

Mechatronics Project Proposal

Self Balancing robot

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Overview:

The self-balancing robot is similar to an inverted pendulum, we balance it by moving the robot in the direction in which it will fall. Repeated steps of the process:

1. We get the Gyroscope and Accelerometer sensor signal to know the current angle of the robot
2. We combine both results to obtain accurate measurements of the current angle
3. Using a tuned PID controller, we get the needed power to drive the motor

We get the measurement of the angle of the robot from two sources, from the gyroscope and from the accelerometer.

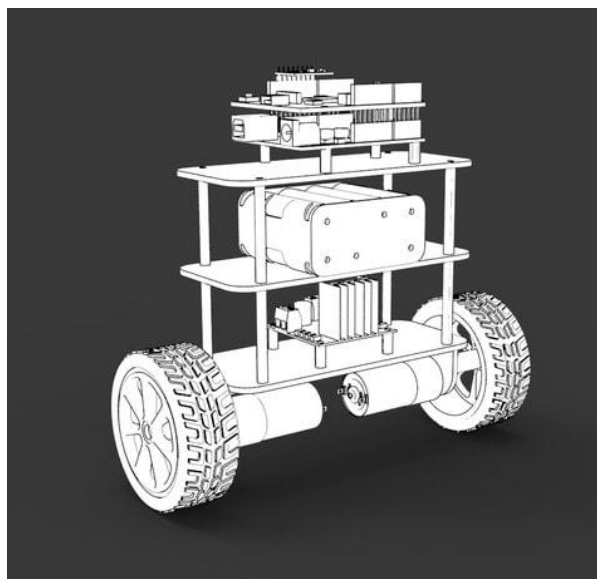
Using the accelerometer, to measure the angle of inclination of the robot we need acceleration values along y(horizontal axis) and z(vertical axis)-axes. The $\text{atan2}(y,z)$ function gives the angle in radians.

Using the gyroscope sensor, we read the gyro value about the x-axis, convert it to degrees per second and then multiply it with the loop time to obtain the change in angle. We add this to the previous angle to obtain the current angle.

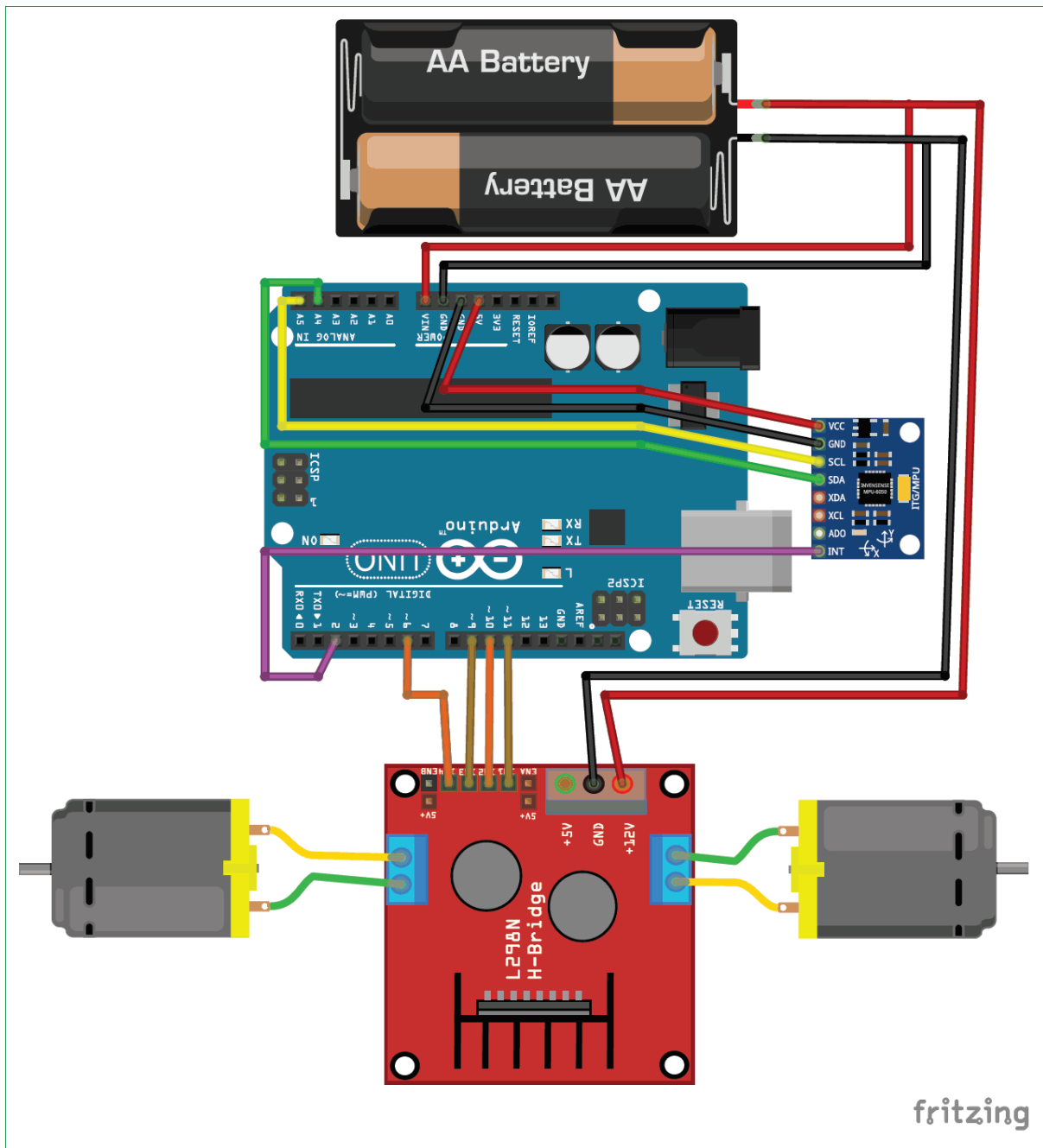
The accelerometer gets affected by sudden movements, while the gyroscope takes long duration signals to get affected. We take both measurements and combine or filter them to obtain a stable accurate angle reading.

$$\text{Current angle} = \alpha * (\text{previousAngle} + \text{gyroAngle}) + (1 - \alpha) * (\text{accAngle})$$

This angle is then feeded to the PID controller where we control the motor based on this angle.



Functional Diagram:



List of Proposed components:

- Arduino Uno
- MPU-6050 (6-axis accelerometer and gyroscope)
- L298N H bridge
- 2 DC geared Motor
- 2 Wheels

- Batteries and Holder
- chassis
- ultrasonic distance sensor (may be used as an additional task)

Controller: The controller that we will use here is Arduino UNO, why because it is simply easy to use

Motors: The best choice of motor that we can use for a self balancing robot, without a doubt will be Stepper motor. But To keep things simple we will use a DC gear motor.

Motor Driver: we will use L298N H bridge to drive our two gears .

Accelerometer and Gyroscope: The best choice of Accelerometer and Gyroscope for our robot will be the MPU6050.