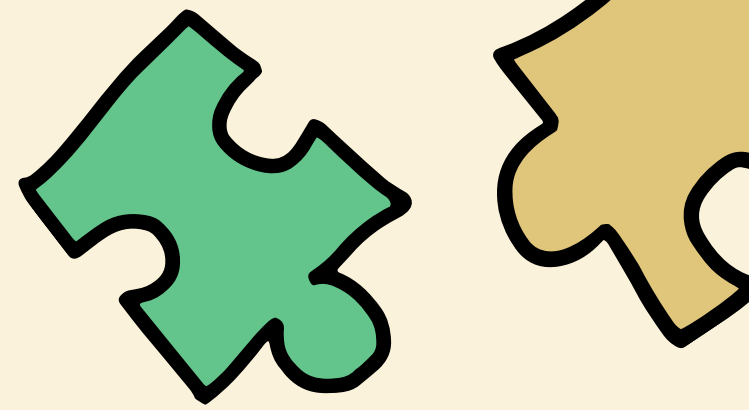
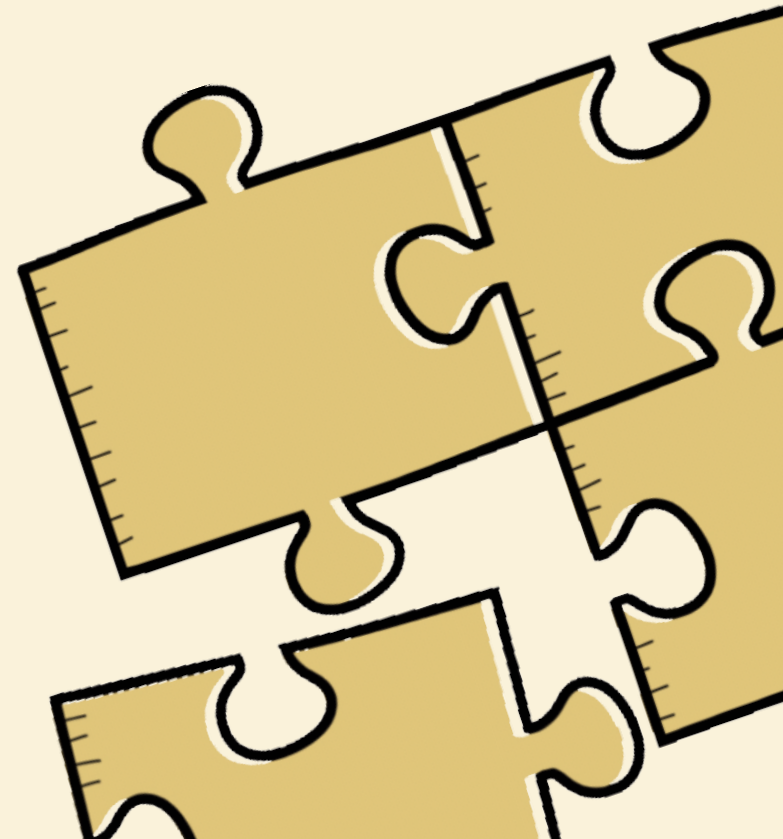




An-Najah National University



Wi-Fi-Based Indoor positioning



Prepared by:

Rahaf Nasrallah & Masa Masri

Supervised by:

Suleiman Abu Kharmeh



Outline



- **Introduction**
- **Project Details**
- **Results**
- **Constraints**
- **Future Work**

Introduction



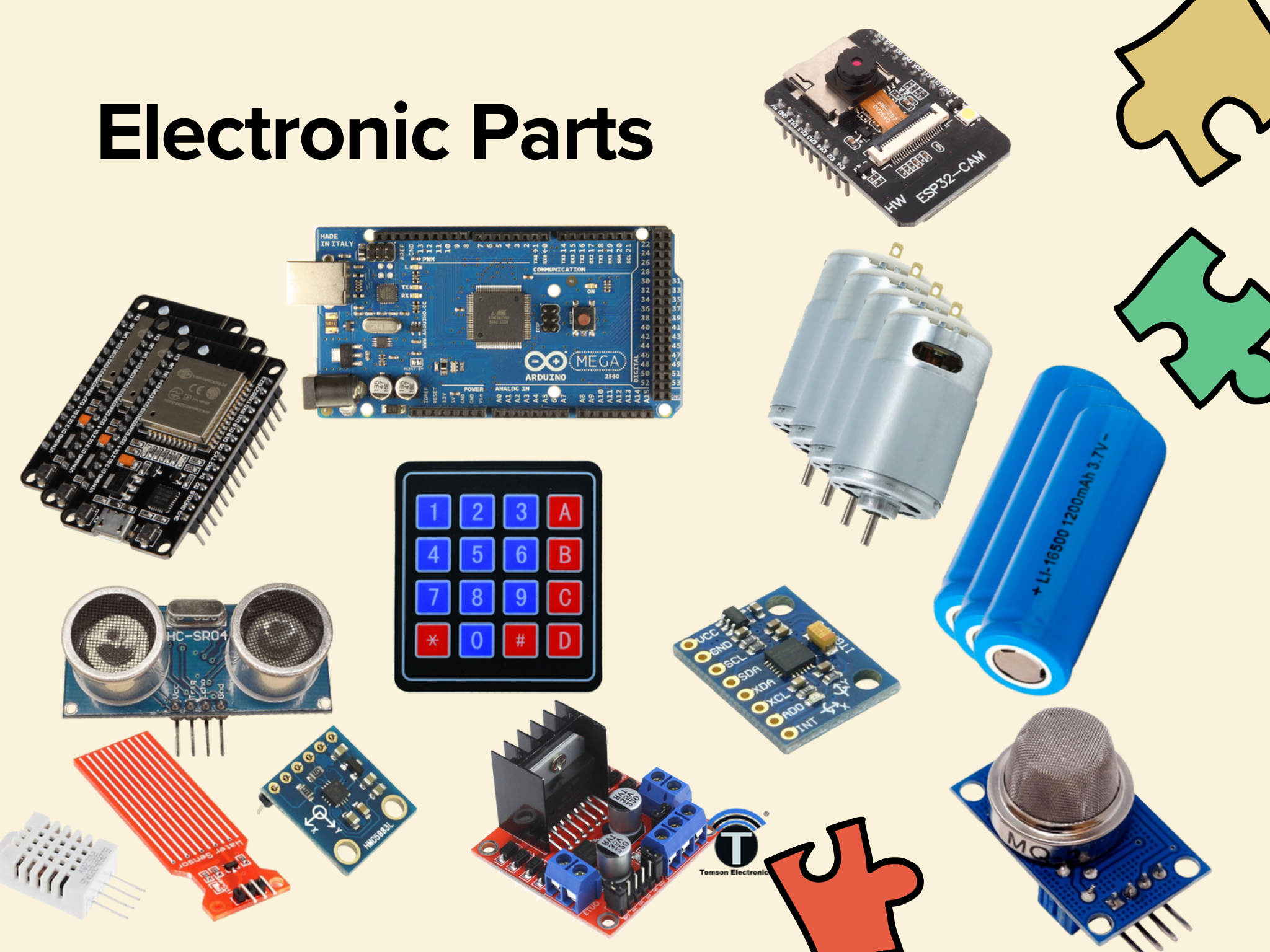
- **Applications of Indoor Localization**
- **Why did we choose Wi-Fi based localization**
- **Brief about our project**

Project Details



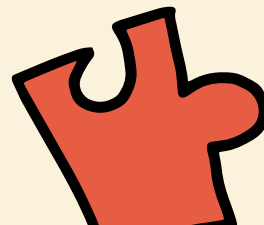
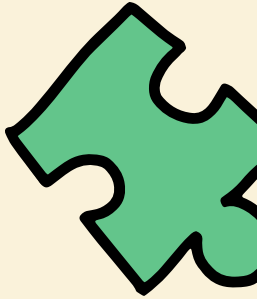
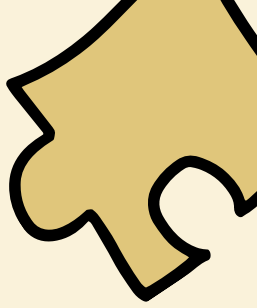
- **Electronic parts**
- **Localization**
- **Navigation**
- **Surrounding Conditions**
- **Mobile App**

Electronic Parts

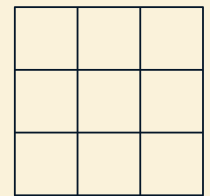
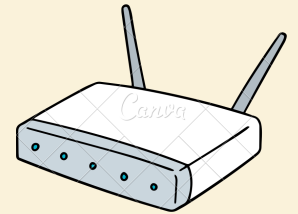
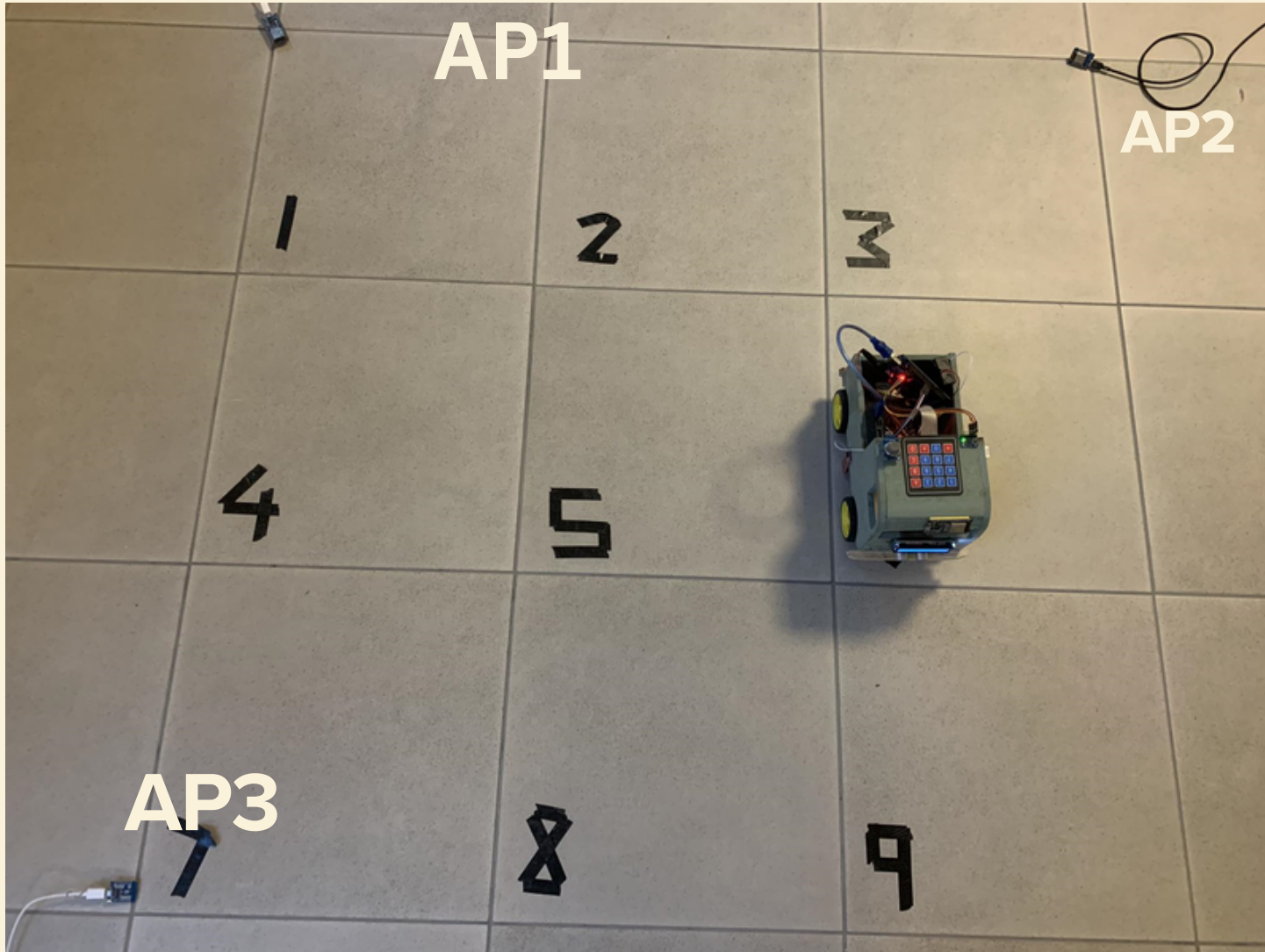


Localization

- Network Infrastructure
- Wi-Fi Scan
- Distance Estimation
- Position Calculations
- Error Minimization



Network Infrastructure



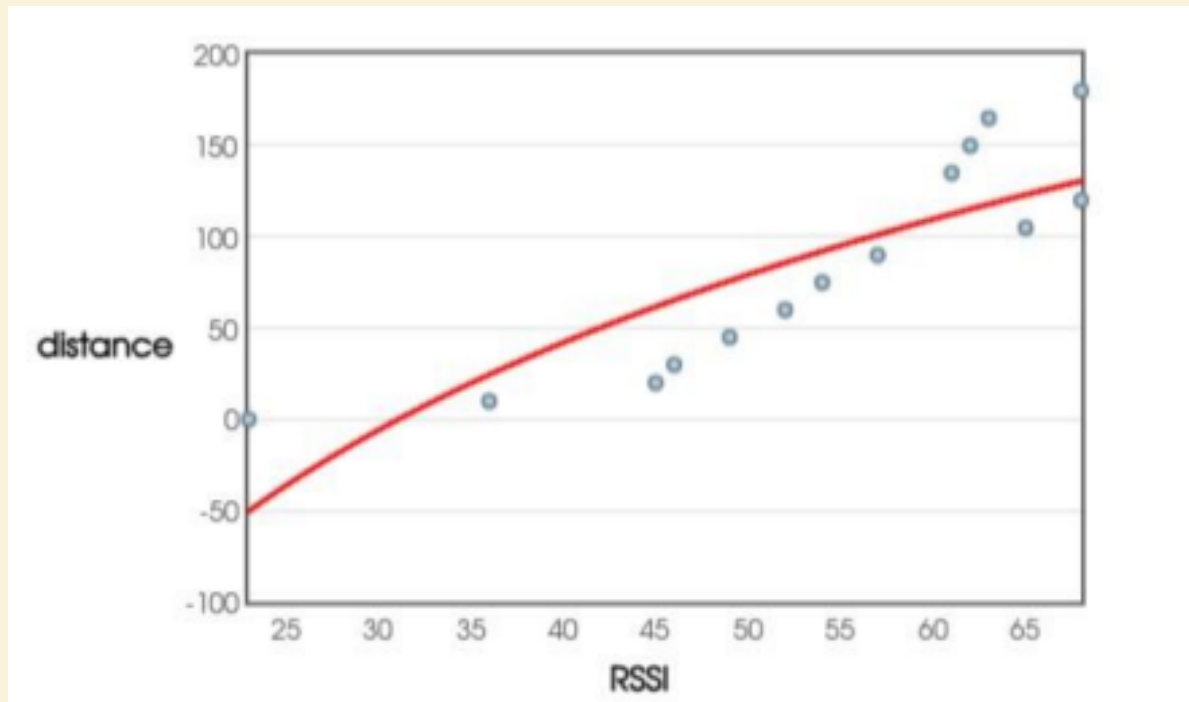
Wi-Fi Scan

C	D	E	F	G	H
		RSSI * -1	RSSI * -1	RSSI * -1	
	distance (cm)	ap1	ap2	ap3	
	0	23	13	30	
	10	36	32	41	
	20	45	42	45	
	30	46	49	51	
	45	49	53	52	
	60	52	55	53	
	75	54	54	56	
	90	57	57	55	
	105	65	60	58	
	120	68	60	63	
	135	61	68	63	
	150	62	64	60	
	165	63	72	68	
	180	68	75	67	

Table: RSSI values from access points at different distances.

Distance Estimation

-Logarithmic Regression



Regression Equation: **DISTANCE** = $-857.9809 + 237.0412 \cdot \ln(-\text{RSSI})$

Correlation: $r = 0.8699$

R-squared: $r^2 = 0.7568$

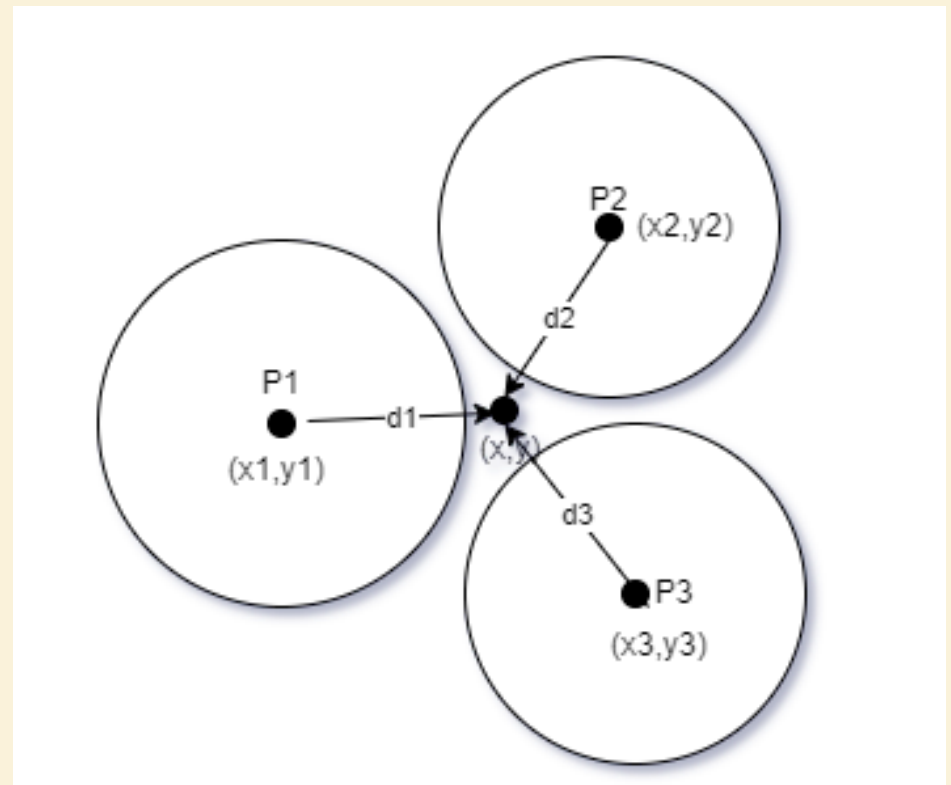
Position Calculations

-Trilateration

$$(x - x_1)^2 + (y - y_1)^2 = d_1^2$$

$$(x - x_2)^2 + (y - y_2)^2 = d_2^2$$

$$(x - x_3)^2 + (y - y_3)^2 = d_3^2$$



Error Minimization

- Average of three RSSI readings.
- Regarding the height of the ESP's.
- Control channel allocation, with non-overlapping channels 1, 6, and 11.

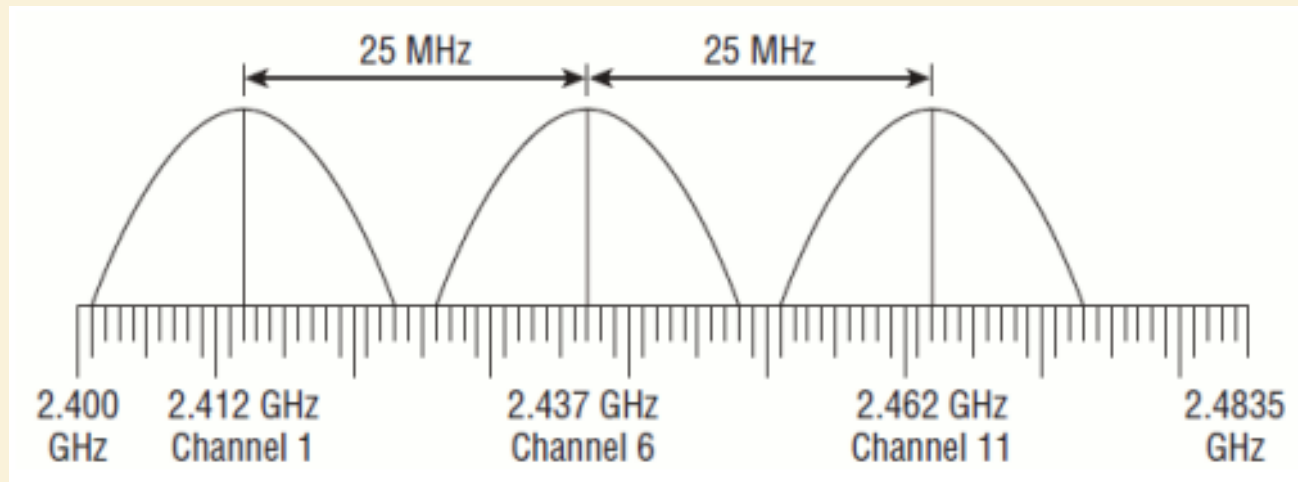
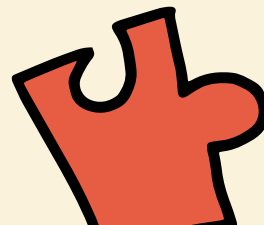
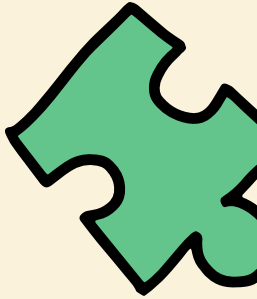
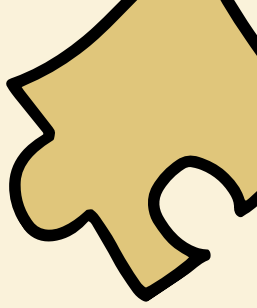


Figure: non-overlapping channels

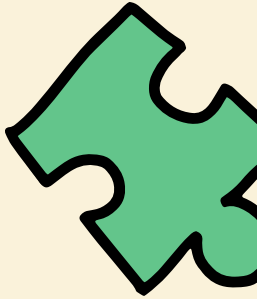
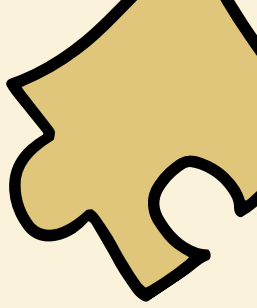
Navigation

- **Dijkstra Algorithm**
- **Mapping the shortest path to the movement of the robot**
- **MPU6050**



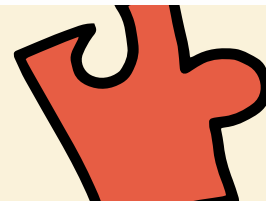
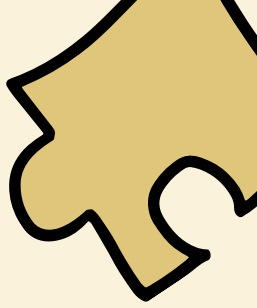
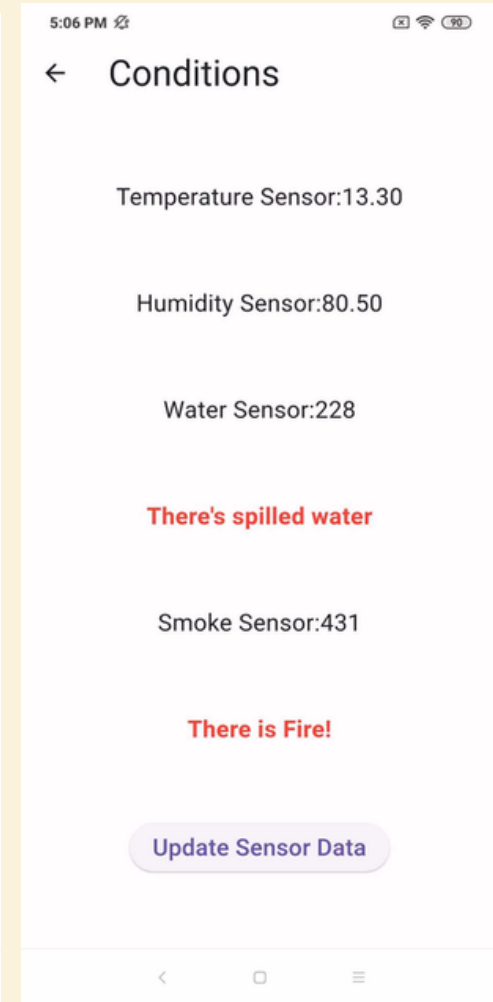
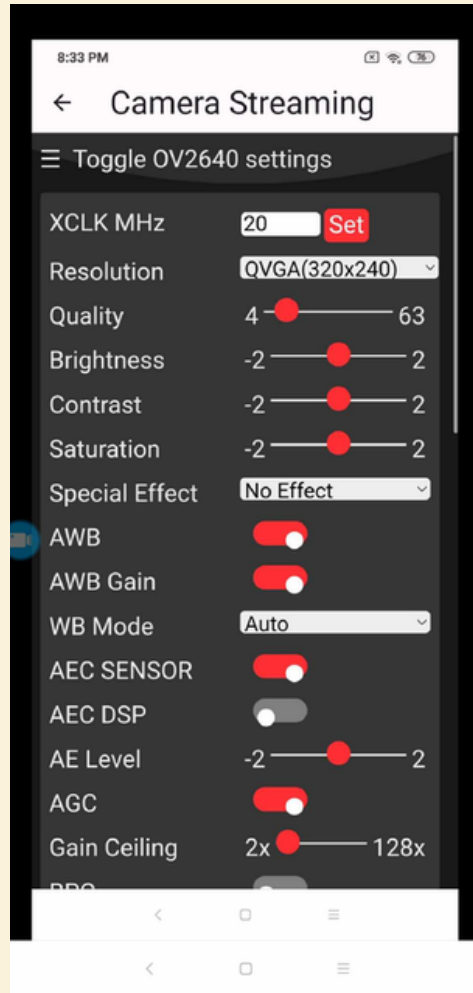
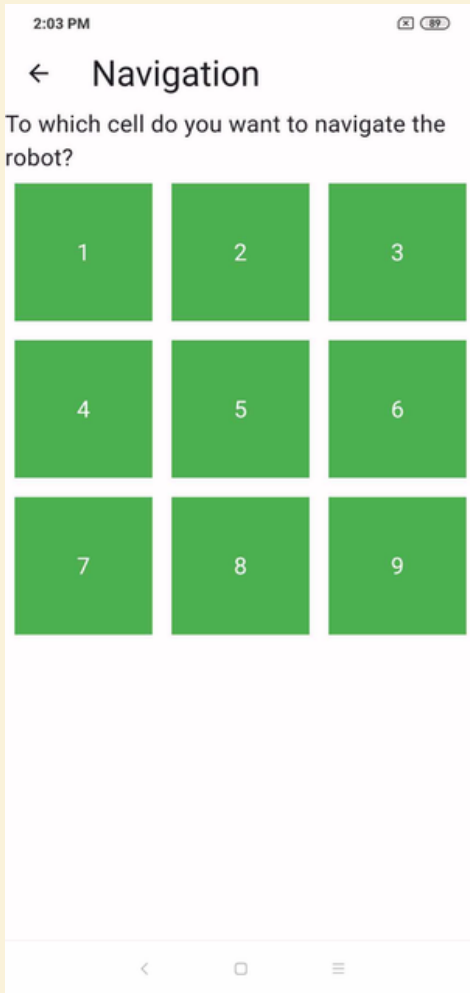
Surrounding Conditions

- Sensing the amount of water below the robot.
- Displaying the temperature and humidity.
- Detecting smoke.



Route Streaming

Mobile App

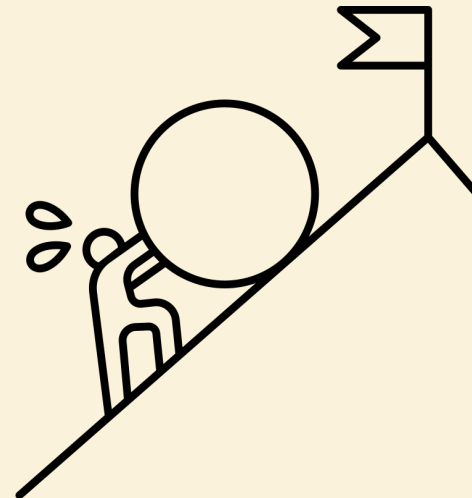
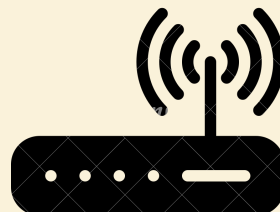


Results & Accuracy

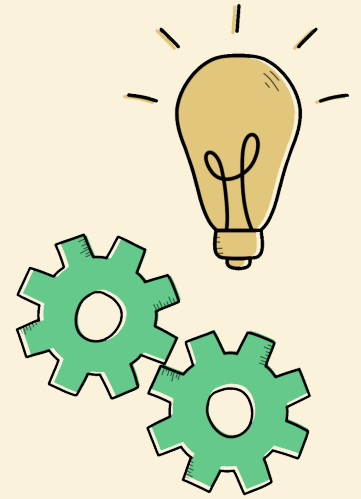
- we were able to build a robot that can estimate its position based on the RSSI values it scans from the surrounding ESPs and can navigate between the positions.
- The positioning accuracy was high in places with a limited number of access points. On the other hand, there were many false positioning times in places where the interference was high.
- Additionally, factors such as device diversity, obstacles like walls, and the height of scanner placement also influenced the accuracy of the positioning.

Constraints

- High interference caused by the multitude of routers and access points distributed across the university campus.
- Multipath Effects and Noise. Due to the inherent nature of the signals, they can be reflected, refracted and diffracted on the walls, metals, and in some cases even human beings.



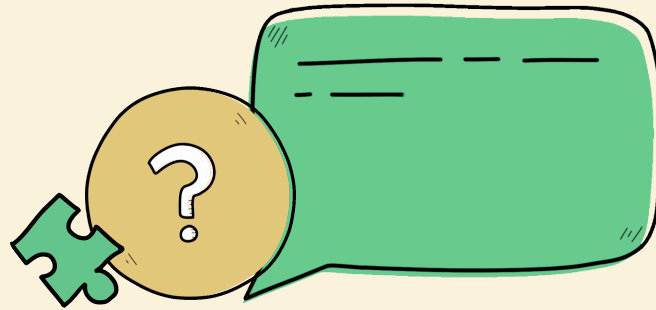
Future Work



- **Increasing the Accuracy.**
- **Expanding the area to reflect a more realistic indoor environment**



Thank you for your time!



**DO YOU HAVE ANY
QUESTIONS?**