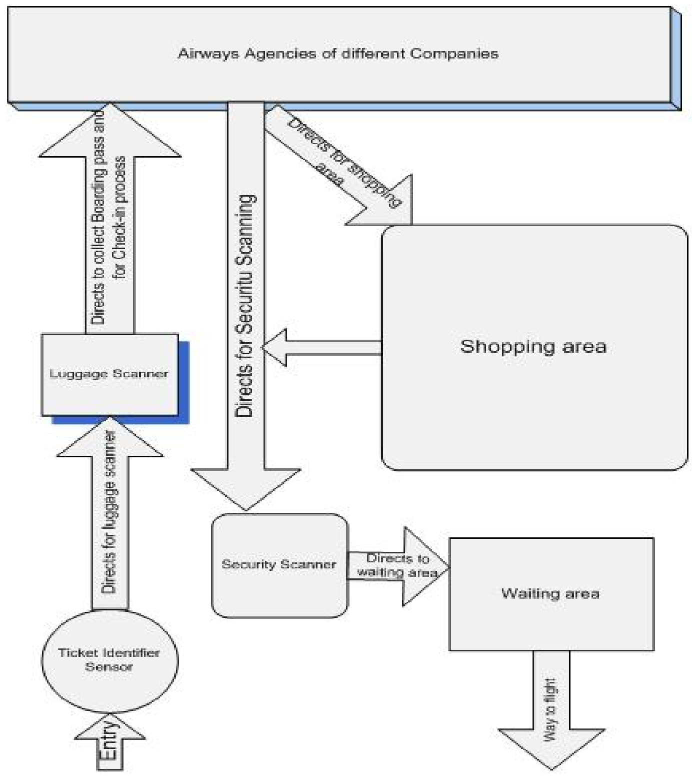

Figure 1: Airport – An Application Scenario

The Air Company will also have a FlyPS Network which indicates when the passenger enters the airport with that company's air ticket and indicates where that person is through the sensor in the air ticket.

The delay in flight's arrival will be send by the flight's on-body sensor to the server in the airport and the server will send the message to the mobile phone of the passengers who are waiting to travel in that particular flight.

These processes will be maintained by the telecommunication company which is owned for this project. The quality of the communication in the airport using the on-body sensors will be accurate. The server does the process of the load balancing.

The four principles of the pervasive computing, decentralization, diversification, connectivity and simplicity are being achieved in the proposal.

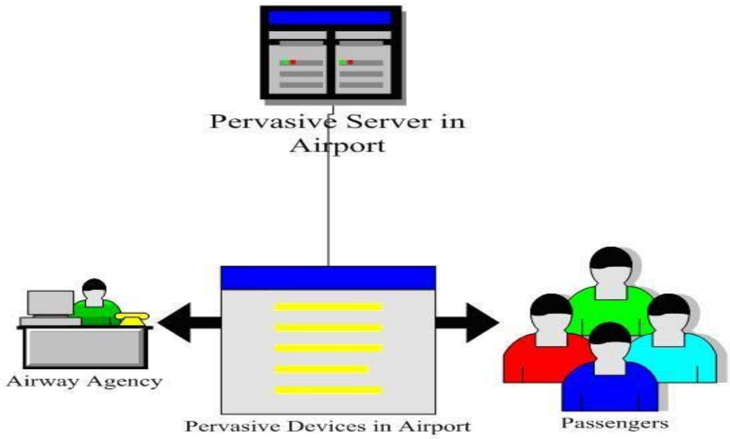

Figure 2: Devices and users in the Airport

5. Pricing Model

The process implemented will be priced to the users of the process. The ultimate user has to pay to the service provider. In our scenario, the telecommunication company is the service provider and the passengers are the ultimate users as mentioned in the figure 3. The passengers will be charged for the service they use based on the number of transactions they use through the user control. The other ultimate users, Air Company will be charged for the sensing process. The cost for the user control will be paid to the Air Company and the Company will pay to the telecommunication company for easy process.

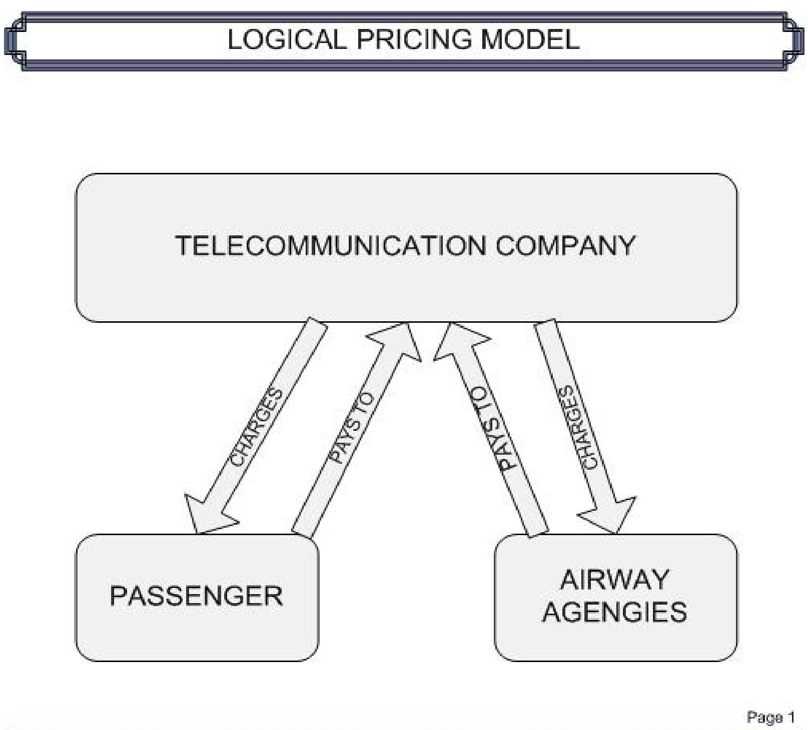

Figure 3: Logical Pricing Model

5.1. Price details of the FlyPS Network:

The cost for the services include sensors for ticket identification, communications such as directing for boarding pass, check-in, directing inside and around airport, departure alert and flight delay alert. The cost also includes maintenance cost. The abbreviation for each cost is defines as follows:

- Boarding Pass - BP
- Total Cost – Tc[BP]
- Flying Cost - Fc[BP]
- Maintenance Cost – Mc[BP]
- Communication Cost – Cc[BP]
- Ticket Identification -Ti[BP]
- Device Cost - Dec[BP]
- Check-in - Ci
- Security Scan - SS
- Directing cost inside the airport - Dc
- Departure alert Cost - Dac
- Flight delay alert - FD

5.2. Calculation of Cost:

- Tc = Fc + Dec +Mc
- Mc per BP = Total Mc / Average BP per day
- Ti = 15% of Mc[BP]
- BP = 15% of Mc[BP]
- Ci = 10% of Mc[BP]
- Dec = (15% of Mc)/Number of devices
- Dc = 30% of Mc[BP]
- SS = 10% of Mc[BP]
- Dac =20% of Mc[BP]
- FD = 20% of Mc[BP]

Let we take the average number of boarding pass per day be 100. And let the assumed total maintenance cost per day be 10000 units. Let average number of FlyPS device to be used in a day be 10. Let the Flying Cost be 1000 units.

MC per BP = 10000 units / 100 BP = 100 units
Ti = 15% of 100 units = 15 units
Dec = (15% of 100 units) / 10 = 1.5 units
BP = 15% of 100 units = 15 units
Ci = 10% of 100 units = 10 units
Dc = 30% of 100 units = 30 units
SS = 10% of 100 units = 10 units
Dac = 20% of 100 units = 10 units
Fd = 20% of 100 units = 20 units
Tc = (1000 + 1.5 +100) units = 1101.5 units

5.3. Price Justification:

A sample case is worked out for a say expenses towards the charges. In this work out, the boarding pass will act as the main units for the calculation. The maintenance cost includes the maintenance of the whole FlyPS infrastructure. So the charges will be calculated as the average on the assumed total maintenance cost by the average boarding pass per day. The Ti cost and the BP cost are calculated as 15% of Mc[BP] because these two services will be provided to every passenger while entering the airport. The Ci cost is also 15% of the Mc[BP] as it is the service provided to every passenger. Dc is charged as 30% of the Mc[BP] as the direction map gives information about the whole airport infrastructure. Dac and the FD cost are fixed on the necessary service for the flight departure. So they costs for 20% of the Mc[BP].

The Total cost includes the Flying cost, Device cost and the Maintenance Cost which is calculated as 1101.5 units. The telecommunication Agency can take the device cost and the maintenance cost which is 101.5 units. The Maintenance cost for the whole infrastructure is 100 units per boarding pass the remaining 1.5 units will be the profit for the company on per boarding pass.

6. Participants of the FlyPS Network:

Table 1. The participants of the FlyPS Network

S.No	Components	Description
1.	Pervasive Server	The invisible server fixed in the airport
2.	Pervasive Sensors	Used to scan the FlyPS object, identity of the passenger, fixed in various places of the airport
3.	FlyPS Object	It is a device given to the passenger for the assistance in the airport

7. Algorithm for FlyPS Object:

FlyPS_Object[guides the passenger throughout the airport]

Step 1: [Declaration]

Number id;
Char ac;
Char c1,c2;
Time system_time, departure_time, waitint_time;

Step 2: [Initialization]

Id=scan from ticket;
Enumerated counters = {counter1,counter2,counter3};
System_time=get time from system;
C1=0; (number of people in queue 1 for check-in process)
C2=0; (number of people in queue2 for check-in process)

Step 3: [function of user controller]

If (id>0) && (id<=2000) then
    Ac=”jet”;
Else if (id>2000) && (id<=1500) then
    Ac=”Spice”;
Else
    Alert message(“Id doesnot match)

Step 4: [Collecting Boarding Pass]

If(ac=”counter1”) then
    FlyPS Object directs to the Airways counter 1;
Else
    FlyPS Object directs to the Spice Jet counter

Step 5: [Check-in]

```
If (c1<=c2)
        Direct the user to the c1 queue
Else
        Direct the user to the c2 queue
```

Step 6: [Waiting time]

- Calculating waiting_time(Waiting_time = Departure_time – System_time)
- Indicate the passengers about the waiting_time and give options to do in that time.
- The airport map is installed in the FlyPS Object for passenger's assistance.
- If the flight is delay, passenger will be indicated by message in the FlyPS Object with the other options for travel.
- Do

```
{
    Waiting_time = departure_time – system_time
}
Until (waiting_time = 15);
```

- If the waiting_time =15
  Warn the user about the departure_time by a message in FlyPS Object.

8. Conclusion & Future Work

The pervasive computing is being implemented with the Sensors and the FlyPS device will be useful in many applications. The load balancing model will be useful for avoiding the traffic congestion. This project can be implemented in many applications where there are many users to use this facility. This process will be maintained and observed by the owning telecommunication company and the required advancements will be included. The trouble shooting of FlyPS equipment and network would be the future challenge. And the Airport networking span and distance must also be worked out.

References

[1]. Andrew Odlyzko, "The visible problems of the invisible computer: A skeptical look at information appliance", AT&T Labs-Research, September 1999.

[2]. Kasim Rehman, Frank Stajano, George Coulouris, "Interfacing with the Invisible Computer", Laboratory of Communications Engineering, Cambridge University Engineering Department, October 2002.

[3]. Parliamentary Office of Science and Technology, "Postnote on Pervasive Computing", May 2006 Number 263.

[4]. Paul Lukowicz, Oliver Amft, Daniel Roggen, Jingyuan Cheng, "On-Body Sensing: From Gesture-Based Input to Activity-Driven Interaction", Invisible Computing, 2010 IEEE Computer Society.

[5]. Sandeep Sharma, Sarabjit Singh, and Meenakshi Sharma, "Performance Analysis of Load Balancing Algorithms", World Academy of Science, Engineering and Technology 38 2008.

[6]. Sara Ilstedt Hjelm, "Designing the invisible computer – from radio-clock to screen fridge", Interactive Institute/CID, KTH.

[7]. Zhong Hui, Qian Zhi-hong, Sun Da-yang, Zhang Ding-guo, "Study on Price-Driven Load Balance in Wireless Sensor Network" IEEE Computer Society, 2009