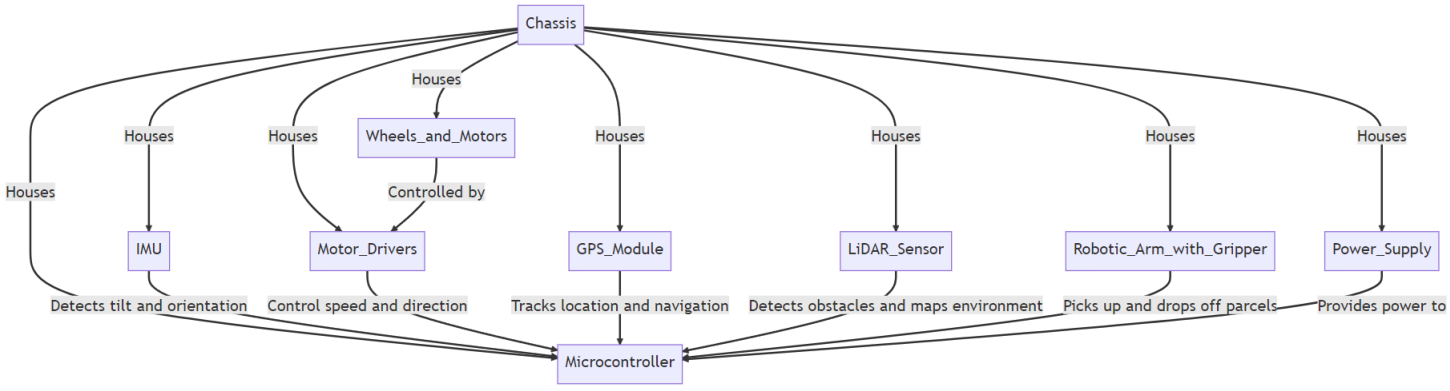
BOT BRAINS ROUND – 2

ROUND 2 - LOGIC LEAP

The following contents are in the next pages (Calculations, Ideation, Theory, Diagrams and References)

DIAGRAM:



Theory :

1) Self Balancing Mechanism :

The self balancing mechanism relies on the Inertial Measurement Unit (IMU) which includes gyroscopes and accelerometers to detect the robot's tilt. A PID controller is used to process the tilt angle data and generate appropriate motor commands to maintain balance.

2) Autonomous Navigation :

The GPS provides the robot's current location, while the LiDAR sensor detects obstacles in the environment. The navigation algorithm processes this data to plot a path to the destination, adjusting the course to avoid obstacles.

5) Parcel Handling System :

A robotic arm equipped with a Gripper is used for picking up and dropping off parcels. This arm is controlled by the microcontroller based on the navigation and task schedule.

6) Dynamic Weight Distribution :

To ensure stability, the robot adjusts its center of gravity using internal weights that can be moved dynamically. This adjustment is based on the detected weight and position of the parcel.

Calculations :

1) Maximum Angle of Inclination :

Given :

- h : Height of CoG from the ground = 0.5 m
- l : Distance between the wheels = 0.3m
- r : Radius of the wheels = 0.1 m
- m : Mass of the robot = 10 kg
- g : Acceleration due to gravity = $9.81\ m/s^2$
- T_{max} : Maximum motor torque = 20 Nm.

$$T_{max} \geq mgh \sin(\theta_{max})$$

Solving for θ max :

$$\sin(\theta_{max}) \leq \frac{T_{max}}{mgh}$$

$$\theta_{max} = \sin^{-1}\left(\frac{20}{10 \times 9.81 \times 0.5}\right)$$

$$\theta_{max} = \sin^{-1}\left(\frac{20}{49.05}\right).$$

$$\theta_{max} = \sin^{-1}(0.408)$$

$$\theta_{max} \approx 24^{\circ}$$

References :

1) Research articles and textbooks on control system and robotics.

2) Online tutorials and documentation for Raspberry Pi and sensor integration.

3) Manufacturer guides for sensor and actuators.

4) Community forums like Stackoverflow.