



Aim & Objectives

This project is aimed at using Bluetooth low energy beacons and building a web application to improve the student or visitor experience on campus in case they cannot find where they are going.

- ① Design a web application with two types of people: users and administrators.
- ② Build a login system for users to log in by username and password or create a new account.
- ③ Build a label system that enables users to put labels on each room and enable administrators of this room to check if these labels are correct.
- ④ Build a search engine that enables users to search some activities or things they want to do and return rooms with the same label.
- ⑤ Users click the room and get the information of this room including location.
- ⑥ Build a chat page with two boards: Question Board and emergency noticeboard. Users can write their questions in the Question Board and other users can answer the questions. The administrators can update the labels according to the answers. Users who want to be answered in an hour can write the questions in the emergency noticeboard.
- ⑦ Connect the whole application to the beacons. A beacon can lead users to the right place when users are in the building.

Outcome

When students or visitors want to figure out where they are going, they can use this application to create a user account and search some keywords about this place. Then they will get some rooms listed on the screen. Once the room is clicked, all the information about this room pop out and the user can check if it is the right place to go. After finding the right place, the user can decide how to go there as the location is provided in the interactive map.

If the students or the visitors still cannot find the right place, they can use this application and ask for help in a chat page. Staffs or people coincidentally browse this question will give an answer. Even if they are in a hurry, they can edit their question and put it onto the noticeboard. This noticeboard has exclusive consultants and would give a notification to all users for each question.

Finally, they arrive at the building and that is when the beacons start working. The mobile phone can sense beacons' location and help the users find their way. Moreover, beacons can provide real-time information like whether this room is temporarily closed or whether the head of this room leaves for some reasons. On the other hand, the beacons collect data like how many students attend the lecture, how many times users look for this room or which key words users search to find the room.

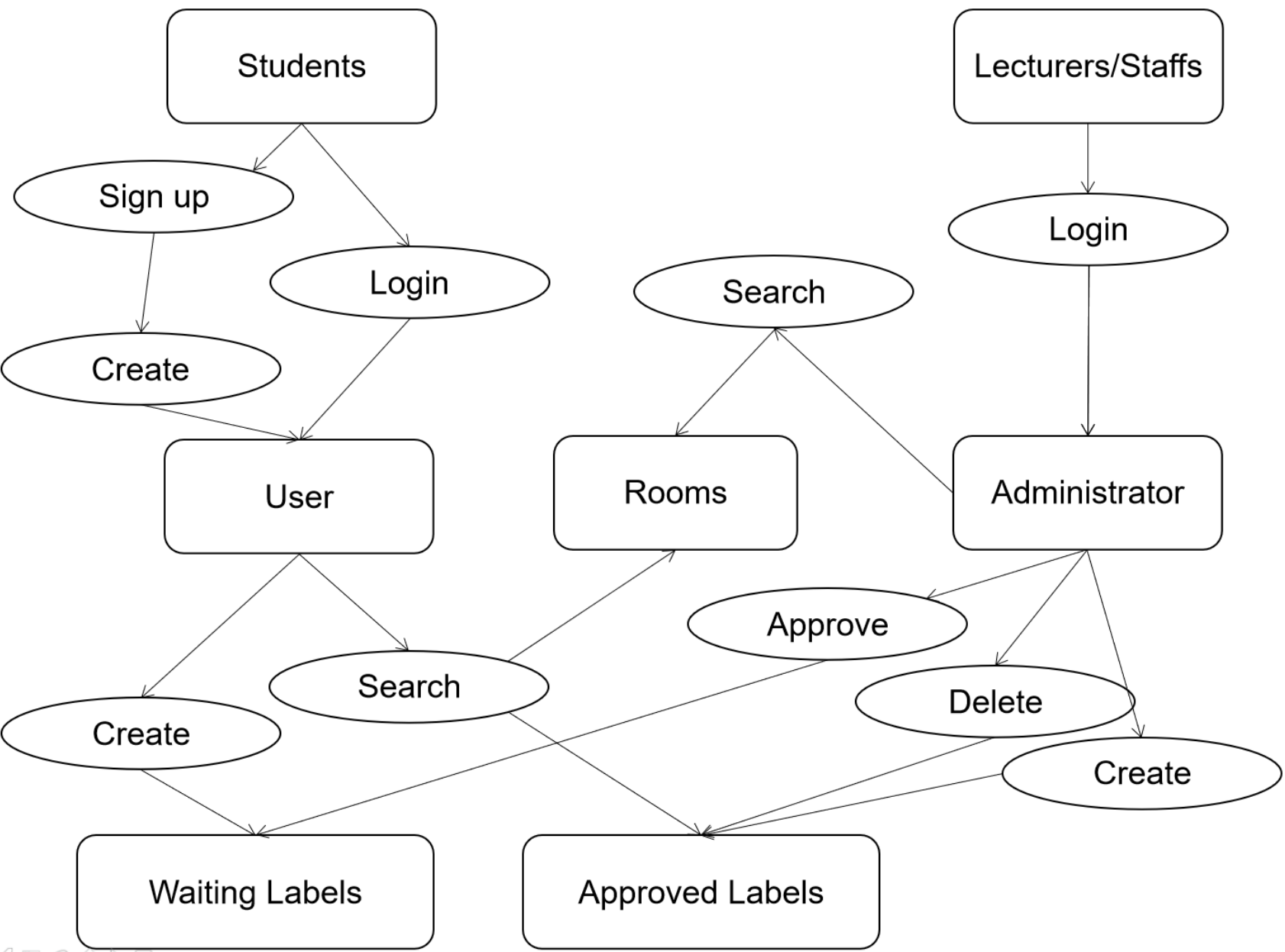


Figure 1. Logical Structure.

Other Systems

1. GPS(Global Positioning System)

①Cost:

free

②Range:

global

③Maintenance:

no

3. Wi-Fi

①Cost:

average cost per month: £35.92

router: cost anywhere from \$60 to \$100

②Range:

An access point (or hotspot) often has a range of about 20 metres (66 feet) .

③Maintenance:

a wireless router typically lasts from two to five years

2. NFC(Near-field communication)

①Cost:

cost an average of 25 cents per chip

②Range:

within 4 cm

③Maintenance:

just buy another one

4. RFID(Radio-frequency identification)

①Cost:

tag: cost as little as 10 cents or as much

as \$50 depending on the type of tag

reader: cost from \$500 to \$2,000

②Range:

2 or 3 feet to 80 feet.

③Maintenance:

Active RFID tags are powered by a battery that will last between 3 – 5 years.

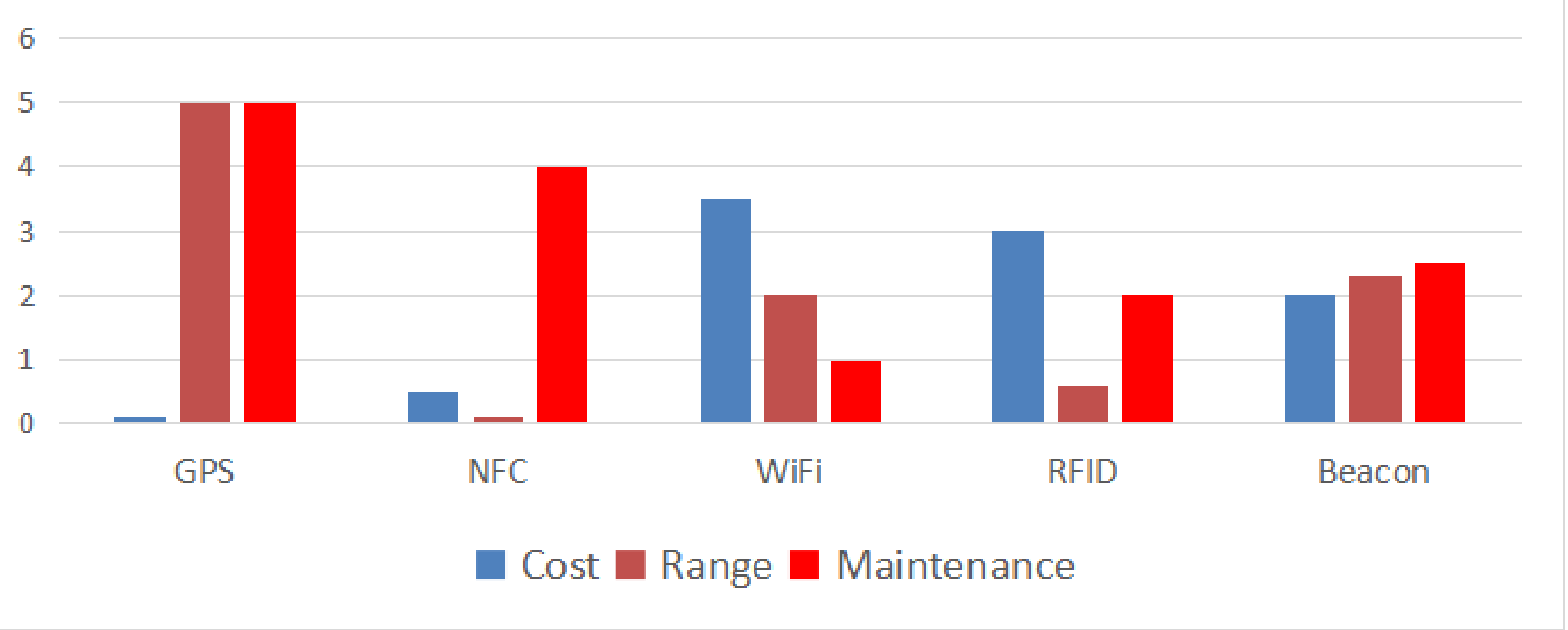


Chart 1. Comparison of different systems.

Conclusions

Students can get help from people they are familiar with like friends or parents and the student services are provided by Student Hub, which can also help. However, this help is not always useful because sometimes it is misleading.

Evidence shows that though there are some studies based on BLE beacons, they are focusing on other areas instead of campus navigation. Although it shows that the usage of beacons is broad, the BLE beacons used in the campus navigation field are still quite few. Therefore, it is very significant to evaluate the use of BLE beacons in this field and compare it with other systems like RFID. As a result, we will get the benefits and the drawback of each of them.

There are many other systems like GPS, NFC, Wi-Fi, and RFID that can be used to help the students find a location. However, they all have some drawbacks compared to beacons. GPS has issues with the precision of the location as well as signal strength. Besides, GPS-based systems work only outdoors with a clear view of the sky, which means it cannot be used indoors. NFC requires users to be very close to the device sending the communication. Wi-Fi-based location requires a high density of access points, which makes it cost-prohibitive because you cannot afford to give each room a Wi-Fi router. Compared to RFIDs, beacons do not require scanning and can work from a distance.

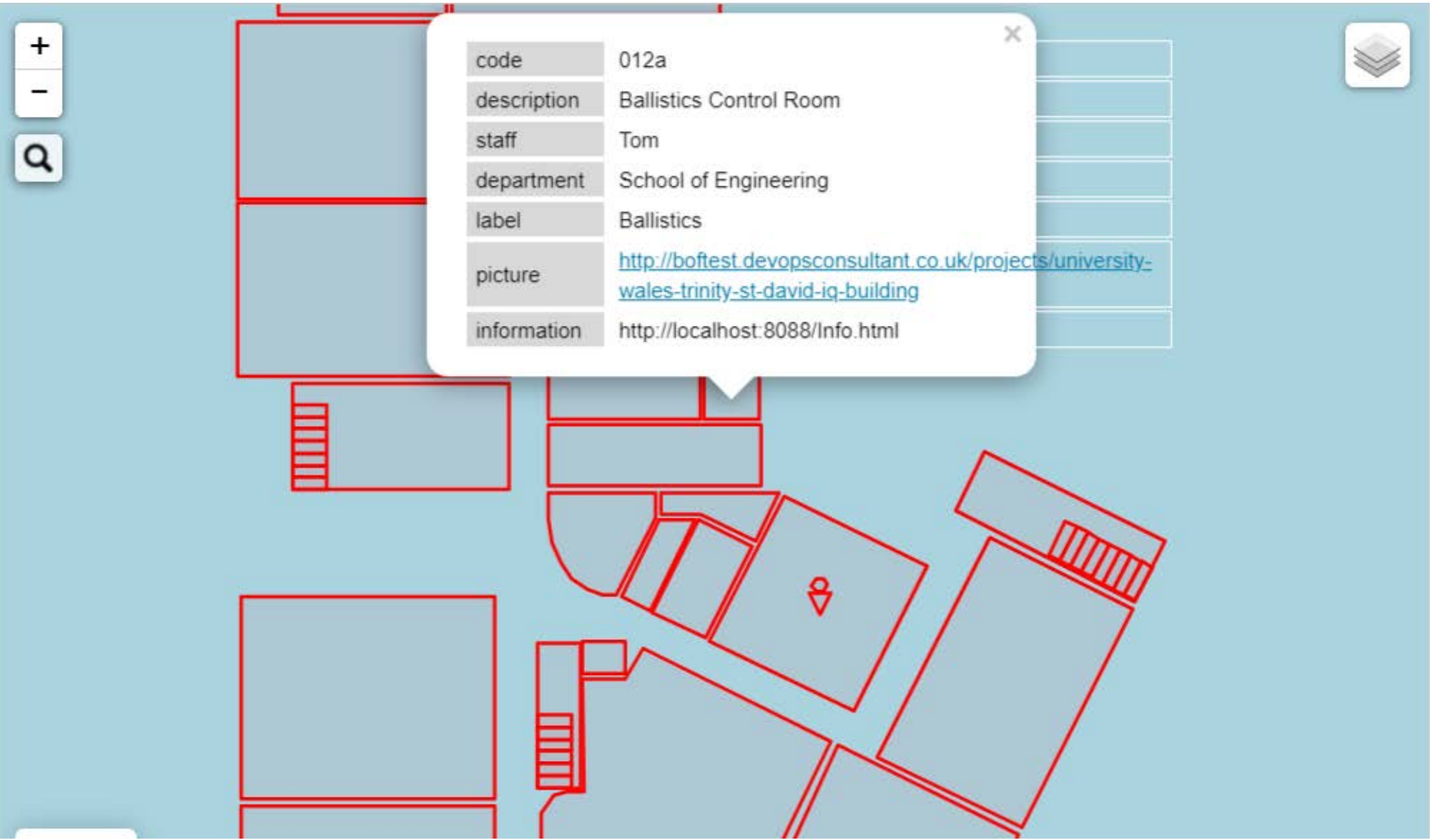


Figure 2. Interactive Map

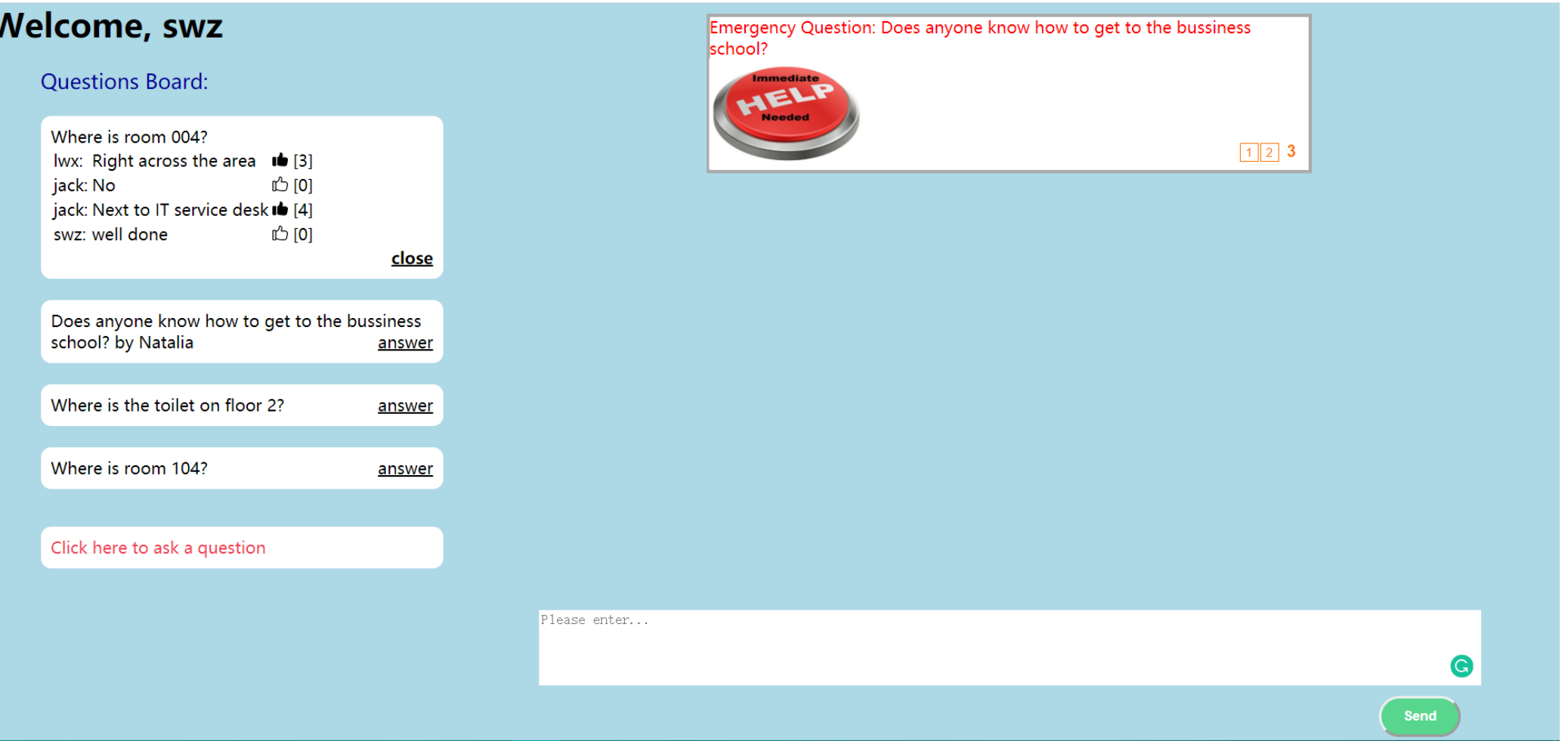


Figure 3. Chat Page

Future Work

1. The most regretful thing in this project is that the testing cannot be carried out because of the COVID-19 pandemic situation so the first goal in the future is completing all the work that should have been done.
2. In the future, the beacons chosen to be used should be more powerful so that their signal should at least cover the whole floor.
3. In the future, it is necessary to develop a real beacon app on the smart phone instead of a web application.