# Smart Home Asset Locator(SHAL)

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## MOTIVATION:

The use of positioning systems has grown in popularity in recent years. One way to describe the positioning system is as a way to pinpoint an object's or person's precise location. We rely largely on global navigation satellite systems such as GPS (Global Positioning system) for outside navigation, yet GPS is ineffective for locating devices or people within.

As a result, our primary aim is to design a system that can precisely find and monitor the device within the buildings.

## CURRENT PROBLEMS WITH GPS

- Weak Signals: Buildings block GPS signals, making it impossible for devices to "see" satellites.
- Bouncing Signals: Signals indoors bounce off walls, causing difficulties in finding out the exact position.
- Less Accuracy: Due to fewer satellites and interference, GPS isn't as precise inside.

## OUR SOLUTION: SHAL

- Using BLE and Triangulation for tracking the devices indoor.
  - Using signal strengths, gives accurate and precise distances.
  - It is of low cost, does not require extra hardware requirements.
- The low power consumption of BLE is advantageous for prolonged operation in battery-powered devices.
- BLE emerges as a standardized solution for asset tracking, overcoming some limitations associated with raw RSSI measurements.

## RSSI (RECEIVED SIGNAL STRENGTH INDICATOR)

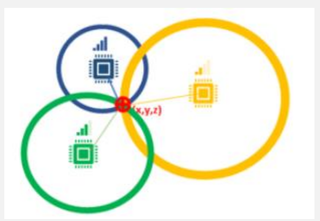
- RSSI is a measurement of power level(in terms of dBm) received by the sensor.
- The distance(in terms of meters) is estimated from the received power using the below formulae: where $d_0$ = 8.838m, $pr_{d0}$ = -56.98dBm

$$\hat{d}_i = d_0 * 10^{\left(\frac{Pr_{d0} - Pr}{10n}\right)}$$

- RSSI between transmitter and receiver:


## RSSI TRIANGULATION

- Triangulation is the process of determining the location/position of the object from the known distances.
- Using RSSI we get the distance of object, but not the exact direction of the object. So we use triangulation to get the exact location of the object. This is valid when we have at least 3 receivers.

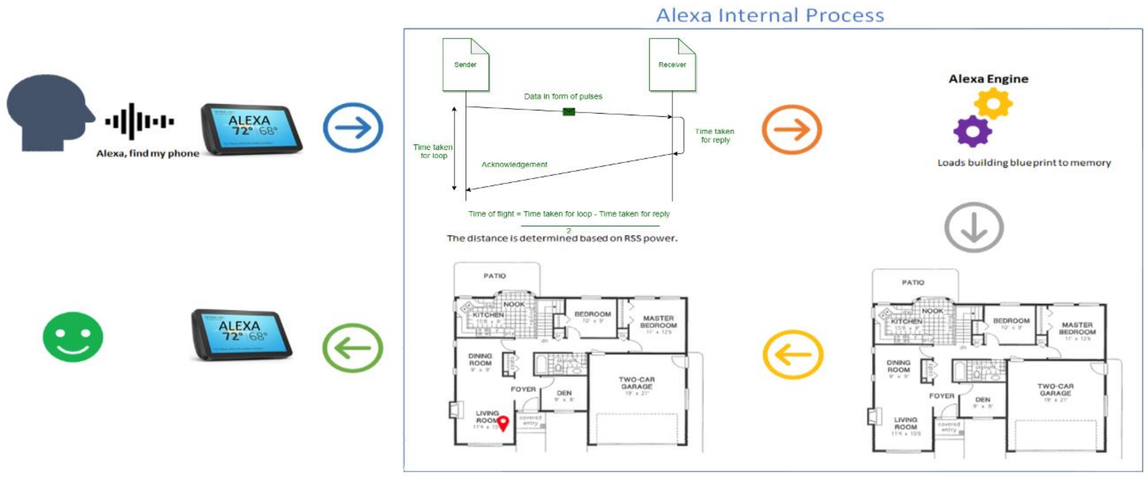



- We find the (x,y) coordinates of an object by using distances given by the receivers.

$$(y_1 - \hat{y})^2 + (x_1 - \hat{x})^2 = \hat{d}_1{}^2$$
$$(y_2 - \hat{y})^2 + (x_2 - \hat{x})^2 = \hat{d}_2{}^2$$
$$(y_3 - \hat{y})^2 + (x_3 - \hat{x})^2 = \hat{d}_3{}^2$$

## WORKING OF SHAL

1. We utilized one ESP32 as a transmitter/device that also serves as an access point..
2. We have utilized four ESP32 devices , were written in arduino programming which functions like receivers/scanners. The scanners were connected to the local house Wi-fi and then obtains the signal power for the device.
3. Each scanner also acts like a web server, where the value is populated in the web URL.




4. When a user requests "Find my phone" in an Android application, we do a http request of the web URL, which internally requests the scanners to obtain the distance in meters.
5. The android application collects all 4 distances from 4 different scanners and In order to determine the precise location of the device, the Android application triangulates the four distances obtained from the four separate scanners.
6. After finding the position android app routes to a new page where the device Once the position is determined, the Android app directs users to a new page where the device's location is displayed as an icon on the room's floorplan.

## CONCLUSION

- Successfully, we are able to show the accurate position of the device in indoors.
- Future work includes more thorough path loss to ensure accurate position of the device inside the buildings.

GitHub VideoLink