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From: BEST (Beacon-based Evacuation System and Technology)

Bacon Beacon

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Summary

Making PowerPoint presentation and scripts were important issue of this week. We made presentation aims to audience who do not have knowledge about network devices, but we got feedback that it is presentation to professor not seminar. Scripts and Powerpoint were modified, and the flow of the presentation was fixed to emphasize the topic.

Also, Articles were modified. Due to the feedback to our team, working on chapter 2 of the paper.

What “BEST” completed this week

- Getting Ready for Powerpoint Presentation
 - Presentation was made by every presenter, and references were added by the others. As we got feedback that our goal is not described well, Introduction were swiped out and written again.
 - The PPT was divided into parts: Roles & Responsibility, Background, Related Work, Overview and Future Plan.

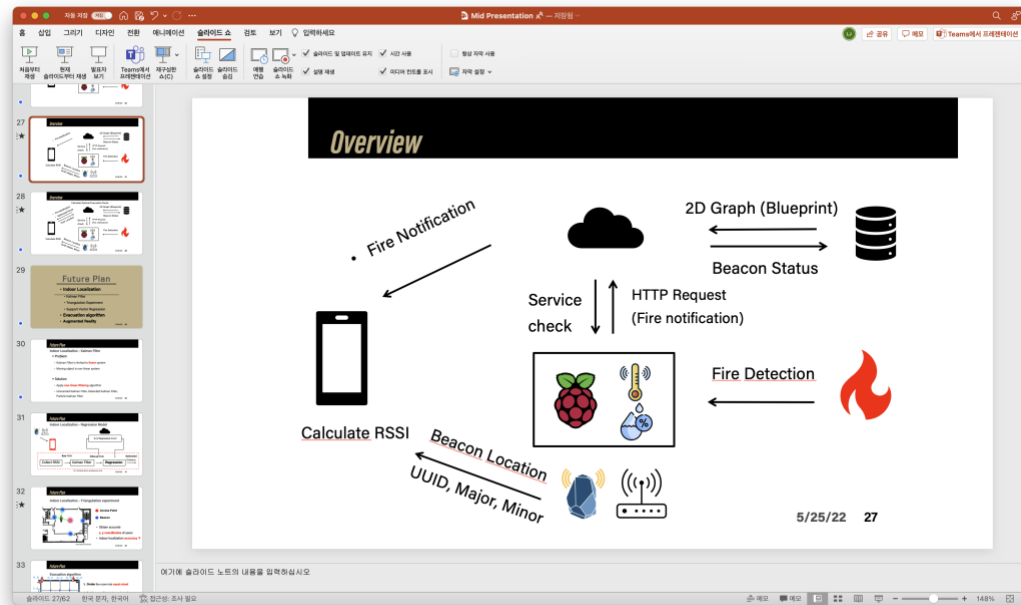


Fig. 1. Powerpoint Presentation
Fig. 1. Working on writing a presentation

- Prepare for Q&A
 - Questions are predicted
 - List of predicted questions were
 1. How to deploy beacons in the building?
 2. How many beacons are you going to use?
 3. Why do you use the beacons and the access point for indoor localization?
 4. Why do you consider Dijkstra Algorithm as path finding algorithm?
 5. Why does server-clients use socket communication?
 6. What if one of the beacons is not working in fire evacuation time?

/// 작성해주세요 ///

- Modifications of Related Work
 - Access Point (AP)
 - As K-SW building area is large, Trilateration with beacons is not available. AP can cover larger space than a beacon, whereby Trilateration can work with one AP and two beacons [1]. Therefore, the mobile devices can calculate the Received Signal Strength Indicator (RSSI) value from AP and beacons. They can take top two RSSI values that come from beacons [5] and from AP. With three RSSI values, they can estimate the location of themselves.

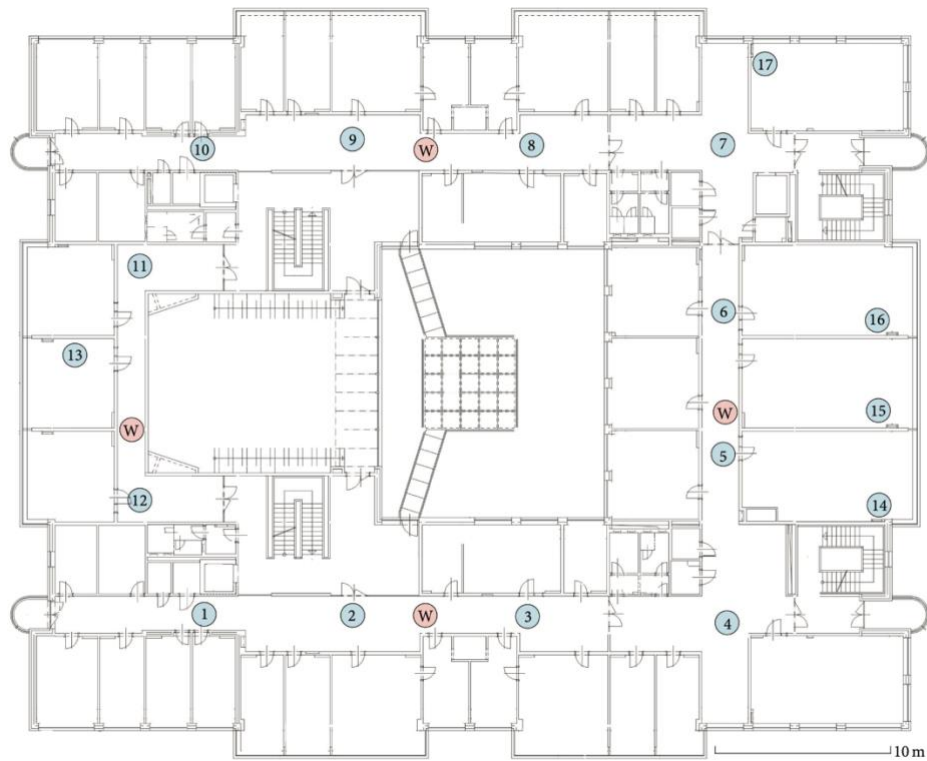


Fig. 2. Indoor Localization by Wi-Fi and Beacons [1]

Fig. 1. describes how to locate Access Points and Beacons to improve indoor localization.

- Experiments

To find out the relationship between raw RSSI, filtered RSSI with Kalman Filter and distance [5], an experiment was conducted. Experiment environment had been set with the new beacon, iOS device (iPhone12) and Android device (Galaxy A30). The distance between 0.5M to 5M was conducted on the floor. The beacon was placed at the fixed point. Two smartphones were used as receivers and moved during the experiment. They received signals for 5 minutes and moved 0.5M far from previous point. They collected raw RSSI, filtered RSSI, distance and Mean Squared Error (MSE) as a CSV file.

- Analysis of Data

Analysis of raw RSSI, filtered RSSI shows that Kalman filter reduces the fluctuation of signal. The goal of the analysis is how much Kalman filter can refine data. With Kalman filter value, the threshold of each distance would be determined by Support Vector Regression (SVR) model [5].

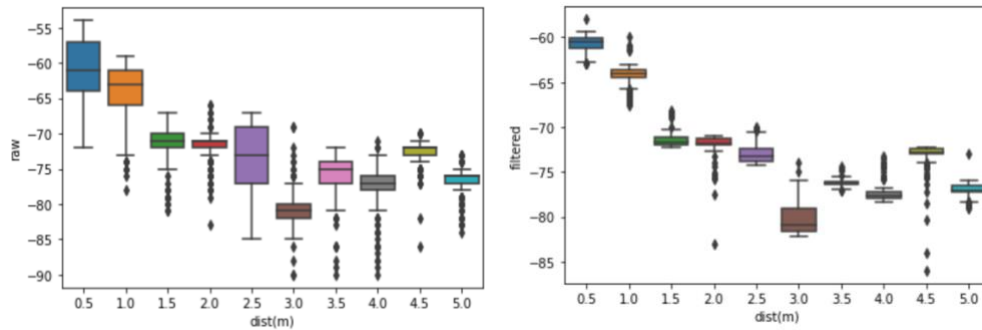


Fig. 3. Raw RSSI and filtered RSSI by the Kalman filter in iPhone 12

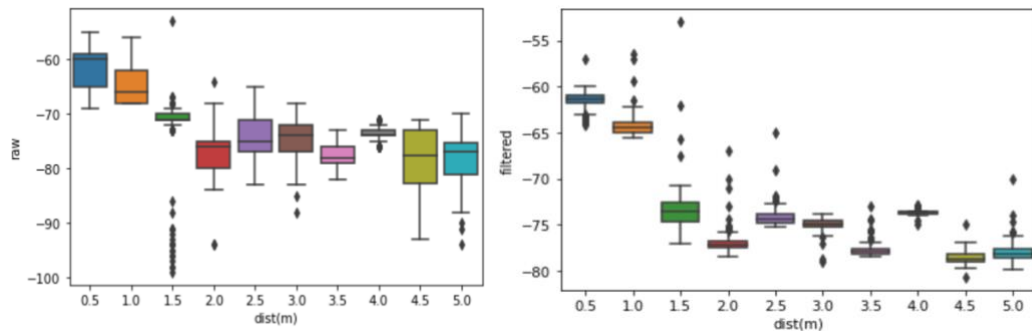


Fig. 4. Raw RSSI and filtered RSSI by the Kalman filter in Galaxy A30

Fig.3. and Fig.4. shows that raw RSSI has larger variance than the filtered value.

Things to do by next week

- Finish chapter 2 of paper
 - Related work will be concentrated on sophisticatedly locate the target position by using trilateration with the 3 nearest beacons.
- Trilateration Experiment
 - The experiment will be conducted by new iBeacons and the access point.
 - Collect the RSSI of the beacons and utilize two beacons with the strongest signal.
 - Apply trilateration, can obtain the accurate coordinates of the user.
- Request for the blueprint of the K-SW building
 - The blueprint of the building will be converted into a 2-dimensional graph for the path planning algorithm.

Problems or challenges:

- Preparing for the presentation
 - According to the feedback, the script didn't describe the exact topic of the project. There was a challenge about modifying the presentation organized.
 - The script was improved to explain the problem situation, the motive to solve the problem more intimately.

References

- [1] P. Kriz, F. Maly, and T. Kozel, "Improving Indoor Localization Using Bluetooth Low Energy Beacons," *Mobile Information Systems*, vol. 2016, no. Volume 2016, pp. 1–11, 2016, doi: 10.1155/2016/2083094.
- [2] D. F. Escoto, "ibeacon-real-time," *GitHub*, Dec. 10, 2021.
<https://github.com/didacfibla/ibeacon-real-time> (accessed May 20, 2022).
- [3] "Optimal State Estimator Algorithm | Understanding Kalman Filters, Part 4," *www.youtube.com*, Apr. 20, 2017.
<https://www.youtube.com/watch?v=VFXf1IIZ3p8&list=PLn8PRpmsu08pzi6EMiYnR-076Mh-q3tWr&index=4> (accessed May 20, 2022).
- [4] R. Lovreglio and M. Kinateder, "Augmented reality for pedestrian evacuation research: Promises and limitations," *Safety Science*, vol. 128, no. 128, p. 104750, Aug. 2020, doi: 10.1016/j.ssci.2020.104750.
- [5] S. Sadowski and P. Spachos, "Optimization of BLE Beacon Density for RSSI-Based Indoor Localization," *2019 IEEE Int. Conf. on Communications Workshops (ICC Workshops)*, vol. 2019 IEEE Int. Conf. on Communications Workshops (ICC Workshops), no. 2019 IEEE Int. Conf. on Communications Workshops, May 2019, doi: 10.1109/iccw.2019.8756989.
- [6] C. H. Lam and J. She, "Distance Estimation on Moving Object using BLE Beacon," *2019 Int. Conf. on Wireless and Mobile Computing, Networking and Communications (WiMob)*, vol. 2019 Int. Conf. on Wireless and Mobile Computing, Networking and Communications (WiMob), no. 2019 Int. Conf. on Wireless and Mobile Computing, Networking and Communications, Oct. 2019, doi: 10.1109/wimob.2019.8923185.
- [7] M. A. Koledoye, D. De Martini, S. Rigoni and T. Facchinetti, "A Comparison of RSSI Filtering Techniques for Range-based Localization," *2018 IEEE 23rd International Conference on Emerging Technologies and Factory Automation (ETFA)*, 2018, pp. 761-767, doi: 10.1109/ETFA.2018.8502556.
- [8] Y. Sung, "RSSI-Based Distance Estimation Framework Using a Kalman Filter for Sustainable Indoor Computing Environments," *Sustainability*, vol. 8, no. 11, p. 1136, Nov. 2016, doi: 10.3390/su8111136.
- [9] M. Lipka, E. Sippel, and M. Vossiek, "An Extended Kalman Filter for Direct, Real-Time, Phase-Based High Precision Indoor Localization," *IEEE Access*, vol. 7, pp. 25288–25297, Feb. 2019, doi: 10.1109/access.2019.2900799.