

# BookAidee: Managing Evacuees from Natural Disaster by RFID Tagged Library Books

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**Abstract.** BookAidee is a system to manage people who evacuate into public school buildings from disaster. The system identifies people by using already implemented structure of school library books that have RFID tags. These tags are used for connecting the person into the system database. We have implemented the system in server and client applications and tested the feasibility.

**Keywords:** Natural disaster, BookAidee, Evacuees, Library, RFID.

## 1 Introduction

The Great East Japan Earthquake occurred on 11th March 2011, caused following Tsunami and nuclear power plant accident. Due to this disaster, a huge number of people were evacuated from dangerous areas mainly to public safe buildings such as school gymnasiums. Up to 581 public schools accepted refugees for days or weeks [1]. In this sudden and confusing situation, it was difficult to manage information of people in the shelter. It is clear that some ID technology will help this kind of situation[2]. Besides, it is practical if the ID device is also useful in a time of peace.

For this purpose, we have implemented BookAidee system to manage people who evacuate into public school buildings from serious disaster. The system identifies people by using already implemented structure of school library books that have RFID tags inserted on their backs. When people check in the shelter, a library book is rented to each of them until they check out, as shown in Fig. 1. Book ID will be used to identify people when, for example, supplying foods, clothing and bedding. Distributing books at check-in can be smoothly done even during an electric power failure. The users can add and edit their personal information while they are in the evacuation building after the power resumes. School library books are exchangeable anytime, and some of them are expected to maintain peace of mind of evacuees, especially of nervous small children.

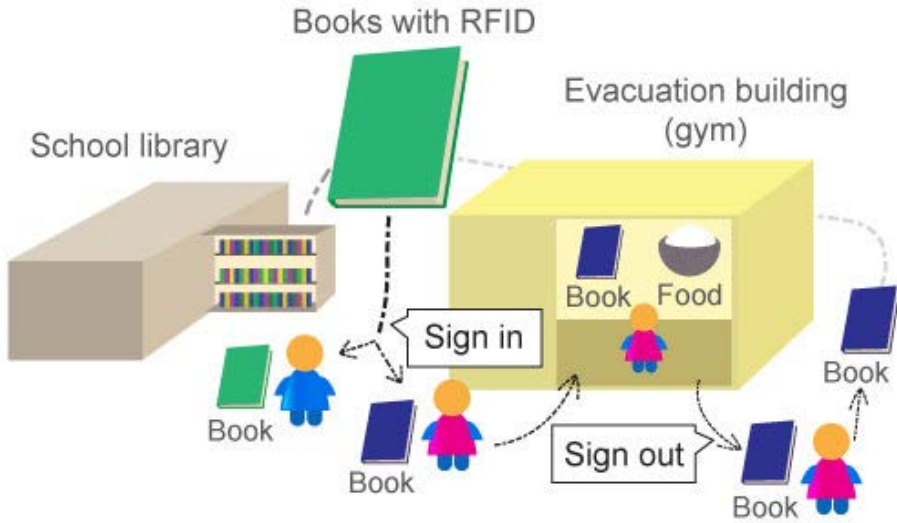


Fig. 1. Diagram of BookAidee system prototype

## 2 BookAidee System Prototype

The BookAidee application and the server prototypes are developed on notebook PCs to verify feasibility and mobility. The system is using Wi-Fi for communications between the client and server applications, as shown in Fig. 2. The hardware used in the prototype is easily deployed even in an emergency situation.

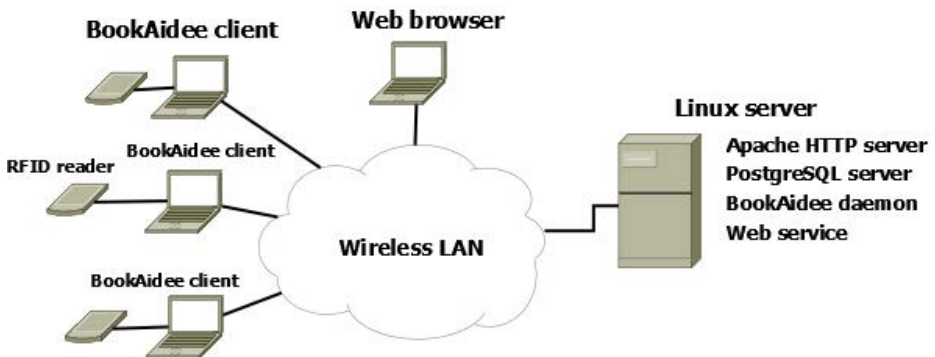


Fig. 2. Diagram of BookAidee system prototype

## 2.1 BookAidee Server

We have chosen Ubuntu distribution of the Linux operating system for the server, because it allows easy usage of open source projects and makes stable base for server usage. The server consists of following main components; PostgreSQL server, Apache HTTP server, Web API, Web service and BookAidee daemon. These components are listed in this chapter individually for having a better understanding of systems internal working.

**PostgreSQL Server.** Database in the BookAidee system is responsible of storing information about the evacuees. When a new evacuee is registering into the system a personal ID is created. This personal ID is used to connect evacuee with the RFID tags ID and allows the interaction with the BookAidee system. The evacuee's personal information is also stored by using personal ID. This personal information includes name, address and age. It should be noted that giving the information is encouraged, but it is not mandatory for the evacuee. One of the reasons why evacuees are not forced to store any personal information is to avoid unnecessary queuing for the evacuees who are entering into the shelter. Accepting people to the shelter quickly has priority over registering personal information and the registration can be done anytime while people are staying in the shelter.

**Apache HTTP Server.** In the prototype system, client applications are not accessing PostgreSQL databases information directly. Instead of direct connection the Web API is implemented for this purpose. The HTTP server is also offering web service for accessing databases information by using basic web browser.

**Web API.** For having a layer of abstraction between client application and the database, a Web API called Wazapi was created for this project. The API is developed with PHP scripting language and its main responsibility is to receive commands from the client applications which are sent as POST requests over HTTP protocol. The response for the client application is sent in JSON format. As an practical example; if it is required to find person's ID which is linked to RFID tags ID. The client would send POST request with command `getPersonId` and as parameter the RFID tags unique ID. After receiving Wazapi would read this message and create a search for the database. Depending of the result of database search the Wazapi would return corresponding message about the database result.

**Web Service.** The web service is offering information for evacuees and administration. Information can be accessed by average browser in a form of website. The web service is allowing general people to search who has registered into the system and when. Password protected page allows the administrators to search more accurate information about the people who have entered their information into system: For example, who has accessed to the item supply.

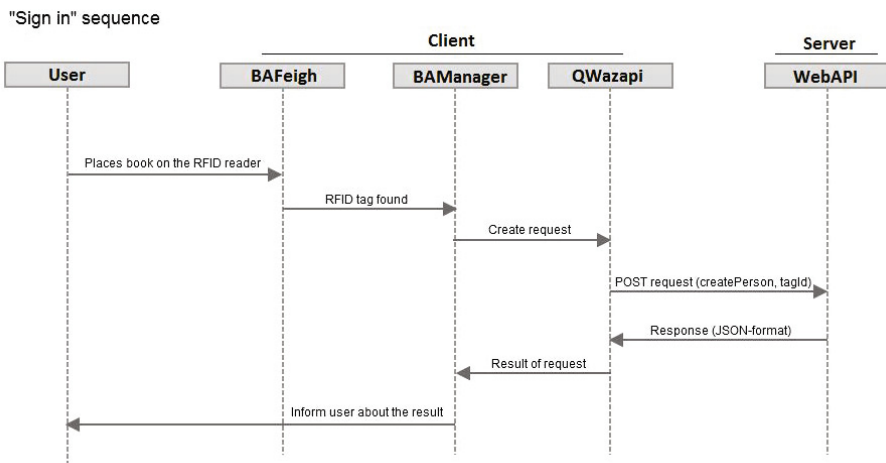
**BookAidee Daemon.** This daemon notifies the server address to the client applications. It is running constantly in the server machine and answers to all UDP broadcasts which are coming from the clients. When a daemon receives a request from a client, it will send response which has current IP address of the server machine. The main purpose of BookAidee daemon is to have a fast way of setting system up without having administrator configuring the network settings.

## 2.2 BookAidee Client Application

With the BookAidee client, our aim was to create an application which would be easy enough for an average person to launch and use. As an example, the system does not require user to insert IP address for the server machine. Instead the application is requesting this information from server's BookAidee daemon by utilizing UDP broadcasting. The BookAidee client was developed with Qt framework and C++ programming language. This allows the application to be ported under different operating systems without much work. Currently BookAidee client is supported under Microsoft Windows 7 and under Windows XP.

The following sequence diagram which is presented in Fig. 3, is visualizing the situation where user is accessing into the system for a first time by using RFID tagged book.

Presented in previous figure, the “Sign in” sequence is rather similar to the sequence other modes. Because of this it can be used as an example of client applications inner workings. Registering a evacuee into the BookAidee system can be simplified into five steps; The user places the book on the reader where it is handled by RFID Reader. Information from the tag is registered by a BAFeig



**Fig. 3.** Sign in sequence diagram

library which will pass it to BAManager. This manager will handle the readings depending of the mode that client application is using. After these steps the client application is requesting information from the Web API (Wazapi) by utilizing QWazapi library. The response is given back to BAManager which will handle it by giving information for the user.

**RFID Reader.** For reading the RFID tags from library books, we have chosen Feig electronics RFID Reader ISC.PR101-USB that works with frequency of 13.56 MHz. This device is matching with the devices that are used in libraries nowadays. The company is also supporting driver development on Linux and Windows operating systems, which is important for having a platform independent client application. Because the nature of RFID readers internal working, we created state machine which is running on separated thread. With this implementation, we could know when book has been placed or removed from the reader. It should be noted that our current prototypes client application has a requirement of being used under windows platform. The main reason for this is the missing development tools for Linux operating system, which we did not invest at the time of development.

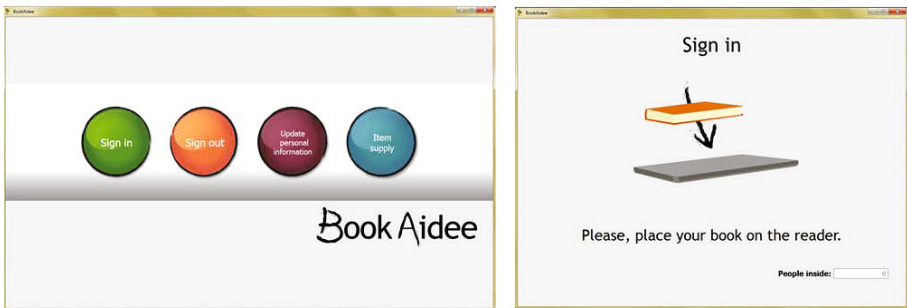


Fig. 4. BookAidee main interface and the sign in mode

## 2.3 User Interface

The main screen of the BookAidee application is simple and assumed to be easily approachable also in a stressful situation. With four big buttons for the main functionalities, the interface provides clear choices for the user, as shown in Fig. 4 (left). Our application is designed to have two types of users; the administrative staff managing the devices is able to access password protected functions and settings of the application, while regular users can interact with the application with the RFID tagged books.

**Functionality.** The four main functionalities of the application are referred as modes. In the "sign in" mode shown in Fig. 4 (right), the tags of the books

are detected via RFID reader and logged into the database. The user interface shows the amount of books signed in so the number of people registered can be observed. In the "sign out" mode the books can be registered out from the system. The recorded actions of the user are kept in the database and the sign out time and date are saved. The sign in and sign out operations are independent and can be done at any time, so using the system doesn't have an effect on how fast people are taken into the refugee center. The staff and volunteers can hand the books over before the system is up and running, or during power shortage. In these kind of situation the signing in can be done later.

When a book is identified by the system, the system is recording the actions of the users into the database. The item supply mode can be used when supplies are provided for the people in the refugee center and in the update personal information mode can be used to save more detailed information about the current holder of the book. The switch books function inside this mode allows users to exchange books. Also sign in and sign out times and dates are saved.

**Book Aidee**

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**What is BookAidee?**

BookAidee is a RFID-project that helps people in evacuation situations. Through this page you can search for people registered in BookAidee, or even persons who were registered but have already left.

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**Search from BookAidee** / **List from BookAidee**

Search people by:

Last name

First name

List

All

signed in

signed out

**Fig. 5.** Web application

**Web Application.** The bookAidee web application has access to the information recorded about the users. If the users have given data, for example their full name, in update personal information mode, it is possible to search them through the web application as shown in Fig. 5. Then it is possible to find out when this person has registered into the refugee center and if he/she is still in the center or already signed out. It is also possible to list all registered tags and the information recorded to them or sort the search by, for example, which tags have used the item supply mode. Currently the application registers only the timestamp of the tag reading in item supply mode and does not display the type of item given.

### 3 Conclusion

We have developed BookAidee system prototype, which in theory could be utilized in real life scenario to help refugees in the difficult times. The system prototype works as it is, but even the setup is relatively simple to build, many improvements are required before system can be put in actual use. As the BookAidee system is developed to be used by average users, most of the challenges with development locate in area of usability. For example, in some situations Ad Hoc network is not possible to be utilized and creating Wi-Fi network with actual hardware is required. For the average user this type of task might be overwhelming. The current prototype has features which should be improved. The item supply mode would need more development to be more functional. The system at its current state is capable of recording only the timestamp of a given item, not the type of the item. The administrators should be able to specify a type of item and the importance of it for better control of individuals in the refugee center. If the system would detect that some individuals haven't received important items such as food or medication, the administrative staff would get a notification to inspect the situation.

### References

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