177_Self Balancing Robot

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***Abstract*— Self-balancing robot is an effective approach to the development and advancement in the field of robotics. In this particular model, the concept of inverted pendulum is used. Self-balancing is a process by which a system achieves stability by internal forces. The basic idea of this project is to overcome the challenge of balancing initially unstable system, by providing control mechanism to the robot so that it can balance on its own. The robot uses sensor values provided by accelerometer and gyroscope to find exact position of itself in three-dimensional geometry and send the values to microcontroller. The microcontroller on the other hand uses programs in it to give proper instruction about rotation of wheels to the motor driver module which in turn helps to balance the robot. This robot is advantageous over traditional four wheeled robots as it helps in taking sharp turns and navigating through tighter areas thus, serving as an essential machine for various industrial applications.**

Keywords- ATMEGA328P, Self-Balancing, Accelerometer, Gyroscope, PID, Complementary filter

I. INTRODUCTION

The invention of self-balancing robots has been a massive milestone in the history of robotics. These machines are particularly characterized by their ability to balance on two wheels by the implementation of a closed loop algorithm. A self-balancing robot has an unstable dynamic system unlike any other robot which rests itself on either three or more wheels. It works on the same phenomena as that of an inverted pendulum. Its design is more complex, as it needs to maintain its upright (vertical) position, however this design has many advantages which allows it to be used in practical scenarios. It's ability to turn on the spot and sustainable architecture increases its applications in industries. It is essential for the robot to not only balance but also maintain its position, withstanding external forces or unexpected disturbances if any. Active researches on two wheeled robots have been widely increased since the early versions of the studies on self-balancing robots by JOE[1] and n-BOT[2] complete with inertial activity sensors, encoders and on-wheel microcontrollers. A board of digital signal processor was featured by JOE, which was
based on a controller board on various microprocessors and the ATMEGA series of the Atmel architecture. It is rapidly emerging as a popular platform for both education and product development, with applications ranging from robotics, to process control and network control.

This paper explains the design along with the construction and control mechanism of a two-wheel self-balancing robot. This robot is self-driven by the interaction of the following components: DC motors, a microcontroller, a gyroscope(3-axis) and an accelerometer(3-axis) for attitude determination. To deal with the problem of sudden horizontal movements and gyro drifts in sensors, a complementary filter is implemented[3]. PID(proportional integral derivative), is the feedback mechanism used for this project.

II. BLOCK DIAGRAM OF CONTROL SYSTEM

Fig.1 illustrates the block diagram of the system. This shows the output from certain blocks and their respective inputs. The microcontroller ATMEGA328P acts like the heart of the system. Because it manages to input readings from the Sensors which include Accelerometer and Gyroscope, and Complementary filter , and based on these readings communicates with the motor driver.

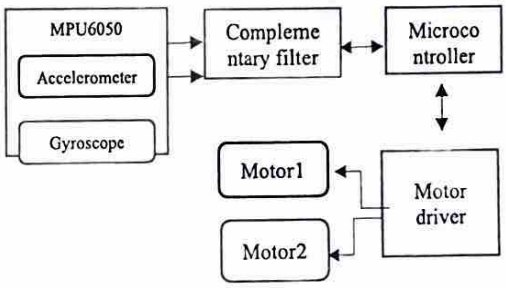

Fig.1 : Block Diagram

III. WORKING AND METHODS

To keep the robot balanced, the motors must counteract the robot falling by rotating the wheels in desired direction as shown in Fig.2. This action requires feedback and correcting elements. The feedback element is the MPU6050 gyroscope + accelerometer, which gives both acceleration and rotation in all three axes. The Arduino uses this to know the current

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