Creation of Beacon apps including webinterface using heatmaps

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**Abstract** Nowadays, almost everyone has a “computer” in their pocket. People call it a mobile phone, it’s official designation is smartphone. These devices are stronger than a 10 year old computer and we almost forgot that they were invented to call someone at a distance*.*

People have senses that we can consider as sensors (for example the ears) and behind the glass of these smartphones, there are technologies located that try to imitate these organs electronically (think about the ‘search by voice’ function). But how can a smartphone realize when an object is close or far away, just like our eyes? Beacons are a very important known fact to the solution of this question, which will be explained later in this paper. What is possible and how can we visualize this and use it for a better crowdcontrol at events.

*Index Terms*— Beacon, Location, Proximity, App, Crowdcontrol, Heatmap, Data Representation

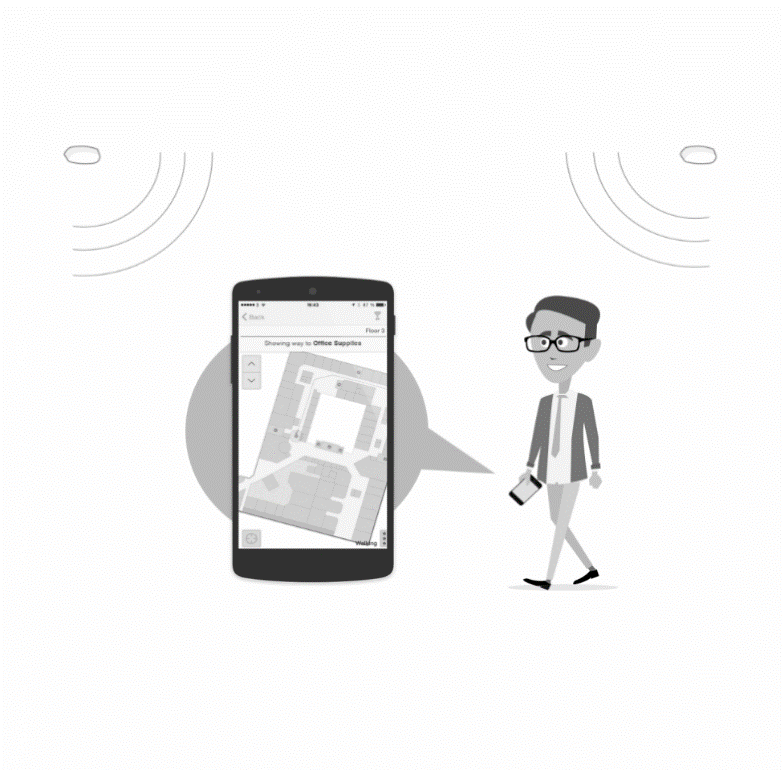
# INTRODUCTION[[1]](#footnote-1)

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mobile app already exists most of the time, so what after that? A question asked by many companies and organizations. A next step could be to integrate beacon-technology into your app. Beacons are small sensors, that transmit signals which your smartphone can receive and interpret. This way it is possible to perform proximity measurements and to interpret them.

Where GPS has a precision between 10 and 15 m, beacons can reach a precision smaller than an arm’s length. This way it is possible to develop new applications that are more extensive with new interactions. With beacons the gap between the physical world and the world of the smartphone data (ones and zeros) will be bridged. A lot of these new applications are built for the retail sector, but it goes further than that. With beacons and a modified app the analysis of location data can be optimized. [1]

With the use of heatmaps we can create a fast and easy overview of bustles, where different possibilities can be applied, such as a webinterface for the organization of an event. Safety is a very important factor here.

  
*Figure 1: Beacon integrated app [2]*

# BEACONS VS GPS [[2]](#footnote-2)

The precision of a GPS is limited to several meters. At indoor locations it only is more difficult, because of the disrupting of the signal. With the use of beacons we can reach an accessibility/precision of a few centimeters (under ideal conditions). There is no other machine or technology that can improvethis combination. When we talk about location data on events, this tolerance is obviously higher, but this is a less important factor. [1]

# LOCATION VS PROXIMITY

Beacons define “how close you are”. It is often linked with “where you are”. Many people see it as one concept, but that’s a misunderstanding.

Location is an absolute, unchangeable concept, defined by coordinates. When we talk about geographical coordinates, there is latitude and longitude, like a location on a world map or Google Maps. [3]

The concept “proximity” (like in the question “What is nearby?”) is not the same as defining an exact location. But we can ask ourselves which places or objects are located in a radius of 20 m around us.[1]

Beacons can only measure proximity, which is often sufficient for the retail sector. When we talk about localization for crowdcontrol, there are 3 beacons needed nearby in order to determine the location. When the proximity of the 3 beacons relative to a smartphone is known, the location can be calculated.

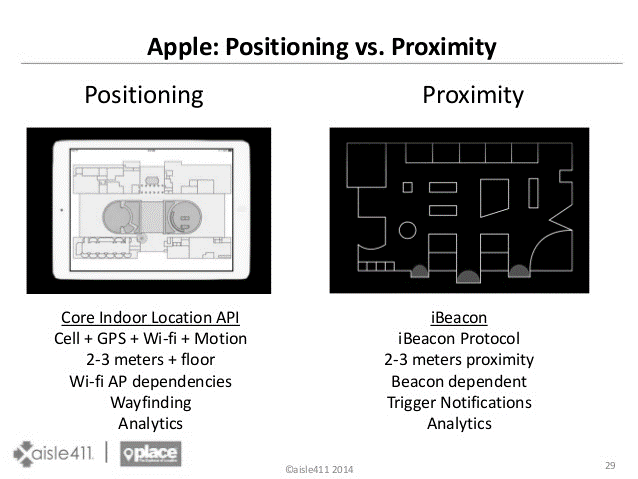


Figure 2: Positioning vs Proximity [4]

# Beacon integrated apps

Beacon apps are often used for “personal messaging”, for example a person who visits an event and at the entrance he receives a message “Welcome!”. If this person came to the event several times, we can notice this because of the collected data in the central database and potentially reward the users. This aspect can be expanded to “Location-based messaging”. This technology enables you to remind or convince people to do a particular act in a specific area.  
 Due to the beacon integrated apps it is possible to raise the involvement of the users and to improve their experience. Apps will become very interactive and the content will be more relevant than ever before.  
 We also may not forget the financial aspect. An engaged audience allows you on the basis of the info to send messages about donations, sponsors, other tickets,…  
 Nothing but praise to the beacons, but what we are interested in is the improvement of crowdcontrol. [5]

# Crowdcontrol

There is a growing demand to the crowdcontrol of the flow of people in public places and events. Extra control won’t only improve the organization of the event, it has also a positive influence on the safety of the people.

Heatmaps are often used to show datasets. These datasets contain the location data of the visitors. Collecting this data happens by people with an active “tag”. These tags can be located in objects like bracelets, but here we are talking about datasets that are built on the basis of location data that are extracted from beacon integrated apps.

Learning how users navigate through your event is a good lesson, it allows you to understand what the most popular places are, the peak hours included. This information can help you to deploy workers and more, but a good and safe crowdcontrol remains the most important aspect.



Figure 3: A good crowdcontrol can safe lifes [6]

# Google maps (heatmaps)

Google maps (before Google Local) is the online map service of Google which can be used to find geographic locations. Google maps automatically shows additional information if desired. The biggest competitors of Google Maps are Apple, Bling Maps, OpenStreetMap and Yahoo Maps. Due to the most optimal system, Google Maps is leading on the market.

Since 2007 it is possible to create your own personal map on Google Maps. The user can add lines, shapes, marks and photos themselves. [3]

Due to the easy api the functionality has been extremely expanded. With the integration of the beacons in the apps, we are especially interested in the use of the api Google Heatmaps. Individual data (in this case the longitude and the latitude of the visitors) inserted in a matrix can be showed easily based on colours. People can fastly, easily and clearly detect where the crowded places on an event are. Of course the whole system is mobile friendly. [7]

# Materials needed

For the practical implementation of a working system (beacon integrated app) on an event, there is a need for an appropriate infrastructure. First of all, the user must own a smartphone that has Bluetooth 4.0 and of course the beacon integrated app. It’s necessary to have enough beacons present at the terrain (Estimote Beacons is market leader and they have a good reputation). The collected data will be forwarded to a central database where all the data is saved. An internet connection and a database (that is located on a server or computer) is also necessary.

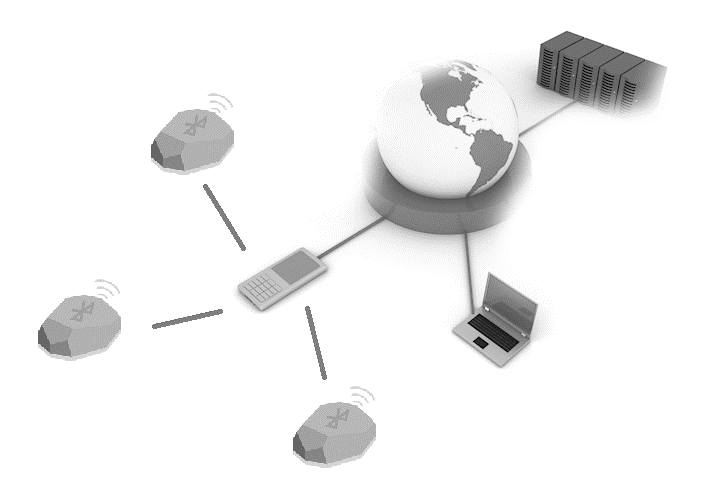


Figure 4: Infrastructure beacon network

# Proof of concept

A. Target

When all the elements that we have discussed are combined, we can start thinking about a proof of concept. Location data from the app is forwarded to the database, where a webinterface will collect the data to visualize this for the organization. The result will lead to a better crowdcontrol.

B. App

When there is a framework integrated into the app, we are talking about a beacon integrated app. So it’s possible to connect a smartphone with the beacons that are located on an event. Of course the framework has to be based on the existing beacons. The framework will forward the longitude and the latitude of the app-user to the central database and save this data.

C. Database

The most important table of the database contains the beacon loggings, it collects all the location data. This means: id\_beacon\_logging, id\_user, latitude, longitude en date\_logging. Based on this data we can accomplish calculations and graphically display the visitors on a heatmap. The other tables in the database are needed to achieve an optimal use of the webinterface. Different events, including their stages and of course the related boundaries. The data in the database can also be returned to the users. This way it is possible to expand the app of the event with benefits for the visitors.

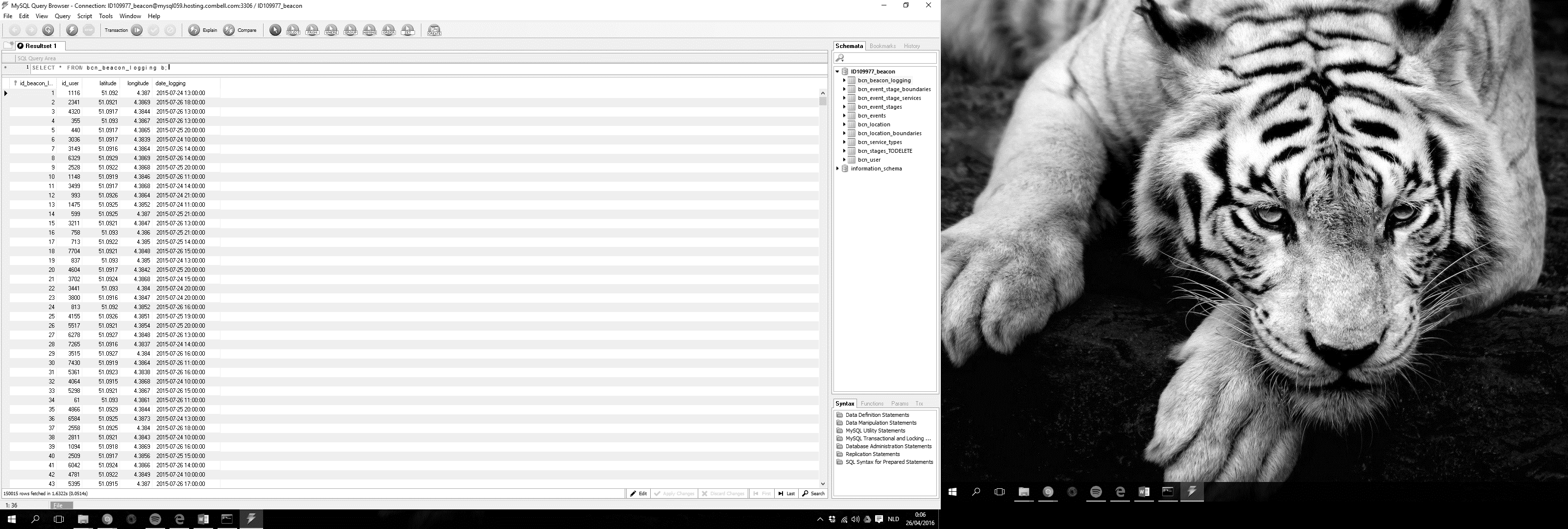


Figure 5: Database loggings (proof of concept)

D. Webinterface

The webinterface is used by the organization and the emergency services and has the important goal to create a better crowdcontrol. It gives an overview of the situation. By connecting this webinterface to the database, the locations (longitude and latitude) are put on a heatmap. The heatmap is divided in the different stages, whose data is also imported from the database.

By using a JavaScript graph, combined with PHP, it is also possible to look at the bustle per stage at every hour.

# Sxsw-festival

Last year from 13th till 17th of March they realized a big iBeacon application on the festival South by Southwest (SxSW). More than thousand of iBeacons were used for the optimization of the crowdcontrol. The iBeacon application made sure that the visitors had a completely different experience. With the app it was very easy to network with other visitors and easy to find your way around the festival.

Thanks to the function“Attendee Match” you can socialize with other visitors you are interested in. If you want to go somewhere fast, you could use the “Around me function”. The function showed all the nearby activities, based on the iBeacon technology. In practice it has been proven that the concept actually works. [8]

# Conclusion

The integration of beacons in an app doesn’t mean a complete review in terms of the design of apps. This technology forms an addition to traditional apps and offers an up-to-date research method. Safety, marketing, ease of use and much more will benefit from this information. Beacons take care of the collection of data of your visitors while they are busy on the terrain.

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1. [↑](#footnote-ref-1)
2. [↑](#footnote-ref-2)