TWO WHEELED BALANCING ROBOT AS AN EMBEDDED SYSTEM:

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1. Abstract and Problem description

Two- wheeled self balancing robot is designed using the concepts of embedded system design. This embedded system is an assembly of various sensors and actuators with Arduino as a processing unit. It is automatic that carries a payload from source location to the destination according to user commands by balancing itself based on sensory inputs.

2. Requirements:

Requirement design and analysis of customer needs

2.1 High level requirements:

Test ID	Description	Category	Status
HLR_01	The robot shall be expected to transport a payload from one Location to another.	Functional	To be implemented
HLR_02	The robot shall able to control the direction of its motion	Technical	To be implemented
HLR_03	The robot shall be expected to balance itself and also the payload while working.	Functional	To be implemented
HLR_04	The robot shall balance itself from sudden obstacles.	Functional	To be implemented
HLR_05	The robot shall able to control its speed of motion	Technical	To be implemented
HLR_06	The robot shall be expected to calculate the torque required.	Functional	To be implemented
HLR_07	The robot shall be expected to calculate the torque and speed required to balance itself.	Technical	To be implemented

2.2 Low level requirements:

Test ID	Description	HLR_id	Status
LLR_01	The robot shall be receiving the source and destination location from user	HLR_01	To be implemented
LLR_O2	The robot shall be employing its wheels connected to DC motor to achieve its goal	HLR_01	To be implemented
LLR_03	The robot shall be carrying load on it throughout the entire process	HLR_01	To be implemented
LLR_04	The circuit will be having a switch which controls the direction of motion	HLR_02	To be implemented
LLR_04	The robot shall be incorporated with sensors like accelerometer and gyroscope or combination of both in order to achieve the high level requirement 2	HLR_03	To be implemented
LLR_05	The robot shall be employing the perceived sensory information balance itself and payload	HLR_03	To be implemented
LLR_06	The robot shall be able to sense the loci of itself and act upon the sudden obstacle found in its way avoid it by acting on sensory input	HLR_04	To be implemented
LLR_05	The circuit shall have a potentiometer to control the speed of the motion.	HLR_05	To be implemented

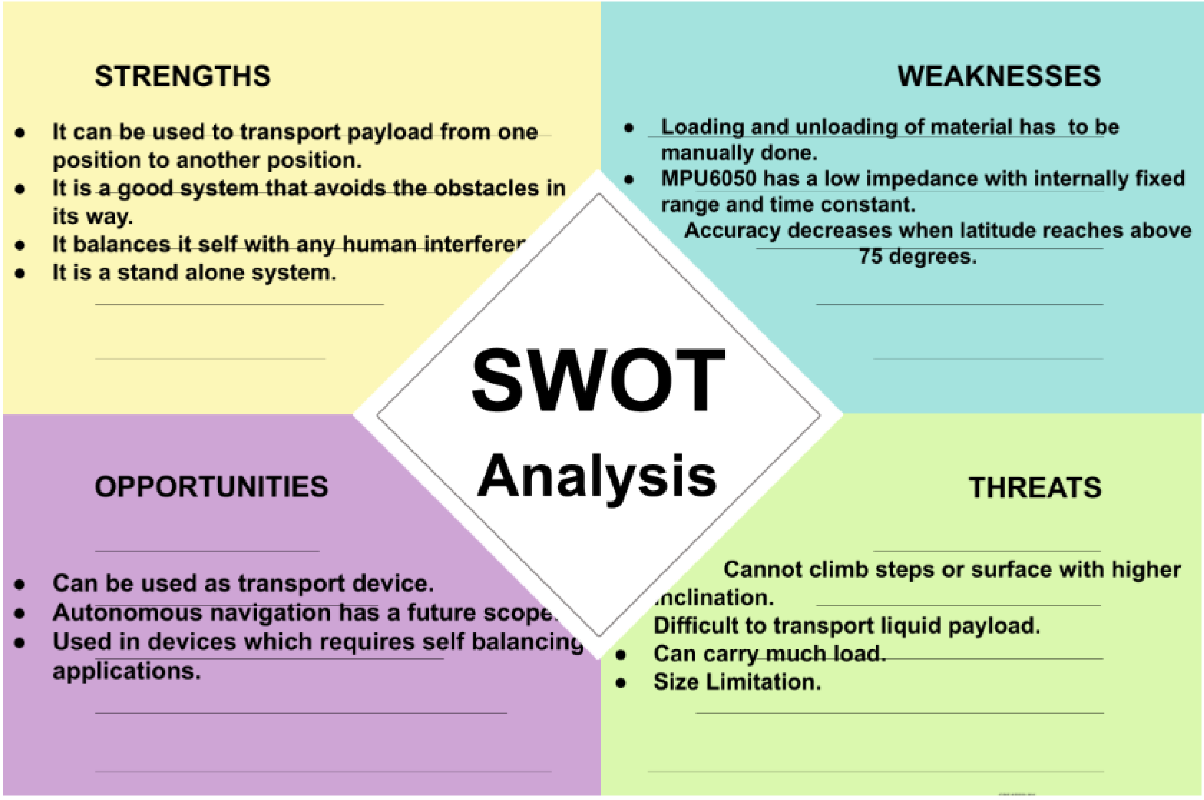
LLR_07	The robot shall be able to process the sensory input and calculate the required torque to balance itself and to move in its way	HLR_0	To be implemented
LLR_08	The robot shall be able to decide the speed required for the motion based on the torque calculated	HLR_7	To be implemented

3. Components used:

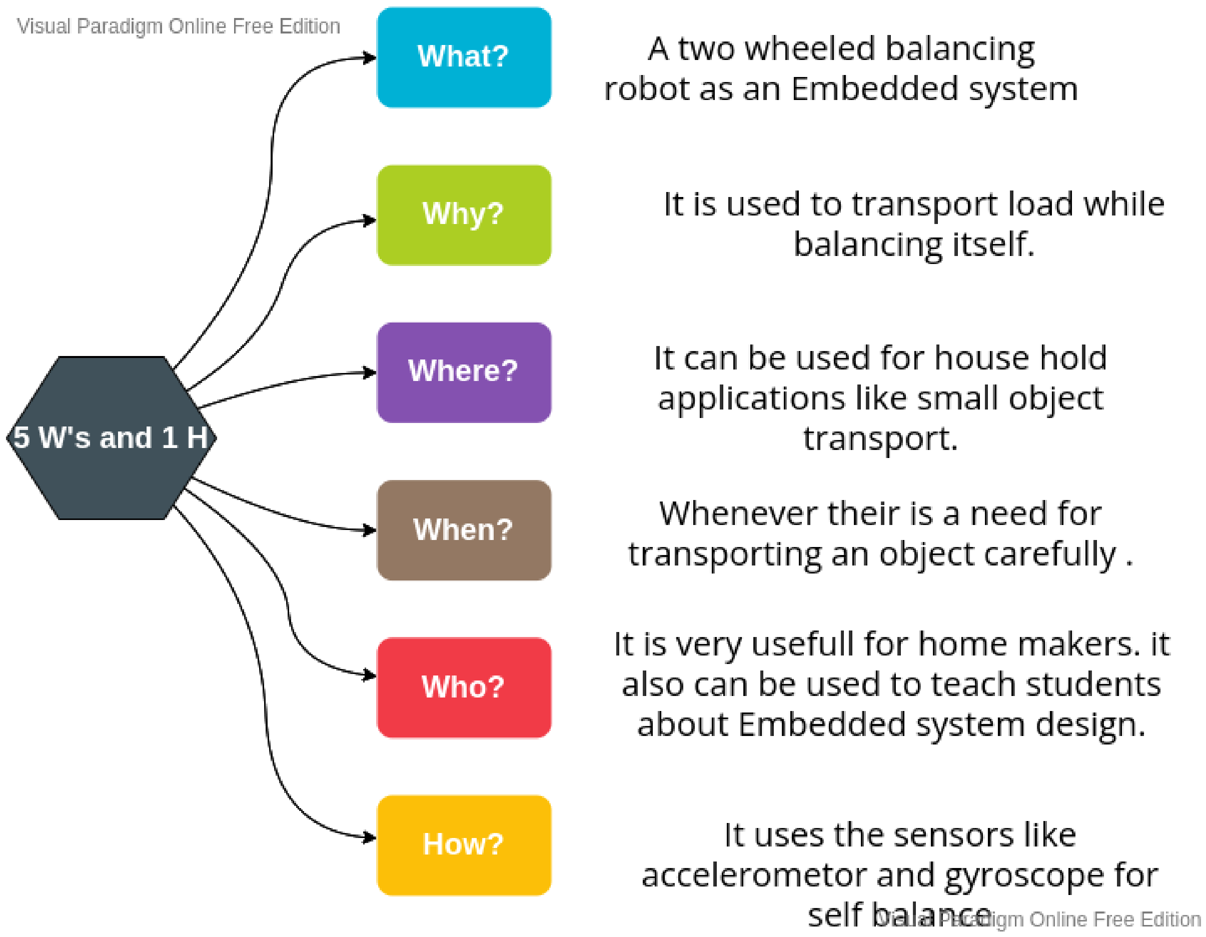
SL No	Component	Description
1.	Arduino Uno	Arduino Uno is a microcontroller board based on the ATmega328P family. It has 14 digital input/output pins (of which 6 can be used as a PWM outputs), 6 analog inputs pins, a 16 MHz ceramic resonator, an USB connection, power jack, an ICSP header and a reset button.
2.	MPU 6050 (Includes both analog and digital sensors)	The MPU6050 consists of a 3-axis Accelerometer and 3-axis Gyroscope. Which measure acceleration, velocity, orientation, displacement and many other parameters. It is a combination of accelerometer and gyroscope
3.	DC Motors	It uses a stationary set of magnets in the stator, and a coil of wire with a current running through it in order to generate an electromagnetic field which is aligned with the centre of the coil.
4.	L293D Driver	The L293D is a 16-Pin Motor Driver IC. It is mainly used to drive the motors. A single L293D IC which is capable of running two

		DC motors at once and also the direction of these two motors can be controlled
5.	Push button	It acts as a switch to control the direction of the motion in this particular case.
6.	Gyroscope(digital sensor)	A gyroscope measures angular velocity (specified in mV/deg/s).
7.	10 Ohm Potentiometer	a single turn 10k Potentiometer has a rotating knob.. These three-terminal devices can be used to vary the resistance between 0 to 10k ohms by simply rotating the knob. In this case potentiometer is used to control the speed of the motors.
8.	Accelerometer(analog sensor)	Accelerometers measure linear acceleration (specified in mV/g) along one or several axis.In this case it is used to determine the speed to be achieved in order to balance the load.

4. SWOT Analysis:



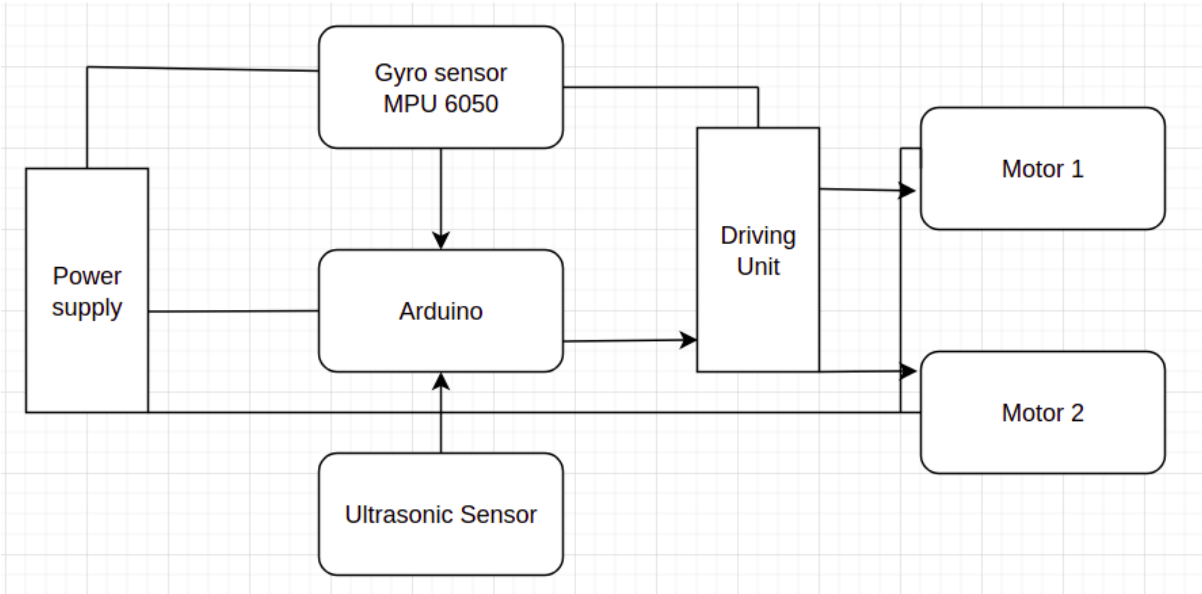
5. 5 W's and 1 H:



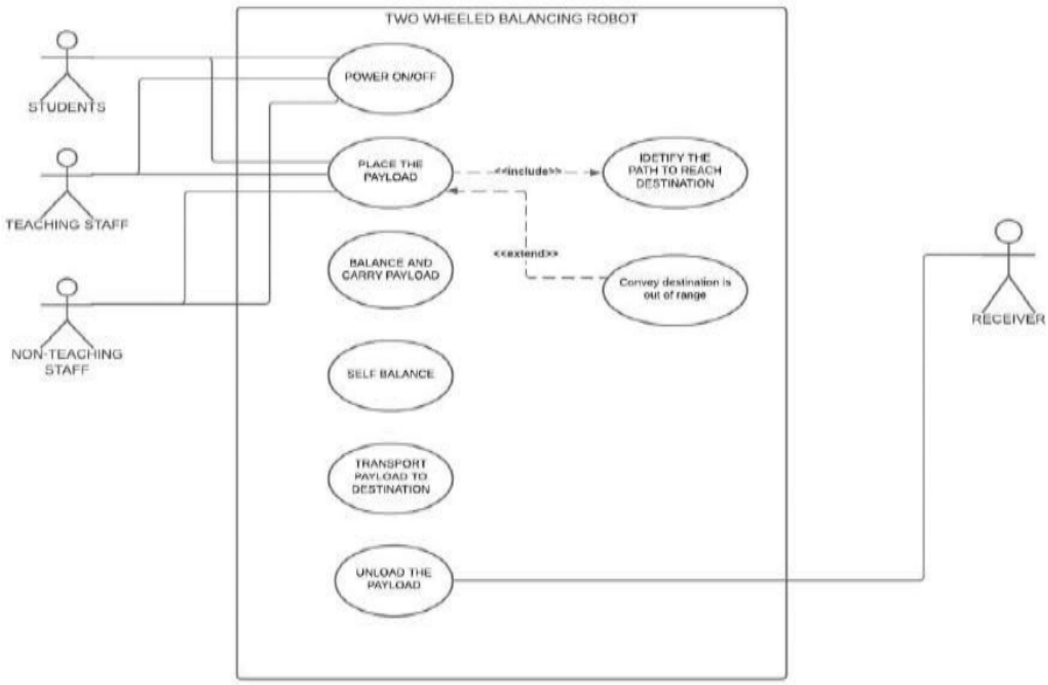
6. Applications:

Two wheeled balancing robots use a “closed-loop feedback control” system. Which means that real-time data from motion sensors is used to control the motors and quickly compensate for any tilting or imbalance in motion in order to keep the robot upright. Similar self-balancing feedback control systems can be seen in many other applications in day to day life. Some of the examples include: Segways bipedal robots, space rockets etc.

7. Component Diagram:

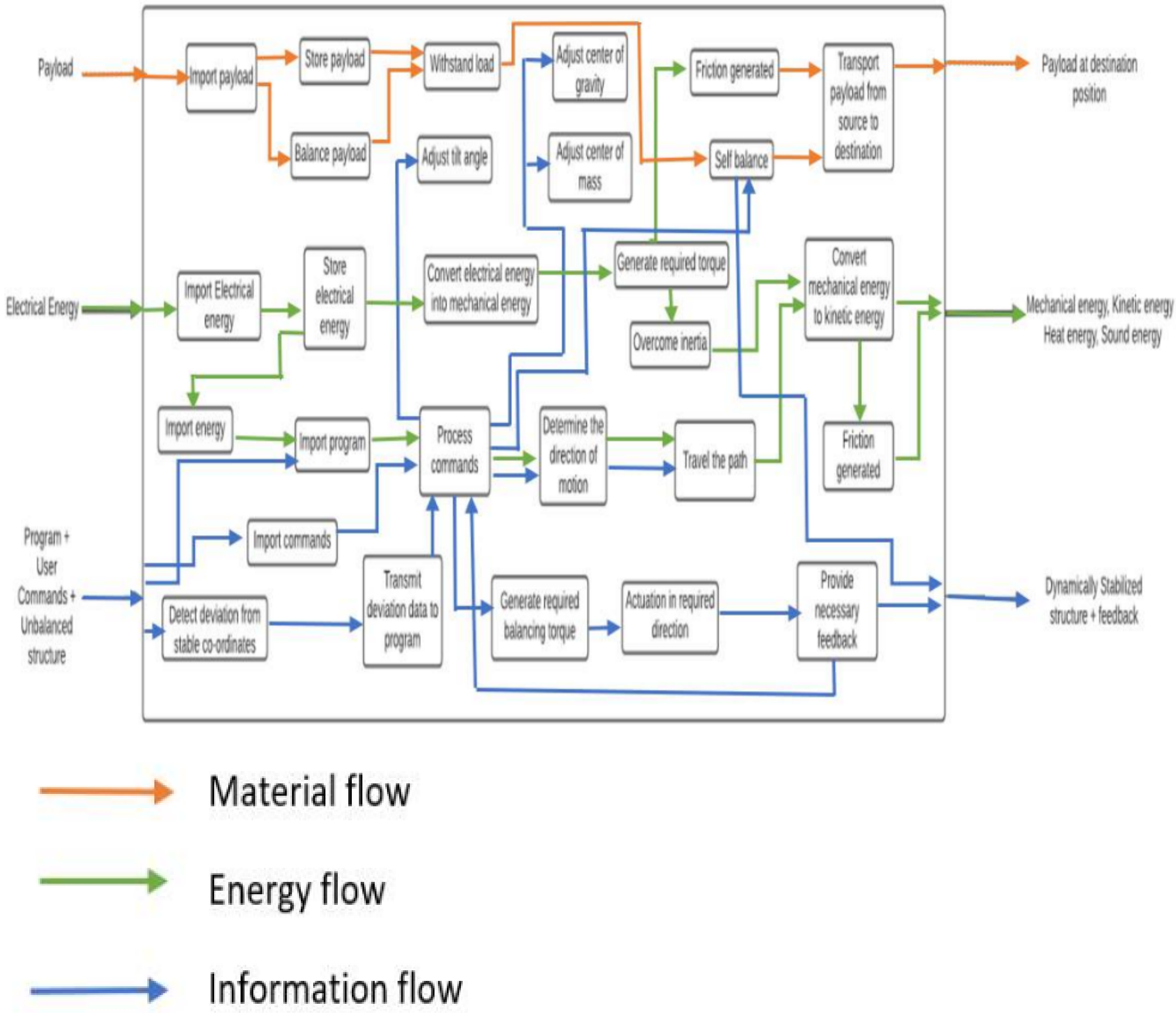


UML Diagram:

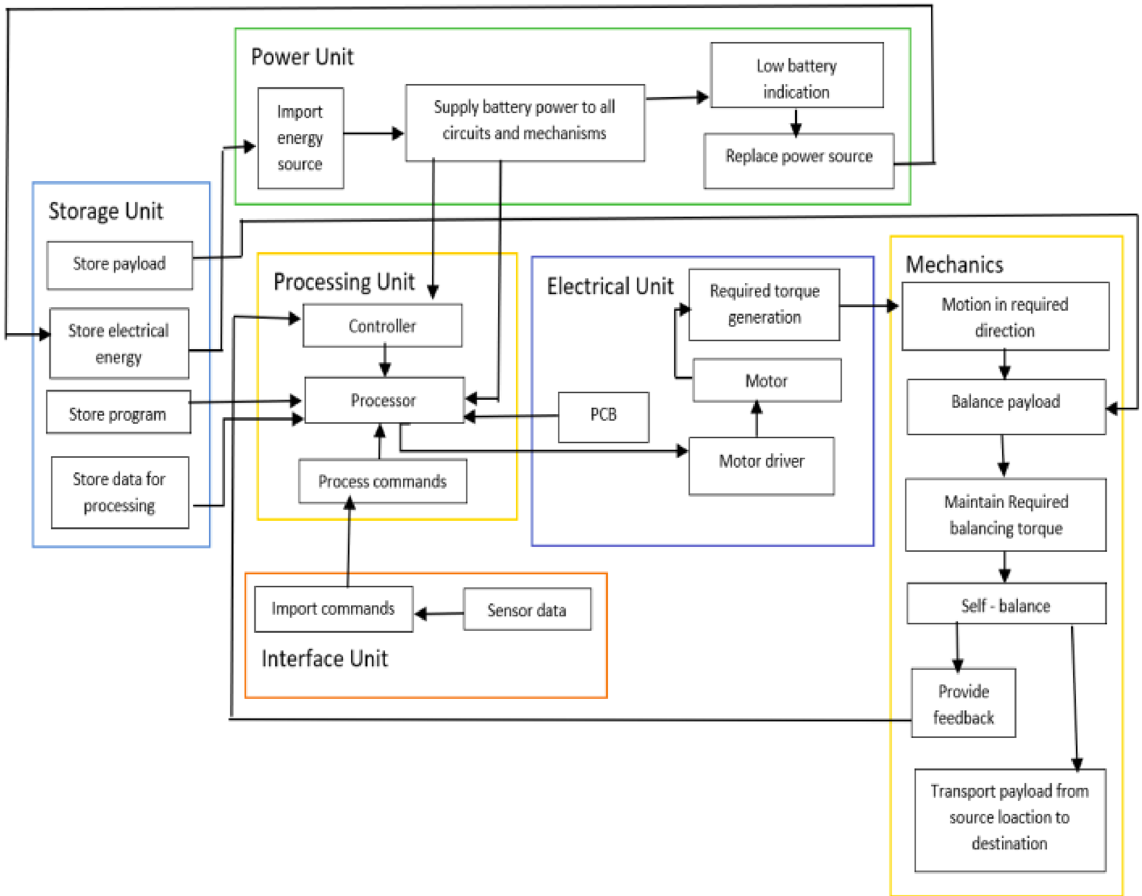


8. Flow chart:

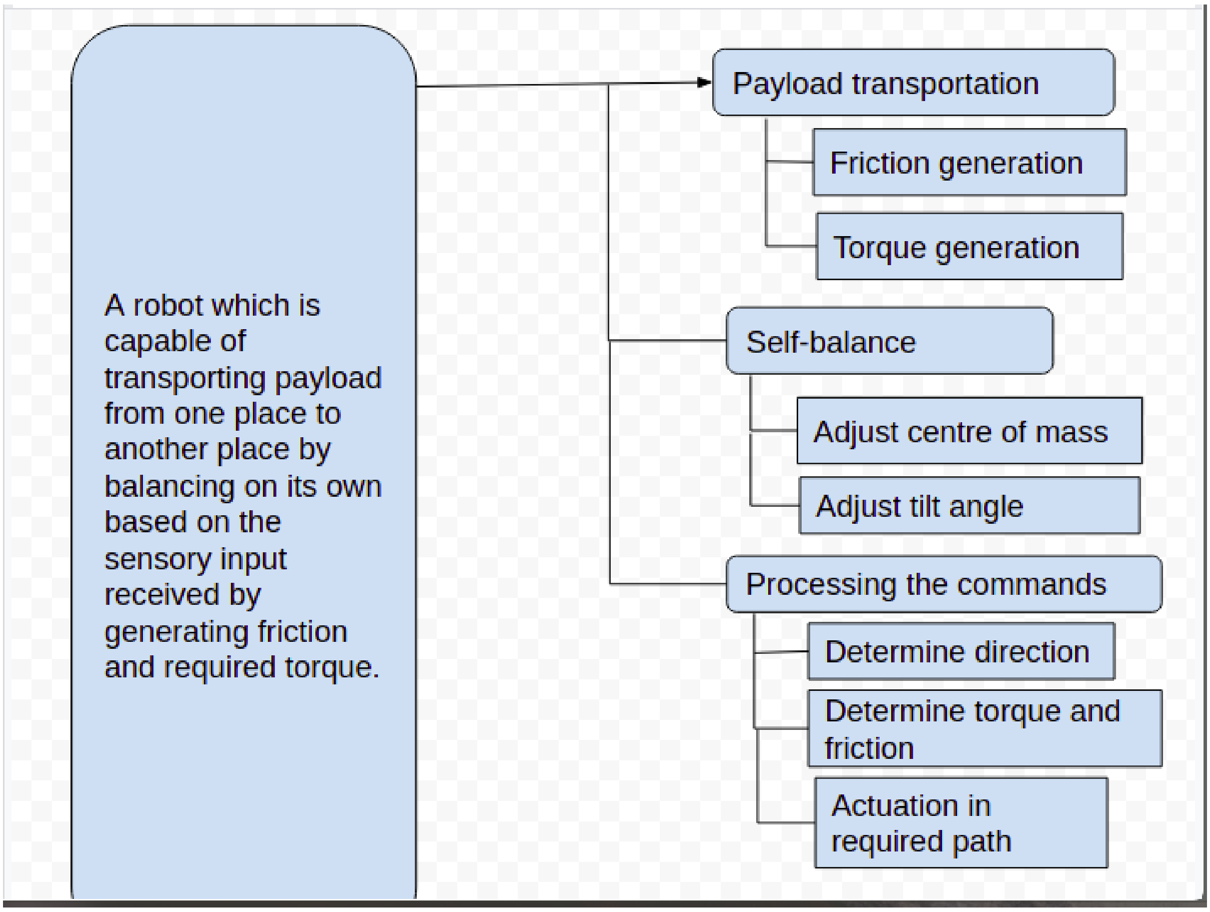
Function structure diagram:



Embodiment_diagram:



9. Sub functions diagram:



10. Results and conclusion:

The project has enabled us to learn and understand the concepts of Embedded systems in detail. We were able to apply our knowledge and skills to build and develop the self-balancing robot using tool chains like simulide. We also verified and designed in a simple , cost effective and easier way. The project has helped us to explore new domains ,develop our skills and troubleshoot the problems in an efficient way. Hence we can say that the project helped us to achieve overall technical development of each individual of the team.