

Case study : Understanding foot traffic using IoT devices

By : Kautsar Hasanah bt Muhammad Khairi

With Internet of Things (IoT) on the rise, one of Maxis's big retail clients is seeking to innovate in this space. They want to understand foot traffic of shoppers in their stores across the nation.

1. Identify the Problem Statement
2. Propose and justify the solution.
3. Present the solution that is easily understandable by a larger non-technical audience.
4. Optional but will garner plus points: Provide a working coding sample on how this might work

What is foot traffic?

According to Investopedia, foot traffic is a term used in business to describe the number of customers that enter a store, mall, or location. It is an important metric because higher foot traffic tends to lead to higher sales and revenue numbers. They usually install traffic counting devices to their stores and some still practice manual counting.

Common problems on using traditional traffic counting devices in understanding foot traffic in stores

Traditional traffic counting devices refers to devices that can only track basic data such as infrared counter and tally counter.

1. Inaccuracy of data
 - Stores that are still practicing counting customers manually will lead to data inaccuracy due to distraction.
2. Not enough information to generate deep analytics
 - Basic data collected such as the number of customers coming in and out the stores is not enough to generate deep analytics such as human behaviour and making an advance planning for future sales.
3. Manual labour
 - Staff will have to count manually using a counter.
 - The recorded data will have to be transferred to a physical or digital storage.
 - Staff will have to set schedules to record data and reset counters.
4. No proper data organization
 - Data is stored manually, creating inefficiency
 - There is no dedicated storage to store the data

Implementation IoT devices using geofencing technology as a solution to understand foot traffic

To analyze customer traffic in stores, the right technology should be used to fully utilize its functionality. The main concept of using digital technology to understand foot traffic is to detect the location of customers in stores. People counting devices such as CCTV, counting sensors can be used to understand the foot traffic. But the most suitable technology is surely using geofencing. Geofencing is a service that triggers an action when a device enters a set location. It uses IoT devices such as WiFi and Bluetooth Beacon to locate customers inside the stores. Using geofencing, stores can set out points in every section of the stores to analyze customer activities.

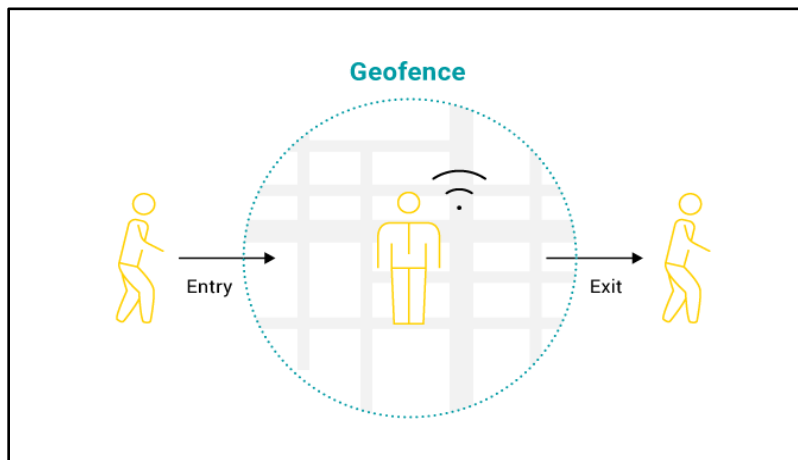


Diagram 1 - Geofencing

Bluetooth Beacons

1. Beacons are small, wireless transmitters that use low-energy Bluetooth technology to send signals to other smart devices nearby.
2. They connect and transmit information to smart devices making location-based searching and interaction easier and more accurate.

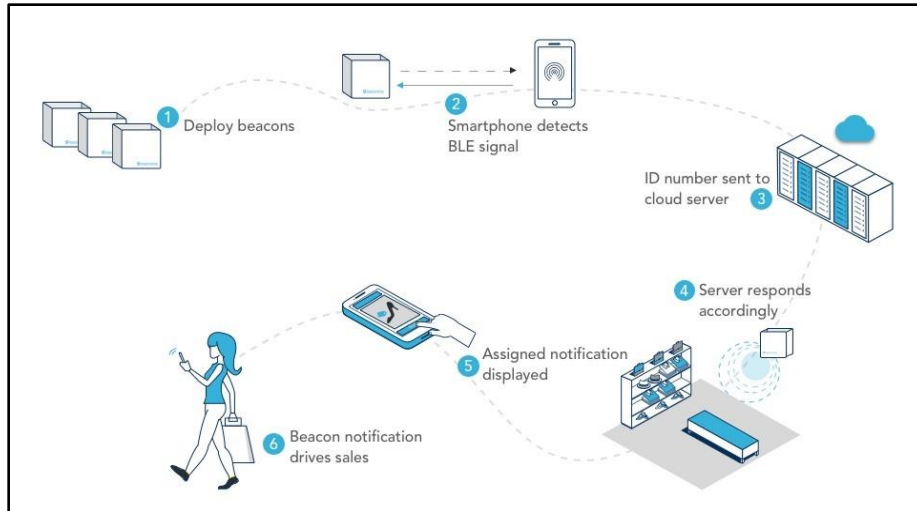


Diagram 2 - How Bluetooth Beacons Work

WiFi

1. Wi-Fi access points can be used to trigger proximity notifications.
2. It will detect the presence of customers in the store, or in the surrounding areas.

Table 1- WiFi vs Bluetooth Beacon

Aspect	WiFi	Bluetooth Beacon
Installation	Stores that already have Wi-Fi infrastructure don't have to deploy additional devices.	Cheaper and easy to install
Accuracy	WiFi signal strength can reach as far as 500m.	Standard beacons have a range of up to 80m while long-range beacons can reach 300m.
Audience	Higher audience, most of customer turn on their wifi	Less audience, as most of customer did not turn on their bluetooth
Functionality	Offer more functionality than Bluetooth beacons. WiFi offers internet access to visitors and can also be used to transmit push messaging to venue guests	Can't transfer large amounts of data. Bluetooth beacons don't offer internet access
Power	Electric powered and require more power	Battery powered and require less power
Sustainability	Affordable in the long run as only have to replace a few wifi devices compared to beacon bluetooth.	Not affordable in the long run. The cost of batteries and purchasing more beacon units can add up over time.

Advantages of using IoT devices with geofencing technology to understand foot traffic

The advantages are related to Data Analytic, Marketing, User Experience and Health perspective.

1. Collect accurate data
 - Number of customers daily
 - Duration of time spent in each area
 - The movement of customers
2. Turn raw data into meaningful information
 - Peak hours and days for customer activity
 - Average time spent in stores
 - Make decisions on worker schedules
 - Make decisions on facility layout
 - Which section has the most foot traffic
 - Estimate trends based on the movement habits
3. Proper data organization
 - Data collected will be stored in a server to ensure proper data organization
4. Enhance customer experience (CX)
 - Discounts, marketing-related notifications
 - Alert shop is nearby, create branding awareness
 - In-store gamification / interactive events/ Pokemon Go for the stores
 - Virtual map
 - Product locator
 - Immediate customer feedback
5. COVID-19
 - Reminder to always practise social distancing
 - Detect distance between customers
 - Alert if customers is nearby each other

Restrictions of using this concept:

1. There are many people who have more than one device (such as a work and personal phone), and who may therefore be counted twice.
2. cannot guarantee that customer devices will be pinging for nearby networks while in store

Demonstration of how basic beacons work :

Using the resources that I have, I will try to demonstrate how basic beacons work using two devices. From the Google Play Store, I've downloaded **Eddystone-URL** by **University of Michigan** to turn my device into a temporary beacon and **Summon [Lab11]** by **University of Michigan** to act as a notification receiver. In this demonstration, the beacon will try to broadcast a URL link. Bluetooth on must be turned on, on both devices to make it successful.

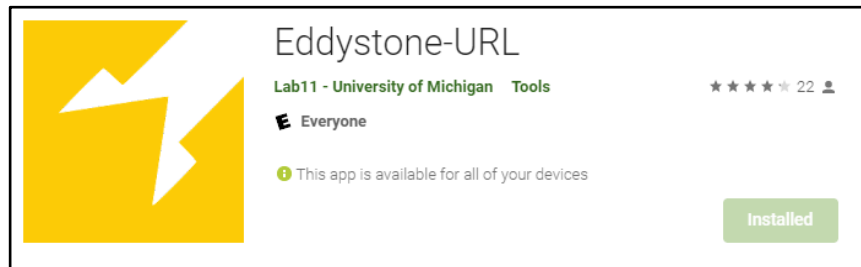


Diagram 3 - Eddystone-URL

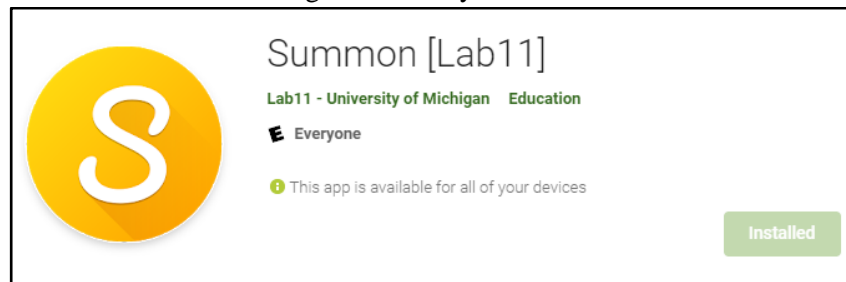


Diagram 4 - Summon [Lab11]

Device 1 : Temporary beacon.

After launching the Eddystone-URL application in the first device, fill in the details including the URL of the website based in Diagram 5. After completing it, slide the “ADVERTISE NOW” toggle button based in Diagram 6.

Diagram 5 shows the Eddystone-URL application interface. At the top, it says "Advertise: https://maxis.com.my". Below this is a toggle switch labeled "ADVERTISE NOW" which is currently turned off. The form has sections for "Beacon Type" (Eddystone-URL), "Parameters" (Protocol: https://), and "Destination URL". A white dialog box is open over the "Destination URL" field, titled "Destination URL", with a text input containing "maxis.com.my" and "CANCEL" and "OK" buttons at the bottom.

Diagram 5 - Fill in details

Diagram 6 shows the Eddystone-URL application interface after the "ADVERTISE NOW" toggle has been turned on. The toggle switch is now green and in the "on" position. The form fields are the same as in Diagram 5: "Beacon Type" (Eddystone-URL), "Parameters" (Protocol: https://), and "Destination URL" (maxis.com.my).

Diagram 6 - Slide “ADVERTISE NOW” toggle

Device 2 - Notification Receiver

In the second device, the notification will be received in the Sumon [Lab11] application. It will scan active bluetooth nearby. Based on Diagram 7, the top row is the notification from device 1. When clicked, it will show the details of the notification and the user can click the “OPEN UI” button to visit the URL based on Diagram 8.

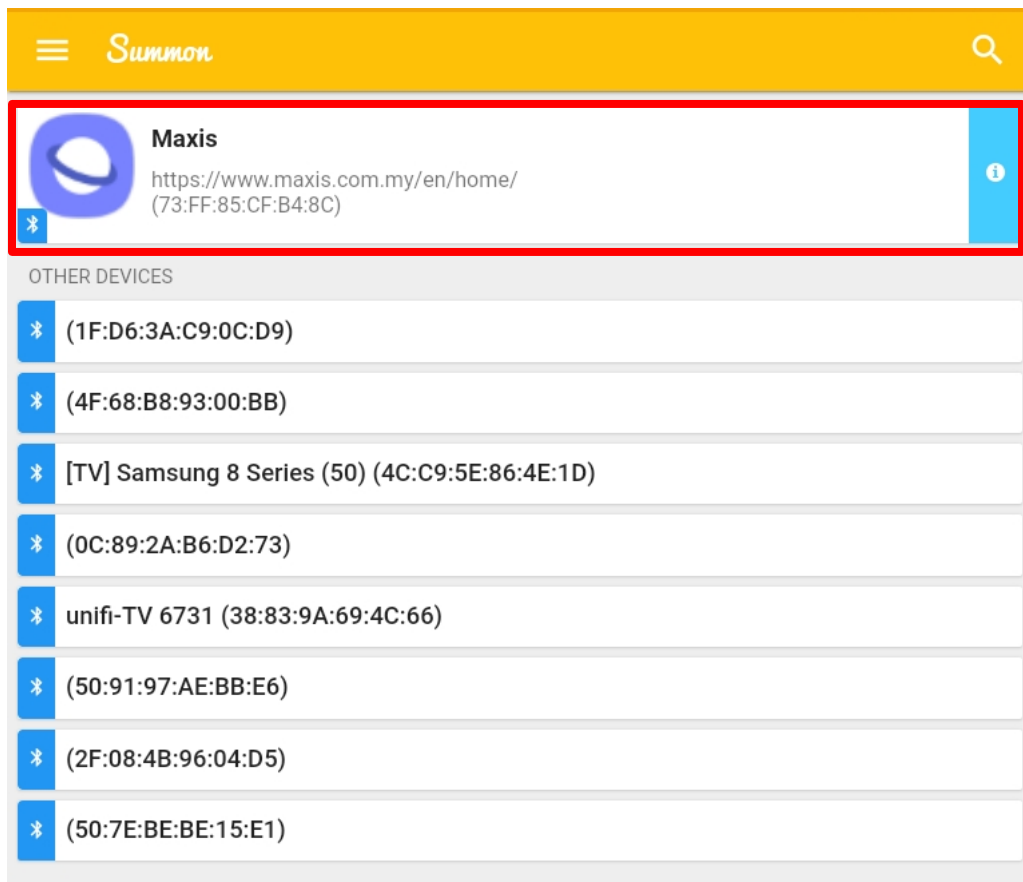


Diagram 7 - List of active Bluetooth

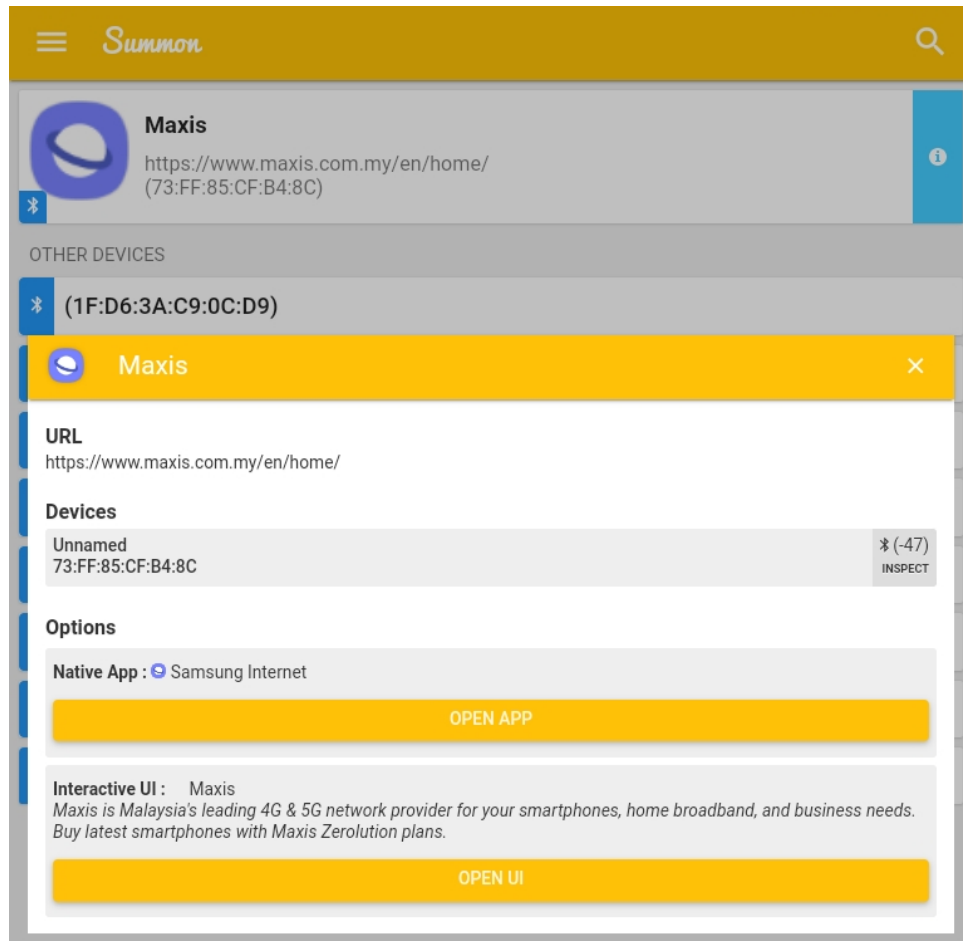
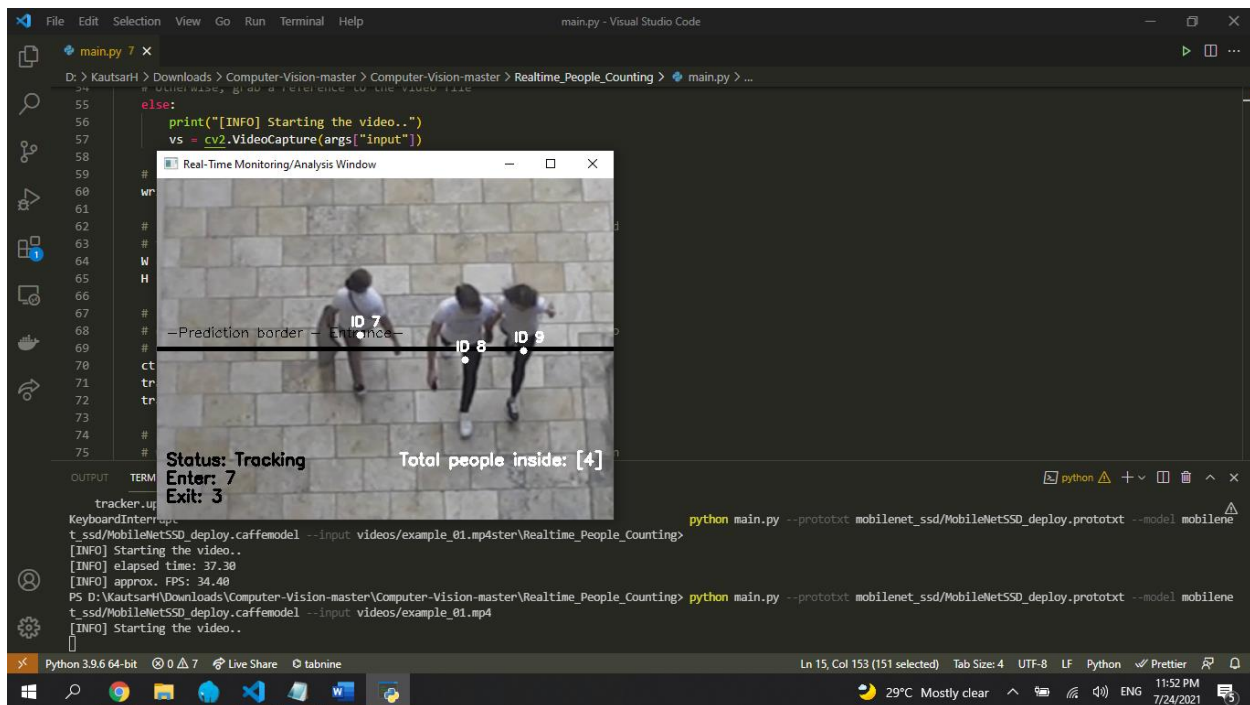


Diagram 8 - Notification details

Trying out tutorial on deploying people-counting system:

Since this case study is about understanding foot traffic using IoT devices, I've decided to follow a tutorial on how to deploy a people-counting system. Using reference from GitHub, YouTube and OpenCV, I'm able to deploy this system in my computer.



Conclusion:

By using this location-based technology, you can personalize your out-of-store marketing, helping you monetize any potential foot traffic. With mobiles now an integral part of everyday life, proximity marketing will only continue to grow. Therefore, implementing it effectively will add another dimension to your digital strategy.

Reference :

1. <https://www.wordstream.com/blog/ws/2018/10/04/beacon-technology>
2. <https://locatify.com/blog/ble-beacons-they-can-coexist/>
3. <https://www.investopedia.com/terms/f/foot-traffic.asp>
4. <https://wingarc.com.au/how-accurate-is-your-retail-foot-traffic-data/>
5. <https://urish.medium.com/exploring-the-physical-web-without-buying-beacons-efae51e36c2e>
6. <https://www.investopedia.com/terms/f/foot-traffic.asp>
7. <https://www.trafsys.com/how-to-measure-foot-traffic/#identify-entry%3E2.%20Identify%20Entry%20and%20Exit%20Points%20For%20Data%20Collection%3C/a%3E%3C/li%3E%3Cli%3E%3Ca%20href=>
8. <https://www.mocapatform.com/blog/moca-brings-wifi-based-proximity-campaigns-for-android-devices#.WR138hOLQQ8>
9. <https://econsultancy.com/how-retailers-are-using-geofencing-to-improve-in-store-cx/>
10. <https://www.avsystem.com/blog/wifi-geofencing/>
11. <https://www.linksprite.com/overview-of-people-counting-techniques/>
12. <https://blog.beaconstac.com/2018/08/ble-made-simple-a-complete-guide-to-ble-bluetooth-beacons/>

13. <https://www.pyimagesearch.com/2018/08/13/opencv-people-counter/>
14. <https://www.youtube.com/watch?v=4kJEHy8B3o>
15. https://github.com/noumannahmad/Computer-Vision/tree/master/Realtime_People_Counting