Multipurpose Smart Beacon Solution

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Abstract— **This article highlights a new and low-entry system to use Bluetooth Low Energy beacons to share information about anything, to anyone, by anyone. The authors want to express the features and advantages of this new system, share the outcomes of preliminary experiments with different user groups and some new fields of application. Finally the article considers the educational and commercial value of the system which is used as a practice enterprise for public – private collaboration.**

Keywords— smart campus, BRRR, iBeacon, interactive university, practice enterprise

I. INTRODUCTION

Among all people there is the desire to share information to other people. This is clear from the success of social media and the like. But people not only want to provide information about themselves, but also about things they are related to. They want to share knowledge in a museum, in the streets, about their store, about the menu, about their lab infrastructure. Even if they are not around to do this personally…

Other people hunger for this information. They want to know what their friends are doing, but also who painted the painting he or she is looking at, if there is a discount in this boutique, what the menu is, maybe even the amount of calories, allergic information.

The Smart Beacon system, a system with Bluetooth Low Energy devices [1,2], a back-end database with dedicated CMS, provides a low-entry, easy to use solution for all creative people to dedicate specific information to whatever object they desire, being paintings, statues, shopping windows, garbage bins, … themselves. The Internet of Everything for Everyone.

This paper considers the idea of Smart Beacons, the technical implementation and the preliminary tests with various test groups. It also highlights educational and commercial value of the system.

II. IDEA OF SMART CAMPUS

The Smart Campus is an indoor wireless network to deliver location and user based dynamic information to the different visitors, teacher or students of a university campus, both for day-to-day use as for specific events. This interactive Smart Campus for universities talks to you, through your smart phone. Individual information for all stakeholders is delivered, depending on their profile, their location and time of day.

There are a number of applications that one could imagine to be interesting for the different people present at a campus. Visitors walking on the campus will get interactive information about the different locations, students can get the daily menu and information on student activities, staff members will get an update on the stake values of the organization.

Because of the diversity of the delivered information the developers needed to think of an easy-to-use platform for a wide variety of applications. The solution is to bring the information with 3 key elements: a picture as eye catcher, a text with the information and a link to whatever additional information: a website, a movie, music, a PDF. Moreover, client users should know where the information they want can be gathered. So a plan or a map of their location should also be made available.

The three main components of the system are the Bluetooth Low Energy beacons (Fig1.), a mobile application on Android & iOS and a back-end server with database and dedicated CMS.

Bluetooth Low Energy (BLE) is the new specification of Bluetooth available for all new smartphones. These devices send out their UUID, a major and a minor. They can be placed on or nearby a given object and should last very long on one battery. The supplier guarantees a couple of years shelve live in sleep mode, but this decreases of course when in active mode. In any case do the beacons send out their battery status and batteries are easily changed. They also send out their signal strength, which can be used to make an estimate of the distance. This is promising to do indoor location through triangulation, but it also is very prone to disturbances from nearby people, walls and other EM sources. For this implementation this is no problem, as we need to know if a beacon is very near, near, in the area, further away. Or relatively, which beacon is closest, thus most relevant in a room full of beacons.

Fig. 1. Jaalee Beacons

Fig. 2. Android interface

The mobile application registers a beacon, gives a notification to the client user and activates the mobile device to look up the necessary information in the external database, based on UUID major and minor. It then displays this information, consisting of a picture, a text and a link in an attractive way (Fig. 2). The link points to interesting additional information. The text can be scrolled down and links in the text are also clickable. Another feature enables the user the save the information on the smart phone for future reference when the beacon is not in range anymore.

A number of settings are provided within the app, to make testing and user experience better. First, the beacon range can be set, this is the range from the beacon in which the user is notified and the information is gathered. The user can decide to see all beacons in range or only the relevant nearby. Second, it is possible to change the refresh rate of the content, to allow the user to get the information constantly, once each hour or once each day. It also gives the possibility to limit the reception to new information, because it checks the time of the registration of the beacon and the time of the updated input in the database. Finally, the user can decide to only allow information of specific groups. The users is only interested to get information from beacons which are of interest to him or her, other groups can be blocked. This way the campus could also divide the input of information to public, for all users, and private, for staff only.

The CMS (Fig.3) and database give the suppliers of content, the promotional users, the possibility for changing dynamically the content of certain beacons. They have access to the list of beacons they administrate and can change title, link, text, and picture.

The administrator of the complete system has additional rights to create beacons, change the UUID, major and minor, add promo users, add groups, add users to a group, distribute login details to potential users, add languages, add maps & plans to beacons and look at beacons usage. This way this administrator has full rights to dynamically govern the user community, but with this he also bears the full responsibility for it.

Fig. 3. CMS start screen

III. FLEXIBLE SOLUTION

Suggested software solution consists of three basic parts – mobile applications for Android and iOS, administration application, CMS [3].

Hardware needed: beacons located in specified places.

The mobile application is aimed for scanning for the beacons (Fig. 4) and present information in two modes – "talk" as a list of discovered beacons and "walk" showing the info in the notification bar.
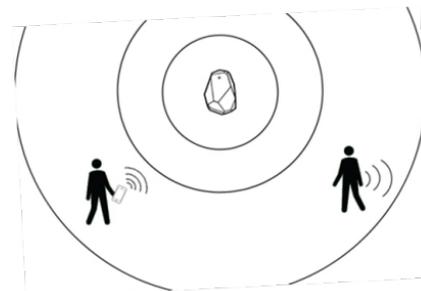

Fig. 4. Beacon range

According to the time set in the settings (Fig.5)   the application requests information from the database (Fig.6) .
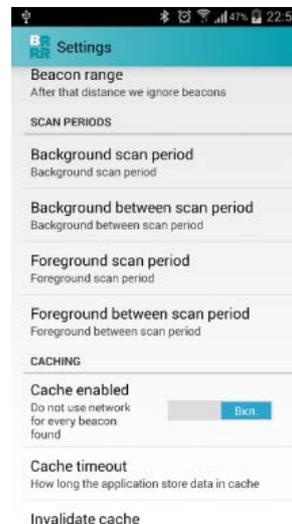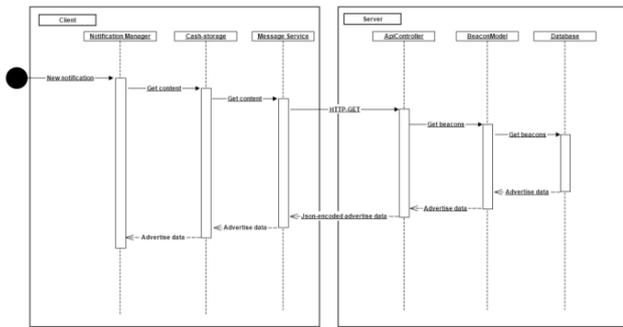

Fig. 5. Application settings

Fig. 6. Mobile App and Server Communication

Cache memory is also realized in both iOS and Android solution. This way the application can detect the beacons from the user groups even without internet connection.

For the administration of the information about a certain beacon the CMS was developed. It allows user to manage all information about beacons, users, groups [4,5].

The system supports an interactive map with the location of the beacons marked on it (Fig. 7) - the system should enable the placement of interactive labels - beacons map / site plan that can have an idea of the geographical location of beacons, as well as double clicks on such a mark to allow the user to view / edit content of this beacon.
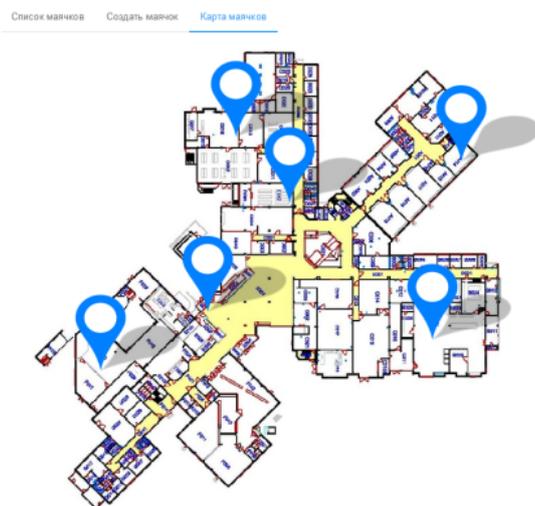

Fig. 7. Interactive map

IV. SMART BEACONS IMPLEMENTATION

A. *Implementation at Thomas More International Days*

Each year Thomas More organizes the International Days where professors and teachers all over the world are invited to give lectures on a topic of their interest and to a diverse group of students and colleagues. During these International Days the conference rooms got a beacon, with "Now speaking" information on the speaker, their home institution and with a direct link to the presentation material or a movie with lab results. If students like the presentation, they can directly push the "like" button to save this information.

The organizing committee also carried around a beacon with the message: "Can I be of any assistance?"

On the social event, our international guests were informed on the menu and ways to receive something for their special diet.

In total 4 location beacons, 3 conference rooms and the restaurant were used and two personal beacons for the two organizers of the event.

B. *Implementation in Youth Club*

The youth club, Chiro Duffel, organized a big game in the village and the woods, where the older members (15-16 years) needed to find beacons and perform the assignment given with the beacon to find the next clue. Their findings were that the system is easy to use, easy to initialize the beacons and to start the game. It was a nice thing to do this traditional game with modern technology, all worked well, all beacons were found eventually and it was a fun evening.

Some setbacks were that you need to have 3G or 4G internet connection, some members had an iPhone and well-hidden beacons were hard to find, without increasing the range. And using smart phones in a more traditional youth club is not completely in line with their philosophy, which can only be applauded in this increasing connected world.

The club used 10 beacons in various locations and 1 out of 2 participants had a smart phone with the mobile application.

C. *Implementation for Interactive University*

In Zaporizhzhya National Technical University application became a part of university infrastructure. All departments are welcome to take part in the experiments.

In summer it is the time when enrolled students come with their applications. It is a real challenge to find in what building administration is located, entrance committee, accountancy and etc. Our application is aimed to guide them in the maze of corridors.

First beacons are located at the administration room with the photos and short information about university managers, which can help visitors to get brief information.

From autumn in each building there will be a beacon placed which sends information from students trade-union (the same as a EU student club) and one information from student employment center.

Application is downloadable from university website (zntu.edu.ua).

D. *Beacon Baby Alarm*

Another future application is the Beacon Baby Alarm. This way the system can be even used to save lives. According to the Huffinton post on average 38 children die in a hot car after being left unattended each year in the United States alone, one each 9 days [6]. In the EU this will be around 20. With a reversed notification system, your smart phone will give you a notification when the beacon placed on your baby's car chair is not detected anymore in a range of 50 meter, i.e. when you

went to for from your car. This alarm is automatic activated when you get near your beacon, in the range of 5 meter, so when you get into your car. By manual activation, the system is also useful on the beach, when your child, with his beacon bracelet gets further than 50 meters from you. This system is currently in development under the working title the Beacon Baby Alarm.

There is no need for 3G or 4G, only a mobile application, Bluetooth and one beacon. This increases reliability of the system.

V. CONCLUSION

It is clear that the developed application can be adjusted to a great variety of applications. First testing experiments showed that the developed system can be easily adjusted to great variety of tasks.

It is clear that the complete system as a lot of academic & research potential, but there is also some commercial value. This too is an aspiration of the developing team, namely to make a complete market-ready product, to sell the product, to get paying customers who use our database, to develop a marketing strategy, business plan and to deliver quality of service to our customers. There is a lot of knowledge on business start-up, legislation, up-scaling production, technical demands, quality issues, and so on to be gained from a practice enterprise. Coping with these issues are typical competences that students can use as future young professionals. To go further than a prototype, and to deliver the quality of an actual end-product, and to get rewarded or punished in the free market is good way to measure and proof the quality of this end-product outside the purely academic domain.

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