Demo: Development of a Mobile Application Interacting with BLE Beacons

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Abstract—The problem of the prompt provision of information depending on geolocation is an actual topic in the field of information technology. This article presents the architecture and functions of a mobile application that notifies the user about current events of Petrozavodsk State University (PetrSU) when visiting the main building and provides the user with additional information about the event of interest. In particular, the application can be used for the event "Admission Campaig" to navigate through the points of acceptance of documents to various institutes of the university. The developed application interacts with BLEAM BLE beacons via Bluetooth protocol to determine the user's geolocation. The application requests the required event data from the developed web page.

I. INTRODUCTION

Currently, applications are created for different purposes. If earlier the main purpose of mobile applications was the entertainment of the user, now there are applications for the delivery of food, for calling a taxi and many others. This has allowed the app market to grow dramatically over the past years. Today, many companies providing any services create their applications in order to simplify the lives of their customers who will use the services. This simplicity is very attractive for companies that want to reach a new quality level of service.

Applications that interact with BLE beacons in demand too. They allow organizations to provide up-to-date information or render services while visiting a specific geolocation. For this reason, there are various developments in this area. One of the existing solutions is an application developed by the Connax company that allows you to provide a service for paying for refueling a car. This application allows you to write off the payment when the user is at a gas station at a specific dispenser. There are also medical applications that use BLE beacons, such as a system for daily collection of reports on the location of patients in a nursing home [1] or a wireless stethoscope [2] that transferring heart sounds and ECG measurement through BLE and visualized it at mobile phone. In addition, BLE beacons are used for orientation at exhibitions. In that case the exhibit has a BLE beacon that transmits some information received by the phone [3].

BLE technology is also used in applications for navigation [4]. Most often, these systems are based on iBeacon technology. But usage of BLE beacons for navigation is not always justified. Most of the time the beacon is in a sleeping state. Sleep mode allows beacons to conserve energy sparingly. It is a advantage, but leads to the fact that most of the time beacon does not transmit the information necessary for navigation. Especially if the movement is carried out quickly enough. Delay of few seconds for triggering can become critical for indoor navigation in this case.

The mobile application proposed in this work allows notifying the user about the current events in PetrSU, when he or she visiting the main building. The user receives additional information about the event of interest at will. The application interacts with BLE beacons (bluetooth low energy beacons) and signals that the user has entered the beacon's zone. For example, event notifications come when you visit the main building of the university. The existing third-party SDK from Connax, which provides beacons and sofware [5] were used for creating the mobile application.

II. FUNCTIONAL REQUIREMENTS

For the development of a mobile application that notifies the user of current events at Petrozavodsk State University, the following functional requirements and limitations were identified:

The user must be able to:

- open the application, if it is closed, by clicking the button in the notification;
- accept/reject a request to use the Internet/Bluetooth by an application;
- accept/reject a request to send notifications by the application;
- find out about the absence of events on the main screen of the application or find out about the current events of PetrSU, if they are taking place at the moment;

- unsubscribe from repeated event notifications at any time;
- receive notifications about current events when entering the beacon operation area at the main entrance to PetrSU, if he or she wishes to receive additional information about the event;
- enable/disable tracking a classroom of the event section, if the classroom is set for the section;
- receive a notification upon arrival at a classroom of the event section;
- get detailed information about a section after receiving a notification of arrival at the classroom of the event section, if the classroom is set for the section.

Add for the "Admissions Campaign" event:

- to receive brief information and a route to any office of the admissions committee from the main entrance of PetrSU;
- select the institute of interest from the list of three institutes.

Constraints:

- the application is being developed for the Android operating system version 8.0 and higher;
- data transfer between a mobile device and beacons must be carried out exclusively using the Bluetooth protocol;
- the application is developed for devices containing Bluetooth modules with BLE module support and Bluetooth 4.0 version;
- the beacon's operation area must be limit by the developer set;
- the application interacts with beacons and sends notifications only with the user's permission;
- the application interface will be presented in Russian;
- the application must be implemented in the Kotlin;
- the SDK [5] must be used for develop the application;
- the user's mobile device must have access to the internet;
- the type of current events should be displayed on the web page located on the server;
- the application must use event data located on the server.

III. APPLICATION ARCHITECTURE

The architecture Model-View-ViewModel (MVVM) [6] was used to separate the model and its presentation in the development. Software development was carried out by a team. MVVM allows conveniently changing code and separately work separately from each other. The architecture is shown at Fig 1.

The View module is responsible for managing application screens and displaying notifications. The ViewModel is responsible for storing, providing and processing up-to-date data. The Model module is responsible for receiving data from the server and files that store information about the binding of classrooms to beacons and the need to receive notifications about the required event. Also there is a NotificationController module in the application architecture, which is responsible for processing information to receive notifications, saving and restoring settings after the application is turned off, and a
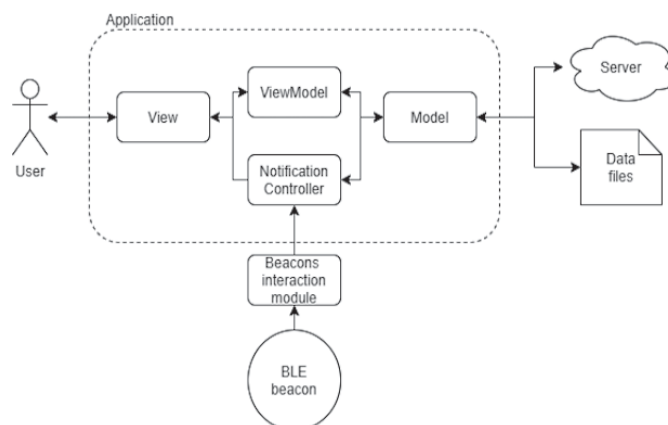

Fig. 1. Application architecture

module for interacting with BLE beacons. This allows to receive notifications in the beacon range.

IV. CONCLUSION

This article presents the architecture and functions of a mobile application that notifies the user about the current events of Petrozavodsk State University (PetrSU) and helps to navigate between their sections.

In the future, this application can be used in other buildings of the university or even in other educational or cultural establishments of the city, such as museums or galleries to navigate between exhibits. The studied problem of developing a geolocation application for user interaction through BLE beacons is relevant in many areas, not only for informing about events. The application quickly provides information to the user without the need to search for it in other sources.

The features of the technology do not allow using it for indoor navigation. It takes a few seconds for the application to exchange data with the BLE beacon. However beacons can be used to identify people, devices, robots, things and etc. in a given indoors location.

REFERENCES

[1] T. Morita, K. Taki, M. Fujimoto, H. Suwa, and K. Y. Y. Arakawa, "Ble beacon-based activity monitoring system toward automatic generation of daily report," in *Proc. IEEE Int. Conf. Pervasive Comput. Commun. Work. PerCom Work.*, vol. 26, Nagoya, Japan, 2018, pp. 788–793.

[2] Y. J. Lin, C. W. Chuang, C. Y. Yen, S. H. Huang, J. Y. Chen, and S. Y. Lee, "Live demonstration: An intelligent stethoscope with ecg and heart sound synchronous display," in *Proc. IEEE IInt. Symp. Circuits Syst.*, vol. 2019-May, Nagoya, Japan, 2019.

[3] K. Hartmann and A. Quirnn, "How useful are ble beacons for mobile guides?" in *Proc. IEEE I5th Int. Conf. on Wireless Networks and Embedded Systems (WECON)*, Rajpura, 2016.

[4] S. N. Karabtcev, T. A. Khorosheva, and N. R. Kapkov, "Ble beacon interaction module and mobile application in the indoor-navigation system," in *Proc. IEEE Int. Science and Technology Conf. - EastConf*, Vladivostok, Russia, 2019.

[5] *BLEAM SDK, repository with program code*. [Online]. Available: https://github.com/Connax-Oy

[6] *Design pattern MVVM*. [Online]. Available: https://metanit.com/sharp/wpf/22.1.php