A Location System with Bluetooth

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Abstract: In this paper, a location system with Bluetooth is proposed. By using this system we can look up the position of the Bluetooth terminal in a room. In addition, the range of retrieval is accurate because the communication range of the Bluetooth terminal is about 10m radius. The position of the terminal can be always grasped so that the system is available for the security service, the positional information service and tracking service.

1 Introduction

Recently, the service of the positional information has been progress. There are some types of services. The user can obtain a map and local information around the position where he is, and send his positional information to other users. In addition, the services is available to a security and tracking. In this background, there is the progress of the technology on the positional detection. The technology enables to get user's positional information easily. In a mobile communication system, the so-called positional information service such as global positioning system (GPS) has been becoming more important.

In order to provide the service every time and everywhere with high accuracy, a system applied to indoor scene is necessary as well as a system applied to outdoor scene in the use of cellular phone and personal handyphone service (PHS).

In the research using a Bluetooth[1] terminal, there is an access network configuration method for Bluetooth equipped routers[2] and a navigation system using Bluetooth Beacons [3] . Moreover, in the research on the ad hoc network [4] using Bluetooth, there are data delivering experiments in a Bluetooth-based ad hoc network[5] , and a distributed scatternet operation protocol for large-scale Bluetooth ad hoc networks[6]. In this paper, a location system is proposed which uses the Bluetooth. Detected local information on position of a terminal is collected by a webserver through IP network. In the proposed system, an inquiry function is only used for detecting terminals and establishment of connection between terminals is unnecessary. Therefore, the system has no restriction of number of terminals in a local area.

There is no restriction in the number of terminal. It takes a few seconds that Bluetooth terminal detects the others. So if many terminals pass through the inside of a communication range, it is possible to use this system. Because the position of the terminal can be always grasped by users connected IP network, this system can be used for the security service, the positional information service and tracking service.

2 Explanation of the Proposed System

2.1 Outline of the Proposed System

The proposed system consists of a webserver with database and some Bluetooth terminals with databases connected by IP network (see Figure1). Usually a Bluetooth terminal is located in a room, and always watches whether any other Bluetooth terminals exist in the room. When the terminal finds an unknown terminal, the database of the room, which the terminal has, is updated, i.e., the detected terminal is registered. Also the information is sent to the webserver so that the server has the information on all rooms. In this system, we can detect terminals asynchronously without any restriction of number of terminals. Furthermore, since the detected information is provided on the webpage, we can get the information everywhere on the LAN.

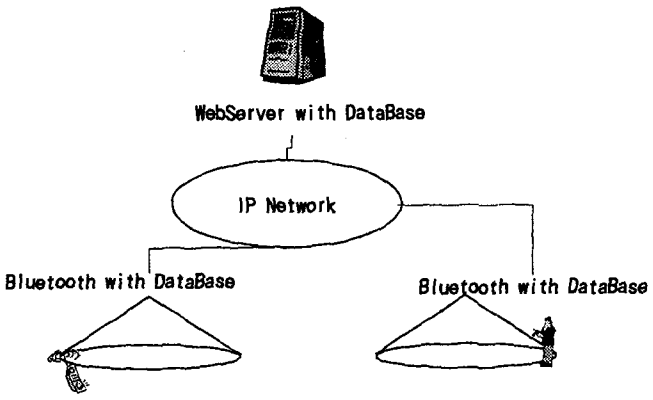


Figure 1:Overview of the proposed system

2.2 How to install the terminal of Bluetooth

1. The PC that registered IP address is equipped with the terminal of Bluetooth.
2. When server and client softwares are started with each PC, an establishment place's name is registered by hand.
3. Inquiry is always continued in the terminal of Bluetooth.

2.3 The function of Inquiry that the terminal of Bluetooth uses

"Inquiry" is used for the Bluetooth terminal called Master. The role of Inquiry is detecting around other Bluetooth terminal. Master broadcasts IQ packet continuously a certain fixed time. The Bluetooth terminal, which received the IQ packet, transmits a FHS packet to Master. As a result, the Bluetooth terminal transmits a Bluetooth address or a Bluetooth clock to Master. In addition, connection is impossible only in the function of Inquiry.

2.4 The function of database in the proposed system

2.4.1 The function of database which webserver has

A place, a Bluetooth address, and time are periodically received from database, which a Bluetooth terminal has.

2.4.1 The function of database which Bluetooth has

It takes 10.24 seconds per Inquiry. So, Database that Bluetooth has transmits the data to webserver in every 10.24 seconds. But, even if there is not the data transmitted, the null data is transmitted in every 10.24 seconds. So if there is no change with the detected terminal (for example it isn't moved), transmitting data of the terminal detected is fastened for a while, and after the constant time, the database that Bluetooth has transmits data to webserver.

3 Simulation

For example, we assume the following situation (see Figure2).

- There are two rooms (Room A (1422) and Room B (1421)) separated by a corridor.
- In Room A, a webserver of the proposed system is located. Also the server is a Bluetooth terminal, too.
- In Room B, a PC terminal with Bluetooth is located.
- Room A and B are connected by a LAN.

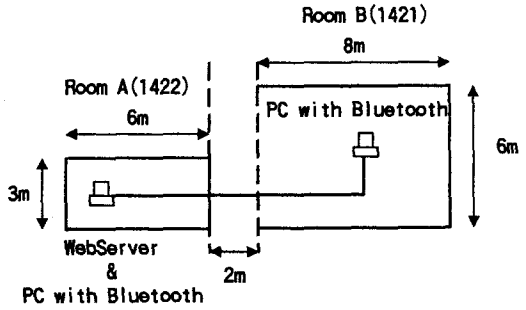
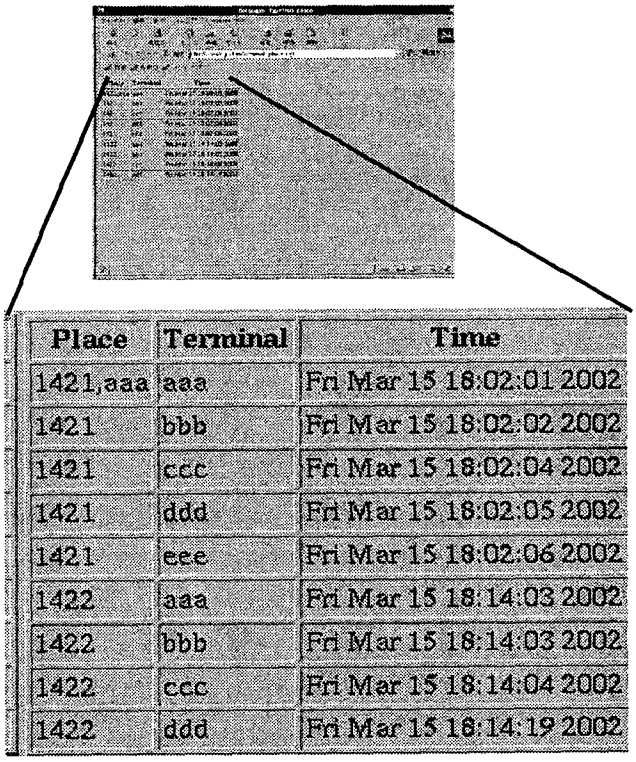


Figure 2:System build in

In this simulation, Bluetooth is emulated by software of both the server and the terminal. Therefore, a terminal name is not a Bluetoooth address.

Figure3 shows a webpage produced by the database of the server that receives detected information in each room.

From the figure we can easily understand the location of all terminals. On this webpage, the place of detected terminal, the Bluetooth address of the terminal, and the detected time are displayed.



Place	Terminal	Time
1421,aaa	aaa	Fri Mar 15 18:02:01 2002
1421	bbb	Fri Mar 15 18:02:02 2002
1421	ccc	Fri Mar 15 18:02:04 2002
1421	ddd	Fri Mar 15 18:02:05 2002
1421	eee	Fri Mar 15 18:02:06 2002
1422	aaa	Fri Mar 15 18:14:03 2002
1422	bbb	Fri Mar 15 18:14:03 2002
1422	ccc	Fri Mar 15 18:14:04 2002
1422	ddd	Fri Mar 15 18:14:19 2002

Figure 3:Result of this simulation

When the person who possess the Bluetooth terminal BBB went into the RoomA (see Figure4).

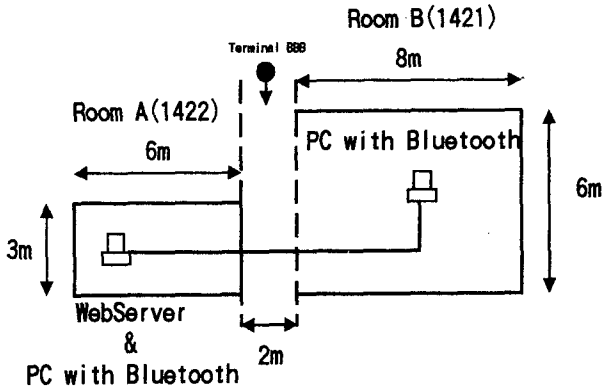


Figure 4:When Terminal BBB went into the Room A

The Bluetooth terminal installed in the room is always carrying out Inquiry (see Figure5).

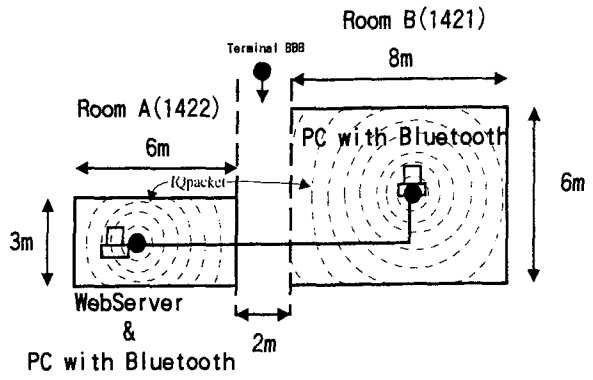


Figure 5:State of terminal installed

Inquiry is the first state of Bluetooth to connect. So terminal BBB will not be in a connection state and is supervising the demand of Inquiry (see Figure6).

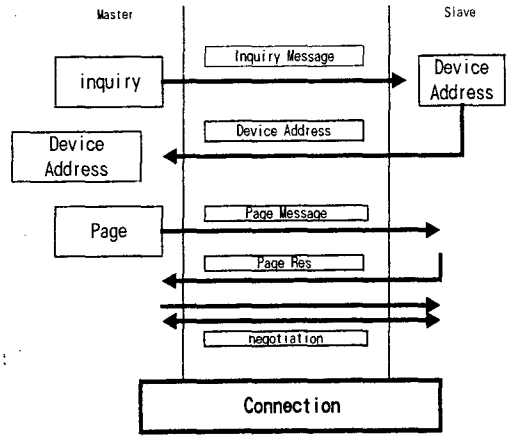


Figure 6:State of Bluetooth

If terminal BBB goes into Room A, terminal BBB received IQ packet of the terminal installed in Room A (see Figure7).

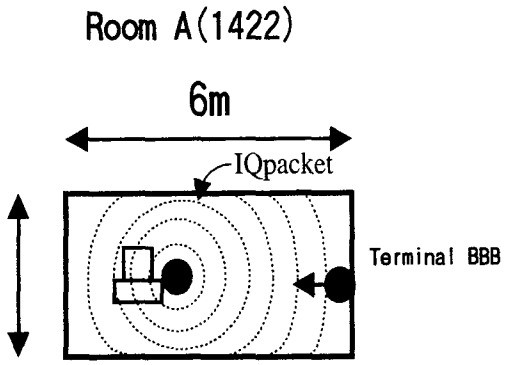


Figure 7:Terminal BBB received IQ packet

In order that Terminal BBB may avoid the collision by the FHS packet between devices, it sets the random pause time called random backoff, and returns the FHS packet which includes the Bluetooth address and clock information to the installed terminal after receiving IQ packet again (see Figure8).

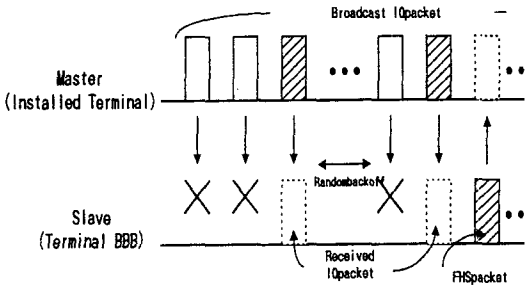


Figure 8:State of Inquiry

The installed terminal carries out Inquiry every 10.24 seconds. For these 10.24 seconds, a FHS packet will be received several times by the above process. Receiving a FHS packet several times will increase the accuracy of the information, which a FHS packet has.

The Bluetooth terminal installed in Room A receives the FHS packet of Terminal BBB, and writes a Bluetooth address in a database (see Figure9).

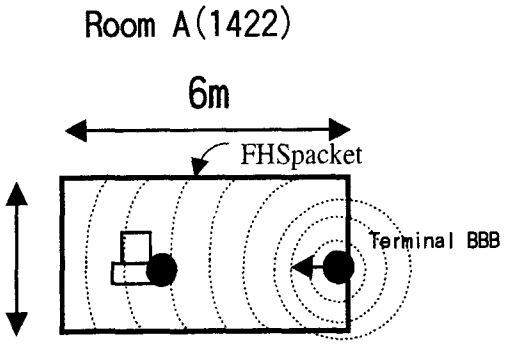


Figure 9:Terminal installed Room A

The data of the database, which the installed terminal has, transmit to the database in webserver. In addition, webserver has always updated its own database and the data of a database is changed into HTML by using CGI (see Figure10). Then, it gone the public by webserver.

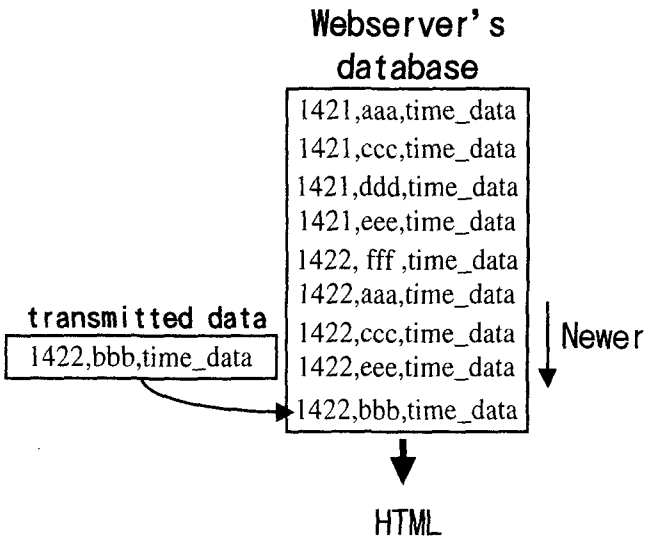


Figure 10:State of database

It is possible to refer to the database in somewhere depending on a setup, if PC with webserver is connected to IP network (see Figure11).

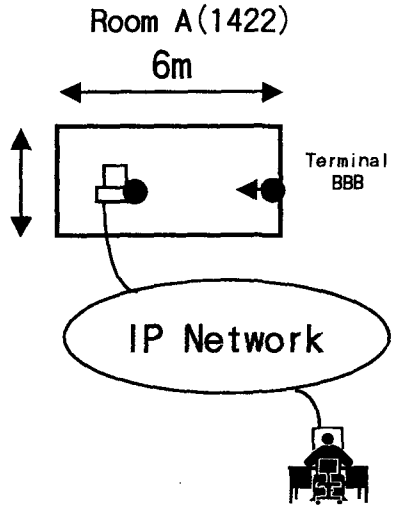


Figure 11: Grasp of a terminal position

4 Conclusion

In this paper, we have proposed a location system with Bluetooth. In the proposed system, since an Inquiry function is only used for detecting terminals and establishment of connection between terminals in unnecessary, the system has no restriction of number of terminals in a local area.

Acknowledgement

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