Design and Implementation a tracking System under Indoor environment

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Abstract

A Location based service (LBS) field is of increasing interest towards healthcare facilities of smart environments and applications such as tracking, positioning, mobile computing, etc., in Information Technology (IT) world. Hospital (track a special patient); Museum (track a tourist); School (track a student); Kindergarten (track a kids), are examples of these applications.

In an Indoor environment has several systems based on various technologies such as infrared radio (IR) signal are emerging particularly; the wireless local-area network (WLAN) (IEEE 802.11b) radio-signal-based positioning system. Consequently, we can determine or track users via the wireless portable device (e.g. laptop, PDA) on a map for each floor in university building.

This research illustrates a tracking system under indoor environment at IT University of Copenhagen that designed and implemented by using a simple, flexible, and intelligent application tool (Flash application) with Action Script programming language. Test and results are also reported.

Keywords: Location Based Services (LBS); Wireless technology; tracking system; healthcare applications.

تصميم وتنفيذ نظام تتبع تحت بيئة داخل الابنية

ملخص البحث

مجال خدمة تحديد الموقع (LBS) زادت اهميته باتجاه تسهيلات مرافق الرعايـــة الـــصحية للبيئـــات الذكية وتطبيقاتها مثل تتبع وتحديد المواقع ، الحوسبة المتنقلة ، وما إلى ذلك فـــي عـــالم تقنيـة المعلومـــات. مستشفى (تتبع المريض دو الاحتياج الخاص)، ومتحف (تعقب السائح)، مدرسة (تتبع طالب)، رياض الاطفـــال (تتبع اطفال) ، كامثلة تطبيقية .

في بيئة داخل الابنية هناك العديد من الانظمة تستند على مختلف التقنيـــات مثـــل الاشـــعة تحـــت الحمراء، وتظهر إشارة على وجه الخصوص شبكات المناطق المحلية اللاسلكية (IEEE802.11b) إشارة اللاسلكية القائمة على نظام تحديد المواقع. وبالتالي، يمكننا تحديد او تعقب المستخدمين عبر اي جهاز لاسلكي محمول (مثل الكومبيوتر المحمول، والمساعد الشخصي الرقميPDA) على الخريطة لكل طـــابق فـــي مبنـــى الجامعة.

هذا البحث يوضح نظام تتبع تحت بيئة داخل الابنية في جامعة كوبنهاغن لتقنيـــة المعلومـــات الـــذي صمم ونفذ بواسطة تطبيق ادوات برنامج فلاش البسيطة ،المرنة ،والذكية مع لغة البرمجة الفعالـــة. الاختبـــار والنتائج سوف تذكر ايضا في البحث.

I. Introduction

In recent years, the proliferation of mobile devices and WLAN technology has rapidly growing interest in LBS [Bahl & Padmanabhan 2000]. Most researches have focussed on developing services or architectures for location-based systems and challenging problem of determining or tracking mobile users, especially under indoor environment, such as those in [Small & Siewiorek.2000], [Djuknic & Richton 2001] and [Bahl & Padmanabhan 2000]. There is a large body of research over indoor tracking and positioning systems, including, Active Badges [Want et al.1992], Active Bats [Harter et al.1999] RADAR [Bahl & Padmanabhan 2000] Cricket, [Priyantha et al.2000] RFID (Radio Frequency Identification) [Finkenzeller 2003].and UWB [Young et al. 2003]

Our indoor tracking system application is simple, flexible, and intelligent thereby the position can be retrieved from a server called positioning server. In order to support different location based applications with user's position, an appropriate engine can be used. The position can be retrieved in X, Y and Z Coordinate, room's id (ID-stand for identification) and floor's id. WLAN, which could be an indoor wireless network communication such as (IEEE 802.11b).

This paper is organized as follows. In Section II, we described technical requirements for the tracking system and we also illustrated the architecture with processing of the system. We discuss the results and briefly validate our system in Section III. Conclusions and discussions of future work are given in Section VI.

II. System Overview

Here we describe the architecture of proposed system which is composed of main components (Access Points (AP), WLAN, and Mobile Devices).

A. Technical requirements for the system

A tracking system to be installed completely and run, it requires two kinds of components; Hardware and Software as shown below:

- Access points (AP) are the terminal parts of WLAN; therefore, they are necessary. The more access points distributed around the mobile device, the more accurate position the system can get for tracking connected clients.

- Mobile devices such as laptop, PDA, etc.

- WLAN running in the building such as IEEE 802.11b.

- Any Positioning System (PS) with a reasonable accuracy in order to calculate the position of a mobile device. The system as Ekahau Positioning Engine is installed and running at IT University of Copenhagen environment (for more information visit the URL:http://mobilitylab.itu.dk/http://www.crossroadscopenhagen.com/,and http://lacomoco.itu.dk/index.jsp)
- Ekahau Client Manager Application has to be installed on the client's laptop, which then registers and tracks automatically throughout the WLAN and inside the building.

B. System Architecture

In this subsection we start to describe and explain briefly the design, content, and production decisions for our system. First of all, the design architecture for the system can be described as shown in Figure 1.The positioning server can locate and track clients in a wireless LAN environment at IT-University of Copenhagen. The Flash application has powerful capabilities such as reads XML format, and consequently we had to have the client information in a XML format. Therefore, Flash application will process this format to locate and track any clients on a map. The flash processing will be described briefly later after this section. As a result, we can be able to show useful various information such as client's IP address for each clients, floor numbers, time, coordinates in meters and pixels. Finally, the specific client's position will be displayed on a map represented as a *red spot* with other clients as a *blue spot* at the same floor. When the client moves to another floor the map will be updated into a new one representing for that floor.

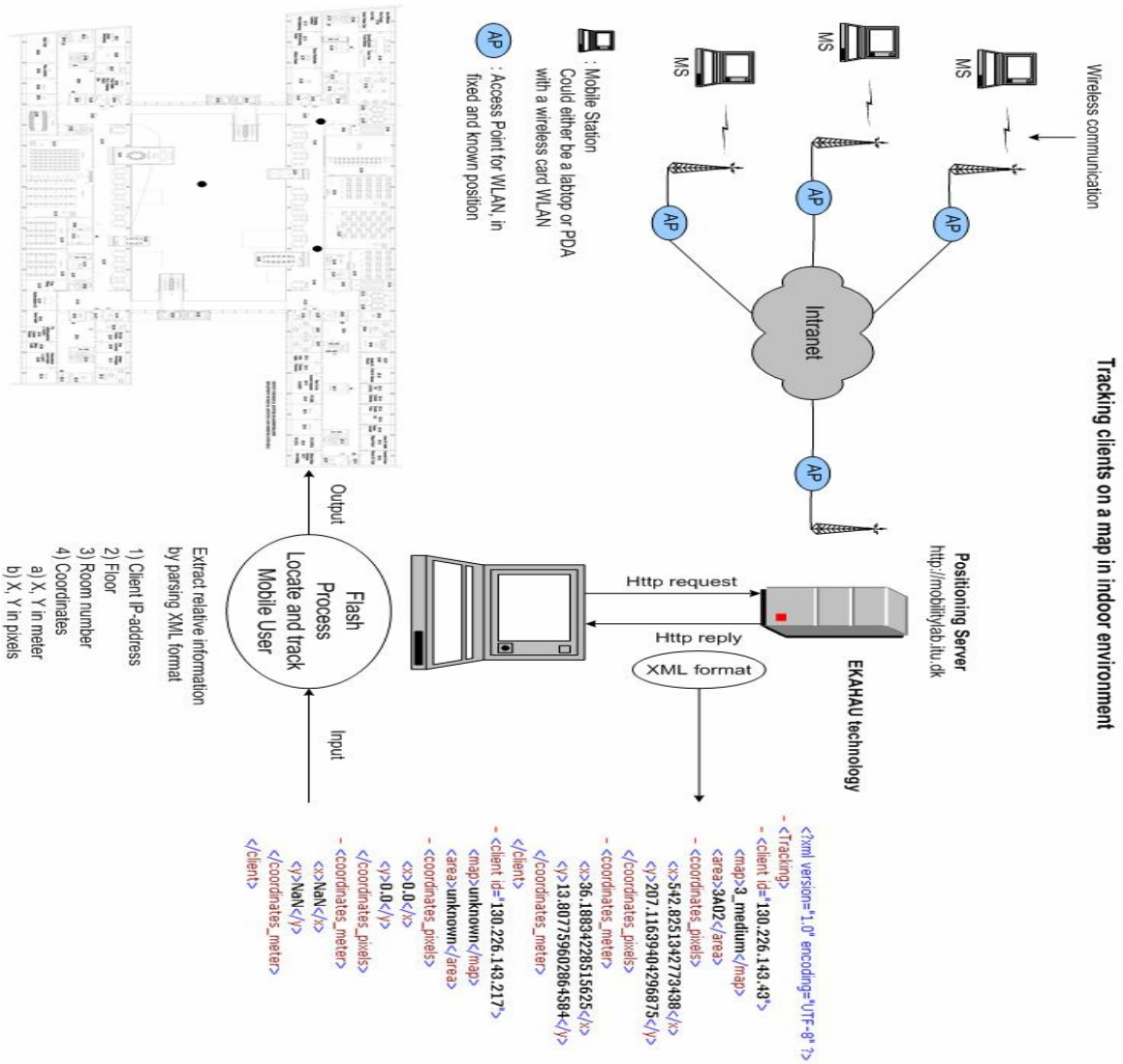

Figure1: The overview system architecture of the system

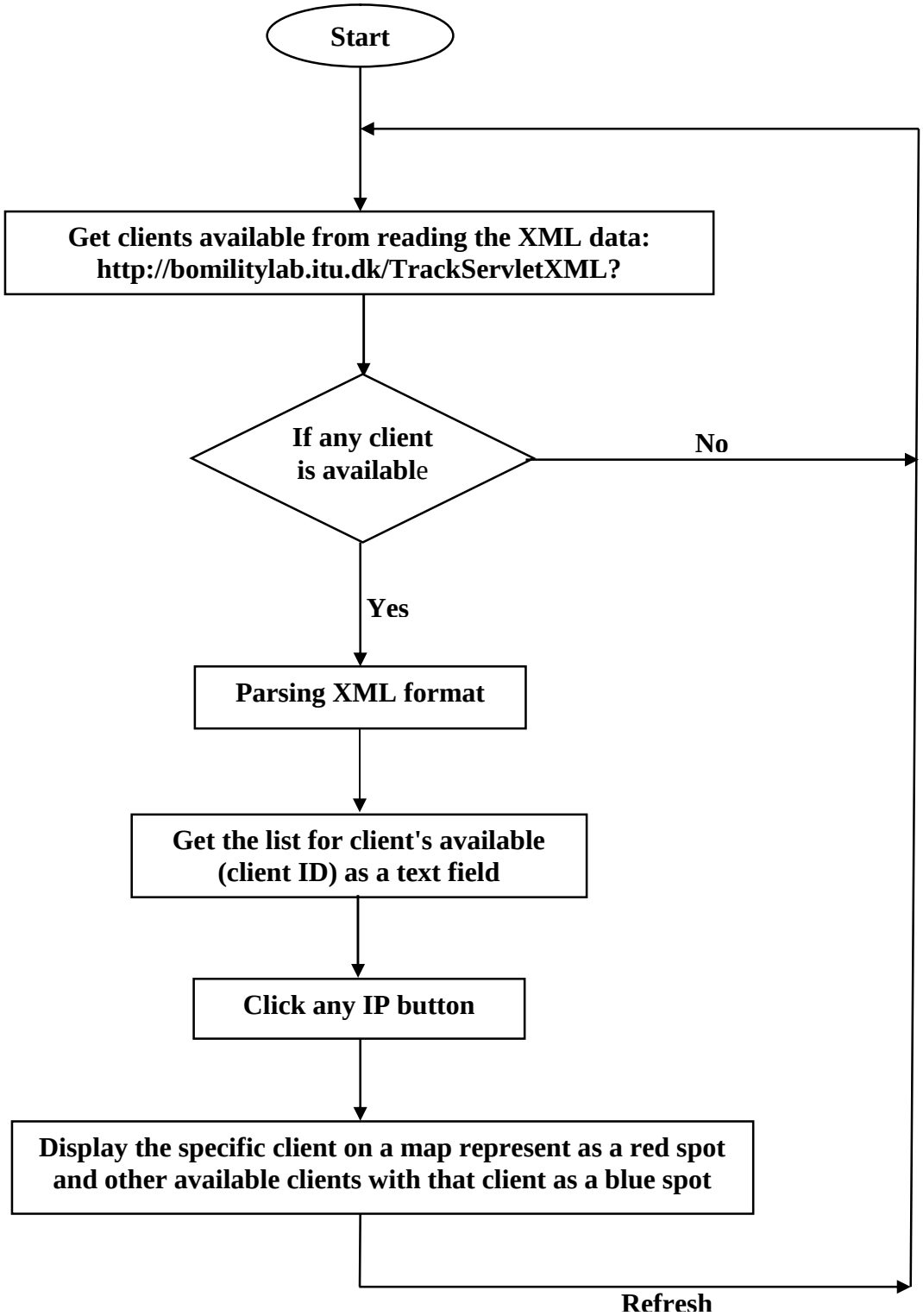

Figure 2: The flowchart of the system

C. The System processing

In the first step we send an *http* request to the positioning server to get a reply representing as XML format as shown in Figure 2. This step is illustrate in fragment code as shown below:

```
xmlData = new XML();
xmlData.onLoad = onMyload;
xmlData.load("http://mobilitylab.itu.dk/TrackServletXML?");
```

If we get any client available from the reply of XML format then the capability of the Flash application can read this XML format and pars to locate and track a client on a map. The XML processing (parsing) is illustrate in fragment code as follows:

```
**********************************************************************
// Here the code of the onMyload function start
//    **********************************************************************

        var str;
        var baseNode = xmlData.firstChild;
        var client;
        var clientElements;
        var clientElementsSub;
        while (baseNode.childNodes.length == 0) {
                (nextBaseNode=baseNode.nextSibling);
                baseNode = nextBaseNode;
        }
// it was client
        clientArray = baseNode.childNodes;
        if (clientArray[0].childNodes[0].nodeName == TrackingStatus) {
                break;
        } else {
                totalNoOfClient = clientArray.length;

                for (i=0; i<totalNoOfClient; i++) {
                        //totalNoOfClient += 1;
                        // tracked client, disable no response
                        //_root.noClient._visible = false;
                        // These values are test
                        //ip                                                    =
random(255)+"."+random(255)+"."+random(255)+"."+random(255);
                        clientElements = clientArray[i].childNodes;
                        ip = clientArray[i].attributes.id;
                        // ip = clientArray[i].nodeName;
                        clientID[ip] = ip;
                        level[ip] = clientElements[0].childNodes[0].nodeValue;
                        area[ip] = clientElements[1].childNodes[0].nodeValue;
                        //
**********************************************************************
```

Briefly, we will be describe a parsing XML format represent as a tree structure as shown in Figure 3. Because we do not know how many clients are available, we need to use an array containing information of each client as a function onMyload () and define an client as array called clientArray providing the information of each client such as client id, floor numbers (level), x and y coordinates in meters and pixels as shown in fragment code as follows:

```
function onMyload ()
clientArray = new Array ();
// Array contain information of each client
        clientID = new Array();
        level = new Array();
        area = new Array();
        x_m = new Array();
        y_m = new Array();
        x_p = new Array();
        y_p = new Array();
```

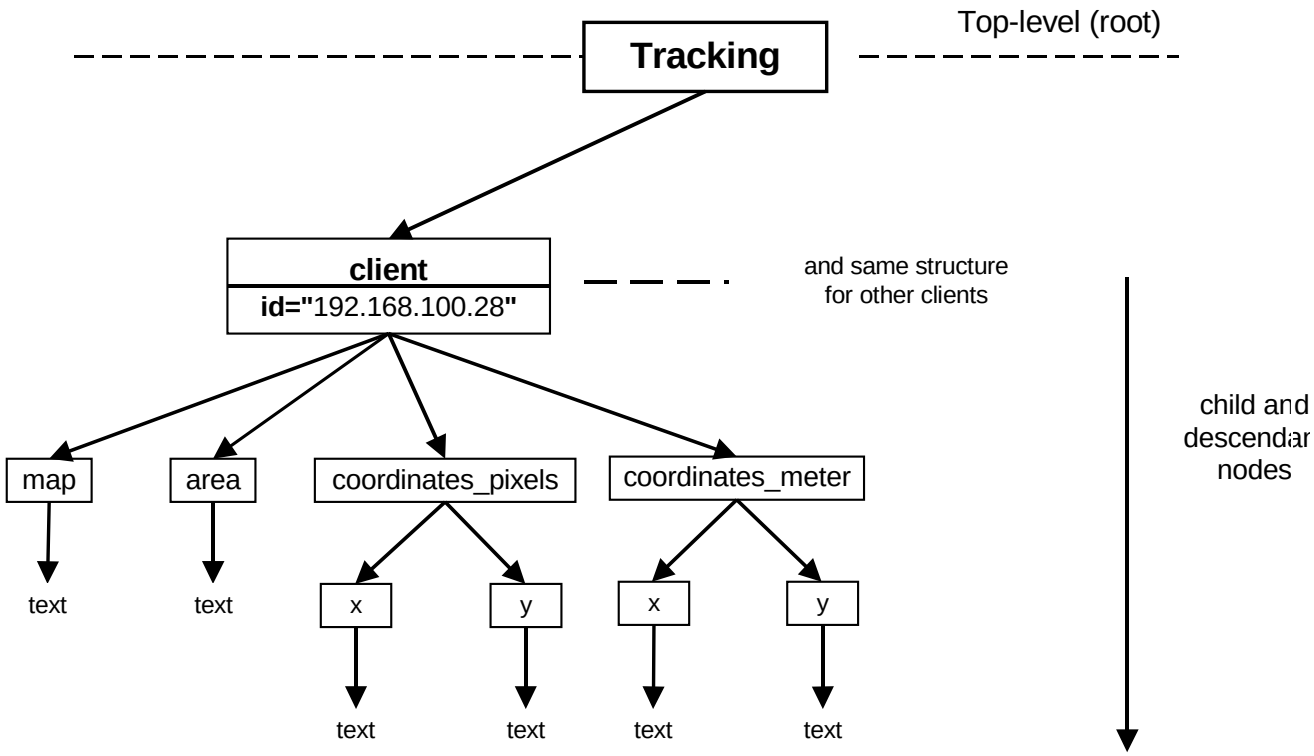

Figure 3: Tree structure illustrating a parsing XML format

III. Testing and Results

In order to test the performance of the proposed tracking system, we testing the categories of the program and then we get a result as shown in Figure 4.that displays the specific client on a map represented as a red spot and other available clients with that client as a blue spot.

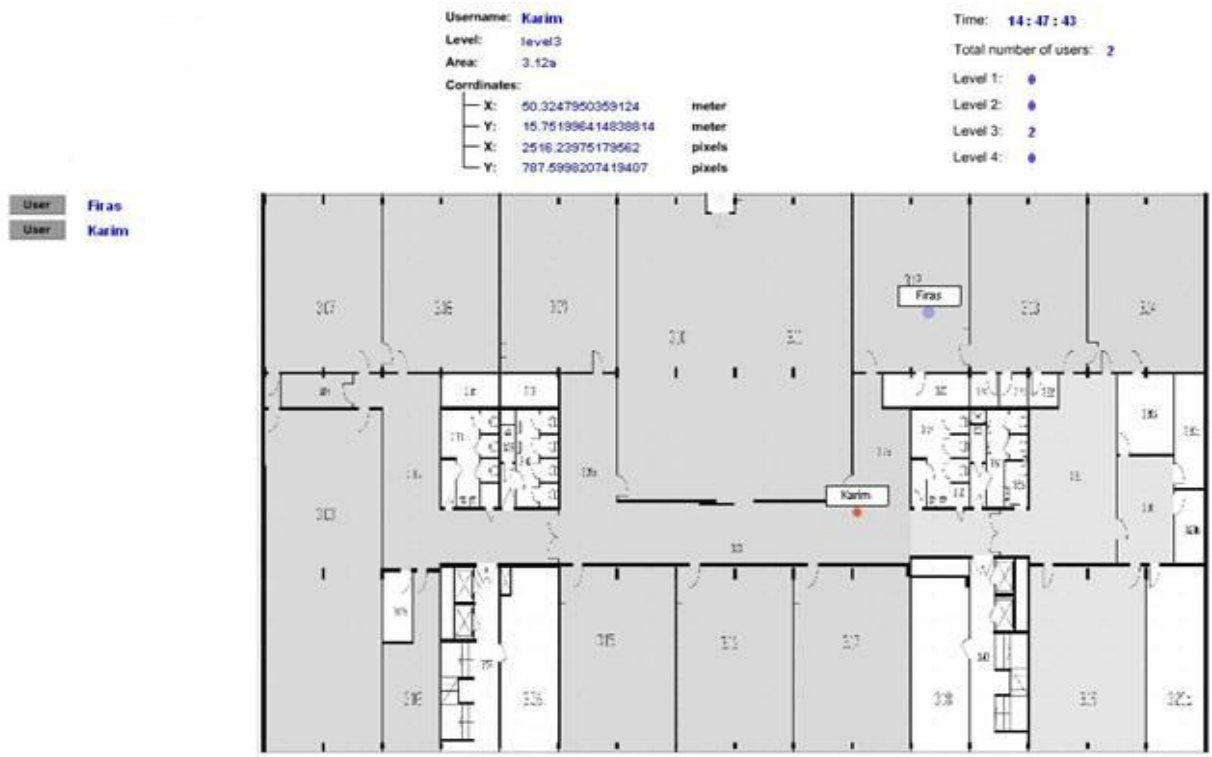

Figure 4: A screenshot showing student participation and her peers

IV. Conclusion and Future work

We conclude that it can be possible to locate and track any client on a map in indoor environment using a powerful and flexible tool (macromedia Flash MX application) having capabilities such as layers and supporting action script programming. Consequently, we get good results without any complicated programming language compare with current programming languages such as JAVA, C++, or any OOP. Also we observed a few points during test that could be taken in accounts; suppose the positioning server does not work or provides an error position of client, then the system will take this XML format and provide an incorrect information and incorrect position's client. Consequently, we can say that tracking system is a dependable exchange information system, when the positioning server runs with reasonable behaviours, otherwise it is unreliable (i.e. particularly when positioning server runs with unreasonable behaviour). Other points about the calibration problem take place at any time (take a lot time to check) and provided that no client is available. The last point must be taken in consideration in order to run, test the system should take place inside University and loading the system could be done in any workstation. In

future work we will continue to provide more functions and more services for both costumer and developer application.

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