ADVERTISEMENT USING BLUETOOTH LOW ENERGY

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Abstract: The goal of this paper is to build an application that receives commercials depending on a user's location in stores. This can be made using client-server architecture. The server consists of an Arduino and a BLE (Bluetooth Low Energy) device. For the client, a smartphone has been used for which an application has been developed. This application is suitable for its operating system (Android 4.3) so that it can communicate with the server (the BLE device) placed in the store. After connecting to the server, the client waits for data from the BLE module attached to Arduino and displays the corresponding advertisement on the phone screen. A questionnaire has been added in order to receive the user's feedback, so that the advertisement's impact can be monitored. All data is stored in a MySQL database.

INTRODUCTION

Originally a Nokia research project, BLE (Bluetooth Low Energy), was first introduced by the Finnish firm in 2007 as Wibree.

BLE was released as part of Bluetooth 4.0 under the brand name of Bluetooth Smart. BLE is designed to be an ultra-low power network that can operate on a coin cell battery for up to three years.

Therefore, BLE is very efficient in terms of power consumption, it is reliable and cheap to implement because of its range.

The iPhone 4S was the first commercial product that included Bluetooth 4.0.

At the time, the technology got some attention from industry observers who speculated about its potential - especially regarding a new technology called BLE. With iOS 7, Apple has extended the possibilities of BLE with iBeacons.

Bluetooth 4.0 comes on all Apple devices released since 4S, including Mac devices and increasingly in Android phones such as the HTC One, the Samsung Galaxy SIII and upward. Since Android Jelly Bean (4.3), Google began offering support to BLE signals for the development of technology.

Starting from the iBeacons idea that iOS 7 is elaborating at the moment, something similar was implemented here, but for Android.

Because BLE can transmit within a radius of 50 meters, the developers can create new experiments with city tours, sales, games that can test the ability of finding hidden gems, etc. IBeacons work without Wifi or internet connection, establishing the location is much more accurate and works from the inside.

When the users are getting closer, their devices can receive messages or information about certain interests. In this aspect lies the idea that was used and which is being further developed. When a client is in the iBeacons range and has the Android application activated, s/he will receive commercials on his phone which contain the best current offers of various shops. Hence, the concept has been used to improve shopping experience. Women will definitely love the idea.

Of course, this technology can fulfill numerous tasks ranging from a pay system, health, sports, and especially can have a huge influence in marketing and advertising.

Therefore, the developers have shown particular interest in BLE due to its micro-capabilities to localize.

As Michael E. Cohen from TidBITS states, "The applications which are using iBeacon can provide an answer to the question: "Where am I?" and not in terms of a map as the GPS, but in terms of where the device is located in a relative position to another device.

This means that the initial location can be determined by different sensors up to a micro level, due to the iBeacons that receive the signal from where other devices cannot obtain it.

The aim of this study is to innovate how advertising works in a time when society is constantly evolving and in the same time, new technologies replace old ones.

2. IMPLEMENTATION OF THE SYSTEM

2.1 Description of the system architecture. The main key words relied on when designing this system are 'mobility' and 'flexibility'.

To do this, the system was designed from the start to operate in the most commonly used medium today: the internet.

But how to get on the Internet an advertisement from the stores we walk past every day?

In order to achieve this, a system based on client-server architecture has been designed (Fig. 1).

2.2 The server consists of an Arduino and a device mode BLE (Bluetooth Low Energy).

This has the purpose of transmitting signal in a certain range and when the client passes by, he can detect it and connect to the server if he takes into consideration some signal requirements.

Once the client-server connection is initiated, the server sends the data corresponding to the advertisements through BLE to the client and then it will disconnect

To display the status of the client-server connection, a witness has been chosen, namely a LED. When the LED is on, it means a client is connected and when not, it is available and waiting for a connection.

For creating the server, the Arduino Uno module has been chosen (Fig. 2) because of the information available on the internet, various open source libraries and its flexibility (each module can be adapted to a user friendly mode, requiring less time for debugging and more time to put into practice the programmer's ideas).

This model has been equipped with a ATmega328 microcontroller.
The Arduino module from Fig. 2 consists of:
- ATmega328 microcontroller with Optiboot (UNO) Bootloader
- USB Programming Facilitated by the Ubiquitous FTDI FT232RL
- Input voltage - 7-15V
- 0-5V outputs with 3.3V compatible inputs
- 14 Digital I/O Pins (6 PWM outputs)
- 6 Analog Inputs
- 32k Flash Memory
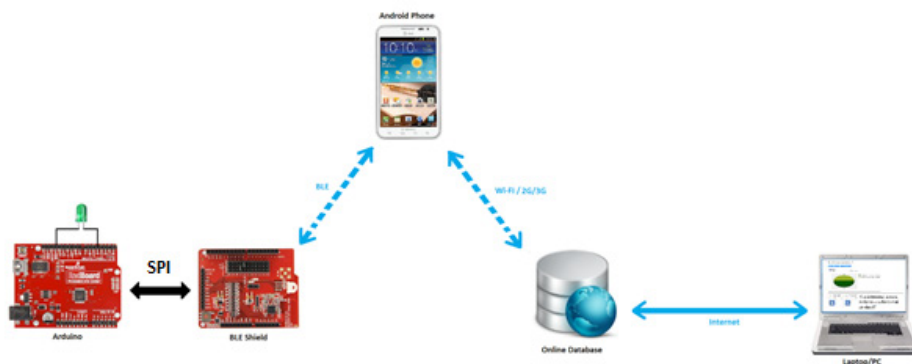- 16MHz Clock Speed
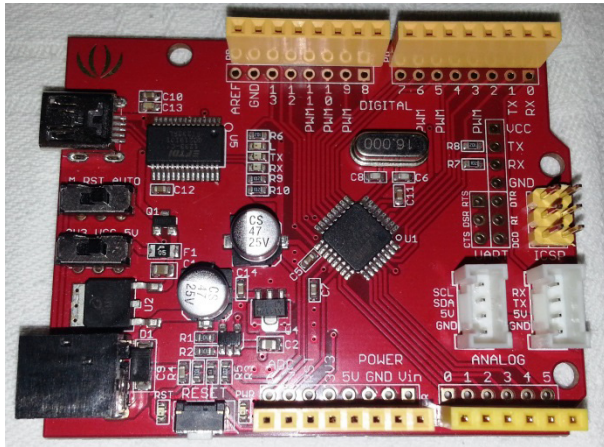- All SMD Construction

Fig. 1. The architecture of the system

Fig. 2. Arduino module

To the Arduino board, a Bluetooth LE (Low Energy) shield - produced by RedBearLab Company - has been added (Fig 3), which helps the server communication via Bluetooth with the client (the application on the phone).
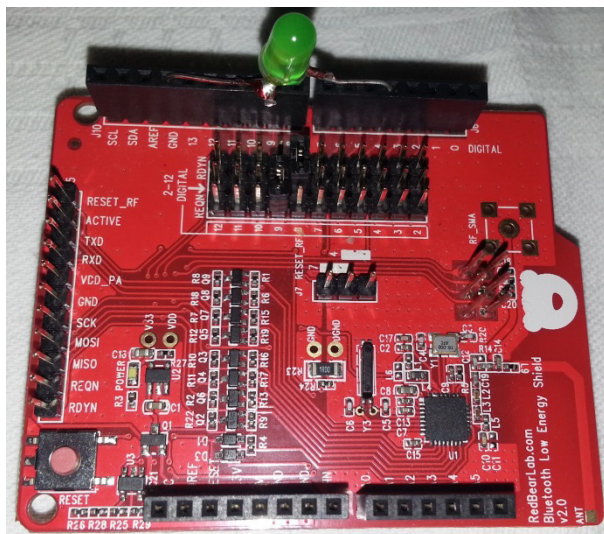

Fig. 3. BLE Shield

The BLE board consists of:
• Besides the on-board PCB antenna, option to use SMA connector for external antenna (soldering is required)
• Flexible REQN and RDYN pins selectable from pin 2 to 12, these pins are fixed at 8 & 9 for BLE Shield v1
• Reset button also resets the Arduino board, and vice versa
• ICSP header provides Vcc (for other shields to get power source)

• ICSP header now passes through (for other shields to connect to the SPI)
• Shield's reset is controllable by Arduino pin 4 or 7.

This shield has the microcontroller Nordic nRF8001 Bluetooth Low Energy IC at its core.

As a way to communicate with Arduino, the SPI protocol is used: protocol which is handled by SPI library from the Arduino development environment (SPI library) using serial communication.

For debugging and connection status, adding a LED witness to the Arduino board has been considered useful in order to notify the seller if the module or server works properly: it will light up when the connection with a client is established and will turn off if the connection is available or not busy with maintaining a connection.

Last but not least, the concept of this system is to be portable. A standard 9V battery has been used to supply the Arduino device.

After creating the server part of the system, Arduino had to be programmed from its own Arduino IDE environment in order to be able to communicate with the BLE module and manage the client connection.

Firstly, the necessary open source libraries have been included. Afterwards the used pins have been defined. Lastly, the on/off switching LED witness has been configured.

2.3 The client – For the client, a smartphone has been used for which an application has been developed. This application is suitable for its operating system (Android 4.3) so that it can communicate with the server (the BLE device) placed in the store.

Samsung Galaxy Note2 was the testing device (Fig. 4).

Fig. 4 Samsung Galaxy Note2

For this, an application for Android has been developed, with help from the AndroidDeveloper dedicated software Tools based on Eclipse IDE.The first screen that appears is:
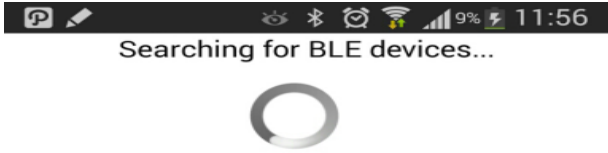

Fig. 5

..and the device with the strongest signal from the list (the closest to the user) is chosen

Fig. 6. Received signal strengths

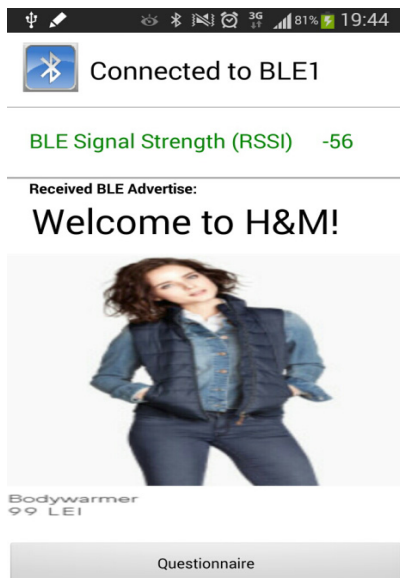…and displays the corresponding data on a screen

Fig. 7. Advertisement on the smartphone screen

Finally, the user's feedback is requested (Fig. 8).

The application has been created so that it always scans the BLE devices in the area; it displays them in a list and then chooses the device with the strongest signal from the list (the closest to the user).

After connecting to the server, it expects data from the server (BLE module attached to Arduino) and displays the corresponding data on a screen. A button has been added to the questionnaire in order to receive the user's feedback, so that the advertisement's impact can be monitored.
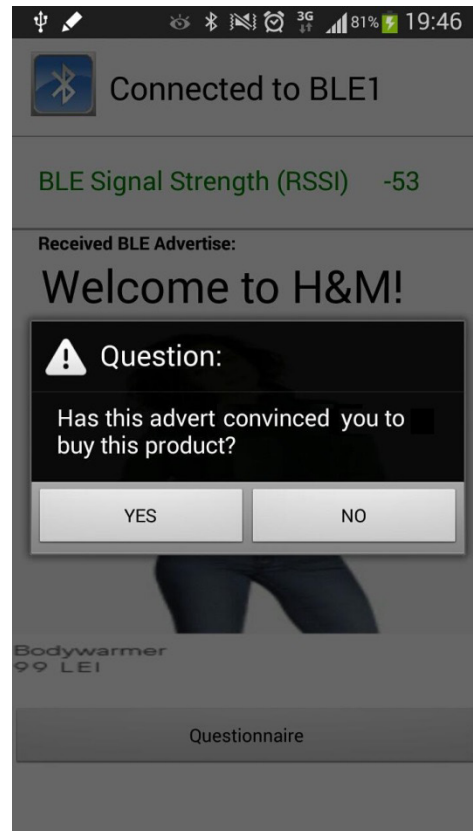

Fig 8. Feedback from the client

After the user completes the survey, the data is sent through the Internet to a certain location and recorded with a php script in an SQL database and then the whole process is restarted on the mobile application.

The utilized libraries specific to BLE Android have been available only since version 4.3.

To connect to the device with the strongest signal from the list the values of the signals were compared and they are stored in the RSSI variable.
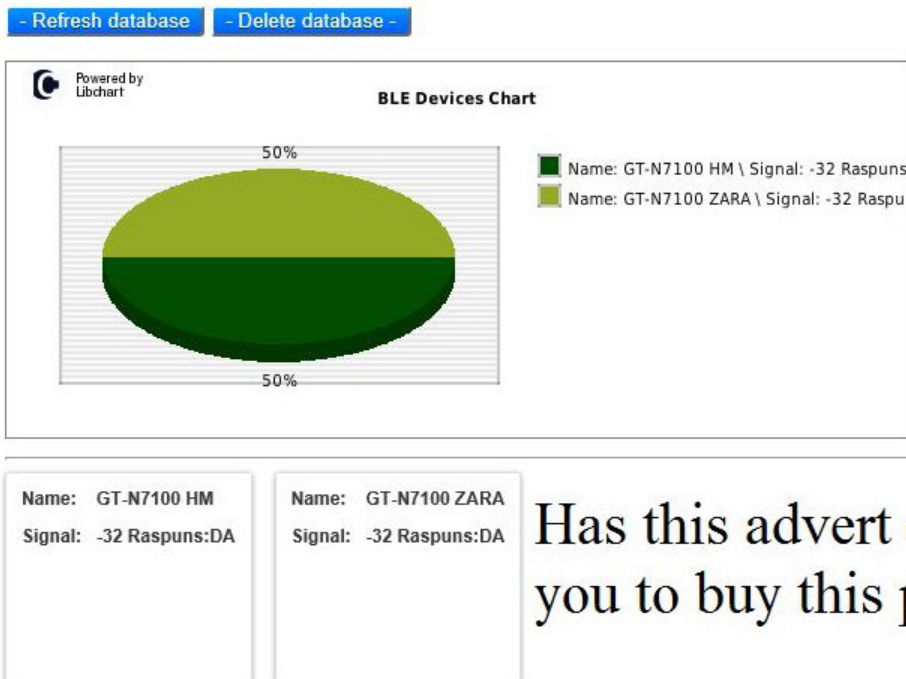
No of shops registered: 2

- Refresh database -   - Delete database -

Powered by Libchart

BLE Devices Chart

50%

50%

■ Name: GT-N7100 HM \ Signal: -32 Raspuns
■ Name: GT-N7100 ZARA \ Signal: -32 Raspu

Name: GT-N7100 HM
Signal: -32 Raspuns:DA

Name: GT-N7100 ZARA
Signal: -32 Raspuns:DA

Has this advert convinced you to buy this product?

Fig. 9. The webpage where the feedback is collected

2.4 The main database online. After sending the response of the questionnaire for the Android application, managing the customer's feedback would be of help and for this a MySql database has been chosen. Therefore, a free domain has been found and a database with a table containing the fields below has been created in MySQL:

- *registrationId*- unique ID for registrations
- *btname*- the name of the BT device from the client's phone
- *answer*- the client's answer
- *shopname*- the name of the shop related to the questionnaire

In order to add/ remove elements from the database some php scripts have been used and for the interface CSS has been used for arranging the page's layout.

The source code of the entire application is not the subject of this paper; it can be obtained only upon request.

3. CONCLUSIONS & FUTURE WORK

There are numerous ways of using BLE in developing applications in almost all areas: from micro-localization of payments, marketing, health, security, traffic performance, product information, advertising, location services and more than that.

To conclude, the work presented in this paper includes an application developed on an Android device for the marketing area. Its purpose is to innovate how advertising works in a time when society is constantly evolving and in the same time, new technologies replace old ones. The internet offers so many opportunities and this is the most important tool used for this application.

In the future this work will be tested in real life at a Shopping Center mall. After the experiment, the data collected and stored in the database will be used for creating new products based on people's wishes/requests.

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