

Two-Wheeled Self Balancing Robot

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This paper presents a method to design and control a two-wheeled self-balancing robot by focusing on hardware description, Complimentary filter algorithm, system modelling and Proportional-Integral-Derivative (PID) back stepping controller design. In the system, signals from the digital Gyro sensor are filtered by a Complimentary filter before being fed to the Proportional-Integral-Derivative back stepping controller. The objectives of the proposed controller is to stabilize the robot while trying to keep the motion of robot to any direction. By experimenting, the values of Proportional-Integral-Derivative parameters such as, Proportional Gain Constant, Derivative Gain Constant and Integral Gain Constant have been obtained and applied for the Arduino board. The special software was compiled to convert the digital data from the accelerometer to an acceleration magnitude vector. The magnitude is then compared to a predetermined mathematical function to infer the angle of tilt of the platform. The angle of tilt is then converted to angle of rotation for the gear motors to act on. Complimentary filter is used to filter the gyro data in order to reduce noise, drift, and horizontal acceleration dependency, for the fast estimation of angle. It was noticed that this approach promises much less lag than the low-pass filter alone, and not very processor-intensive. Tuning for Proportional-Integral-Derivative controller is depending upon the physical properties of the robot and the battery power, due to those reasons tuning the controller becomes a difficult task. Experimental results shows that the platform performed as expected. The two-wheeled robot was able to move towards any direction while keeping its balance.

Keywords: Complimentary filter, Gyro sensor, Arduino board, Accelerometer, Proportional gain constant