DigLogs

Functional Specification PP4

5.2.2 Mobile Safety/Security Pilot

Responsible partner: UNITS Involved partners: All			
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1. Introduction: Mobile Safety/Security

Passengers are currently trained for emergencies [1], but in a real emergency, some escape routes might not be available anymore (especially in case of fire). In such a case passengers could be obliged to turn back and search for alternative escape routes, wasting time. Moreover, evacuation can be hindered by panic occurrence, which might again increase the time required to evacuate the ship. In this context, the usage of mobile technology can enable a reduction of evacuation time, preventing passengers to go in the wrong direction and increasing their situational awareness to limit panic occurrence. The availability of clear guidance information, considering the current status of escape routes, has been already found useful [2], but a test of the adoption of mobile devices is still required.

Here, the technical feasibility of a system based on Bluetooth beacons will be investigated. Besides, the effect on the evacuation time due to the usage of mobile technology will also be studied to prove the benefit of such a system. The test on a small test population is first advisable to compare the standard evacuation time with the one related to the adoption of mobile technology. This will be the main objective of the pilot action carried out by UNITS within the framework of the DigLogs project. The test environment will include an area covering 2 decks connected by multiple staircases on a recent RoRo pax vessel. The pilot system will be composed of a mobile application to be installed on mobile wearable devices (smartbands) and a backend application to configure and monitor the system from the ship bridge. The APP will exploit a Bluetooth beacon net to enable mobile devices localisation. The present document describes the proposed technical arrangement of the pilot system, that has been developed in collaboration with ETEC Minds S.r.l. (UNITS subcontractor). The system has been designed to prove its main functionalities while being easily scalable in future developments.

2. Technical Specification

The technical specification is provided hereinafter, retaining to the pilot system to be installed on a limited area of a test vessel. The pilot system will be used during the experimental campaign, carried out with a small population.

2.1 Main Objective

The system (mobile APP and Backend) aims to reduce ship evacuation time through multiple routes through the application of Bluetooth technology.

2.2 Components and Functionalities

The system runs using 4 physical components having the functionalities defined hereinafter:

1. **Server**: A Raspberry Pi (Ubuntu OS) where the Backend application runs, receives the user commands through a web browser, provides the sending beacons with the directions related to escape routes and stores in a MySQL database the log coming from receiving beacons related to the connected Bluetooth devices enabling their visualization through a web browser;
2. **Sending beacons**: receive from the server through WiFi connection the information that shall be exposed in the considered evacuation scenario. They transmit the information through Bluetooth to all the devices in the area covered by the beacon signal. For each message and each sending beacon, the signal strength can be selected to configure the system for the specific operative environment and evacuation scenario;
3. **Receiving beacons**: search for Bluetooth devices in their covered area. Transmit to the server the MAC address and signal strength of all the detected devices;
4. **Smartbands**: mobile wearable devices given to users. They are by default in a standby mode checking with a 10 seconds time interval the emergency signal exposed by sending beacons. Once an emergency signal is received, the smartbands switch to the emergency mode while vibrating. Then they show on the screen the information associated with the nearest sending beacon (if multiple signals are received, it is shown the one coming from the beacon having higher signal strength). Two information types are available (Fig. 1):
    a. Direction: an arrow indicating a fixed direction rotating accordingly as the user moves the smartband.
    b. Instruction: composed by an icon and a text

In the emergency mode, smartbands search for sending beacons with a 1-second interval. Besides, smartbands send their position to the nearest receiving beacon. The ID of the next beacons along the escape route can be added to the direction or instruction exposed by a sending beacon. Hence, if the smartband receives a new signal from a beacon not included in the foreseen escape route, the smartband vibrates and show the wrong direction instruction. Once the final destination beacon is reached, the smartband shows the related instruction and, if no other sending beacon is detected within 10 seconds, switches to the standby mode.

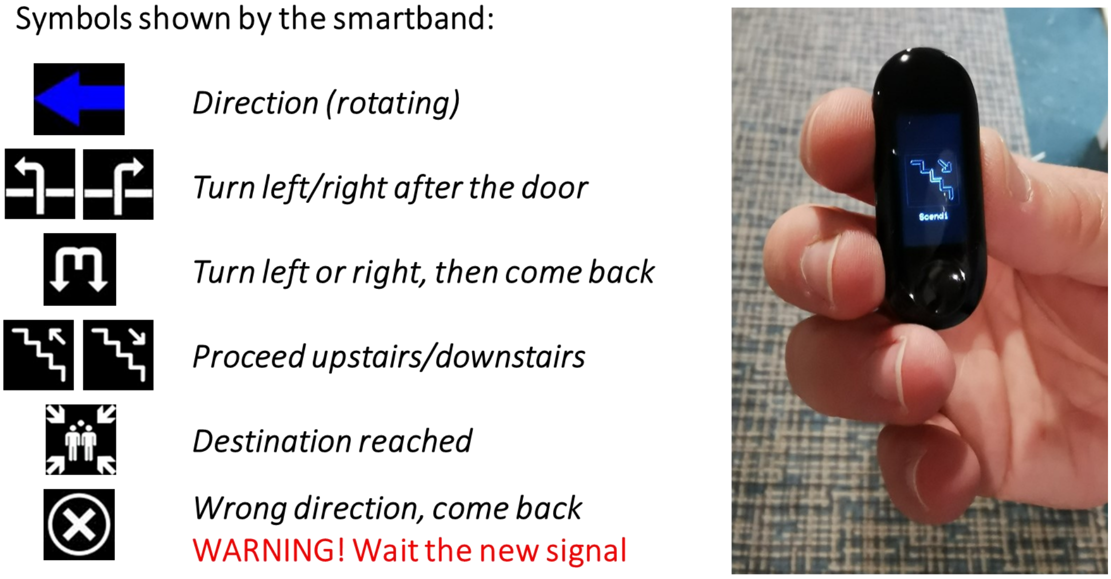

Figure 1. Directions and instructions provided by the smartbands

2.3 System architecture

The system architecture is provided in Figure 2. It is composed of a Server part developed on LAMP architecture. It includes a MySQL database where all the possible evacuation scenarios are stored including the beacons ids and the information to be exposed by each beacon in each evacuation scenario. Through a web interface, the active evacuation scenario can be selected. Besides LAMP architecture, on the server is installed an MQTT broker for the message exchange to and from the beacons.

Once an evacuation scenario has been activated, the server sends through the MQTT protocol the directions or instructions to the sending beacons which publish them through Bluetooth.

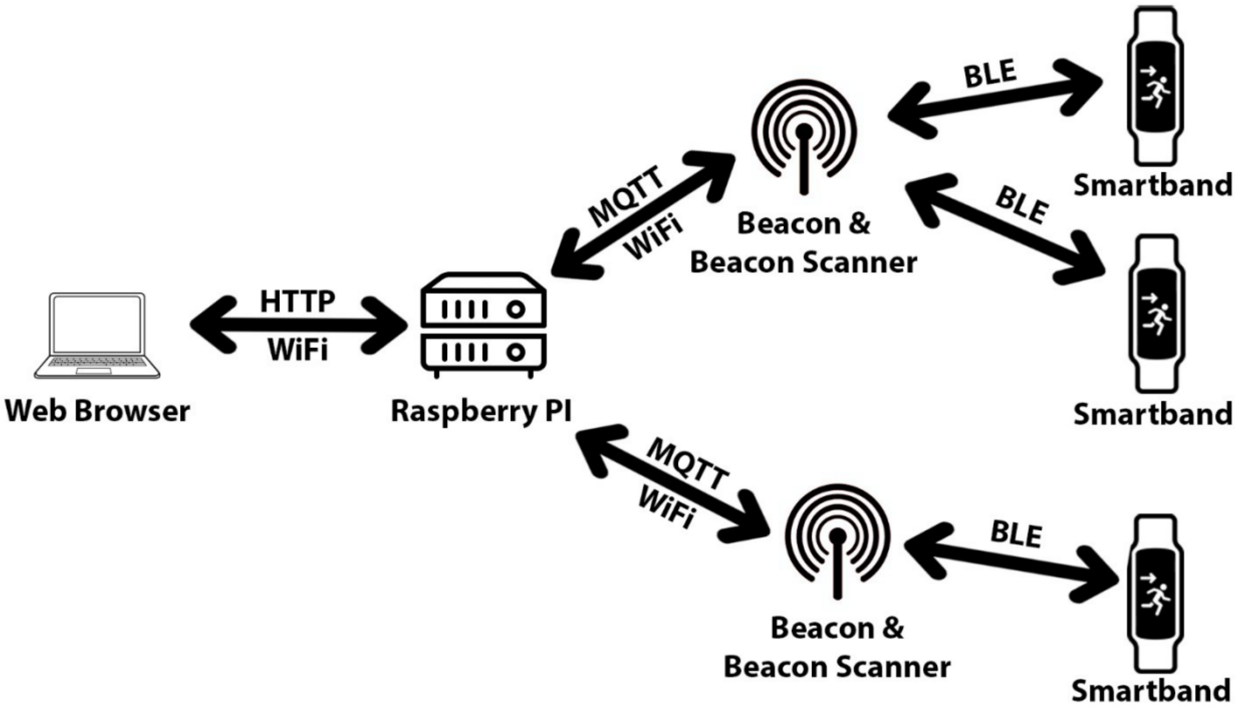

Figure 2. System architecture

The smartbands receive the direction or instruction from the nearest sending beacon and show them on their screen. Besides, smartbands sends to recieving beacons a signal to assess their position through Bluetooth.

The receiving beacons receive the positioning signal and transmit it to the LAMP server through the MQTT protocol. The server collects the information and stores it in the database for visualization.

2.4 Database logic structure

The MySQL database is composed of five tables as shown in Fig. 3 and described hereinafter:

1. Beacons: the table contains the list of all the beacons including a name for easy recognition (e.g. based on its position on the ship), its MAC address and its unique

position in the array of saved beacons in the smartbands (required by the identification of wrong routes);

2. Wristbands: the table contains the list of all the smartbands including their MAC address and a name to identify the user (if required);
3. Routes: the table contains the list of all the saved escape routes including a name to identify each evacuation scenario;
4. Directions: the table contains the list of all the information associated with each beacon in each evacuation scenario. The table includes the route id and the beacon id as external keys.
5. Device_log: the table contains the list of all the devices detected by the system divided by detecting beacon. It includes the MAC address and the signal strength. The adoption of the smartband id as an external key has been avoided to track the single devices. This allows to include in the log all the Bluetooth devices detected in the covered area, which can anyway be limited to the registered ones by filtering.

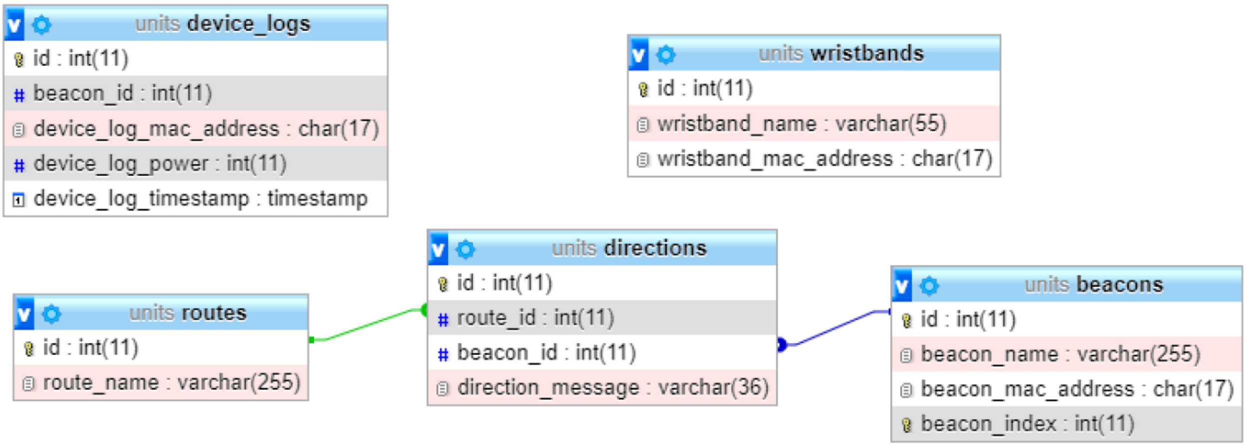

Figure 3. Database structure

References

[1] IMO. 2018. SOLAS Chapter III Part B Requirements for ships and life-saving appliances. SOLAS 2018 Consolidated Edition. International Maritime Organisation. London, UK.

[2] eVACUATE. 2017. Final Report Summary - eVACUATE (A holistic, scenario-independent, situation-awareness and guidance system for sustaining the Active Evacuation Route for large crowds.).