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Two Wheel Self Balancing Robot Using A Smart Phone

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ABSTRACT

In this paper we outline, development and control the two wheel self balancing robot. The adjust display as a two wheeled self-balancing robot that is fit for balancing itself concerning changes in weight and position. Two wheel self balancing robot work through an advanced cell utilizing a solitary versatile application and Bluetooth module. We built up the adjust framework from a solitary gyroscope and a solitary accelerometer. The dependability of the framework is to demonstrate the abilities of the ATmega328 in doing PID circles even with restricted exactness in position readings. PID control framework is intended to screen the engines to keep the framework in balance.

Keywords: Self balancing robot, Accelerometer, Gyroscope, Arduino Uno, Kalman filter, PID controller.

I. INTRODUCTION

Two wheeled self balancing robot depend on inverted pendulum setup which depends upon dynamic balancing framework for balancing and moving. This robot premise gives exceptional robustness and capacity because of their littler size and power prerequisites. Such robot finds their applications surveillance in and transportation reason. Specifically, the emphasis is on the electromechanical instruments and control calculations required to enable the robot to see and act in real time for a powerfully evolving world.

It self balancing robot, if the bot gets tilt by a point, the focal point of mass of the bot will encounter pseudo power which will apply a torque suitable to the course of tilt. This postulation display an improvement self balancing portable robot utilizing PID controller. The stage has been planned utilizing portable robot packs including IMU and to servos, and controlled by an open source microcontroller with PID. An arduino microcontroller, side interest grade servos, and a six level of flexibility (Axis) accelerometer and gyroscope has been utilized to make the controlled stage. The controller has been intended to keep up the stage at an first chose point when the help structure introduction changes.

The estimation of PID parameters i.e. Kp, Ki, Kd has been get and connected to the arduino. The product has been composed with logic to convert the data digital from

the accelerometer to a speeding up size vector. The extent is then contrasted with a foreordained numerical capacity to surmise the edge of tilt of the stage. The edge of tilt is then changed over to edge of connection for the servos to follow up on.

II. RELATED WORK

In this paper, we show the adjust demonstrate as two wheeled self adjusting robot that is fit for adjusting itself as for changes in weight and position and built up the adjust framework from a solitary and a solitary accelerometer. The soundness of the framework is to demonstrate the capacities of the ATmega328 in doing PID circles

even with restricted precision in position reading.PID control framework is configuration to screen the engine in order to keep the framework in equilibrium. [1]

This paper worries about the usage of two wheel self adjusting vehicle using arduino. Tilt edge and engine speed rate are working as contribution of the framework to perform adjusting of the vehicle. Idleness estimation unit and DC engines were utilized as sensor and actuator individually for this framework. The vehicle is produced utilizing modified pendulum idea where conceals both development and adjustment. [2]

The wheels of the robot were fit for free revolution each determined by a high torque DC motor. Data about the edge of the gadget with respect to the ground was acquired from an (inertial estimating unit) sensor which contains an accelerometer and a gyroscope. Data from the IMU was prepared and sifted to acquire exact esteems which were encouraged to the smaller scale processor on the board. The microchip handled the input utilizing a PID calculation to create position control signals. [3]

In this task a remote controlled self adjusting portable robot will be outlined, constructed, and controlled utilizing the rack detecting segments, a machined undercarriage, specially printed circuit sheets, and remote adjusting and control through a MATLAB programming interface. The executions of the robot depend on various hub accelerometer and single hub gyroscope for estimation of attitude and rotational rate estimation. [4]

III. BLOCK DIAGRAM AND DESCRIPTION

The block diagram consists of mainly:-

- Accelerometer
- Gyroscope
- Arduino Uno
- PID controller
- Kalman filter
- Motor driver
- Motors

The robot gets balanced on two wheels having the required grip providing sufficient friction. In order to obtain the verticality of robot two things must be done, in one hand the angle of inclination must be controlled to move left or right, forward or backwards to make an angle zero degree. For measuring the angle, two sensor, accelerometer and gyroscope are used.

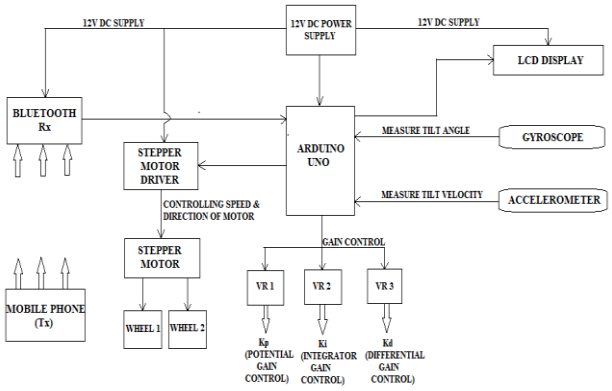

Figure 1: Block diagram of self balancing robot

Accelerometer can sense either static or dynamic forces of acceleration. Static forces include gravity, while dynamic forces can include vibrations and movement. The gyroscope measures the angular velocity, so if this measurement is integrated, we obtain the angle of movement of the robot. The sensor output was fused with a kalman filter. Sensors measure the process the output say α which gets subtracted from the reference set-point value to produce an error is then fed in to the PID where the error gets managed in three ways. After the PID algorithm process the error, the controller produce a control signal μ PID controller signal then gets fed in to the process under control. Process under PID control is to wheeled robot. PID control signal will try to drive the process to the desire set-point value that is zero degree in vertical position by driving the motors in such a way that the robot is balanced.

Here in this section, the components and techniques used for building the model which is composed of arduino microcontroller, gyroscope accelerometer, PID controller, motor driver and motors.

MAIN COMPONENTS

1. ACCELEROMETER AND GYROSCOPE

The sensor utilized as a part of this task is IMU. The IMU is a gadgets module comprising of in excess of one module in a solitary unit, which takes rakish speed and straight increasing speed information as info and sent to the principle processor. The IMU sensor really contains fundamentally two separate sensors. The first is the accelerometer. It is gadget that measures proper speeding up. Here we need to utilized ADXL335 accelerometer is a littler, thin, low power, finish 3-pivot accelerometer. The second sensor is the spinner. It additionally gives three simple signs. These signs portray the vehicle rakish speeds about every one of the sensor pivot. It isn't important to put IMU at the vehicle focus of mass, on the grounds that the rakish rate isn't influenced by straight or precise increasing velocities. The information from these sensors is gathered by the microcontroller joined to the IMU sensor through a 10 bit ADC board. The sensor data conveys by serial correspondences (UART) interface at a rate of around 10 Hz. The accelerometer is utilized on the adjusting framework so as to distinguish the present condition of the model.

Here IMU sensor utilized is MPU-6050. This chip contains a 3-hub gyroscope and 3-pivot accelerometer. This makes it a 6 degrees of opportunity inertial estimation unit. Gyroscope measures the precise rate arround a tomahawks. Tilt edge can be acquired by coordinating precise rate over inspected time. A gauge of rakish removal is gotten by incorporating speed motion after some time. Accelerometer can quantify the power of gravity and with that data, the edge of robot can be acquired. Kalman channel is utilized for the combination of yield of two sensors. It is an arrangement of numerical conditions that gives an effective computational intends to assess the condition of a procedure, in a way that limits the mean of the squared blunder.

2. PID CONTROLLER

The control calculation that is utilized to keep up the adjust on the independent self balancing robot is the PID controller. The corresponding, fundamental and subordinate (PID) controller is notable as three term controller. The contribution to the controller is the blunder from the framework. The Kp, Ki and Kd are allude as the corresponding, fundamental and subsidiary steady individually. In the PID controller the blunder gets managed in three ways. The blunder will be utilized on the PID controller to execute the relative term, basic term for finding of consistent state mistake and the subsidiary term to deal with overshoots. The PID control calculation can be displayed in a numerical representation.

The equation given is to calculate the PID controller output of the balancing system is simplified follow:

Error = set point reading – current accelerometer reading – current gyroscope reading
The output of the PID controller for the balancing the model is
Motor PWM = Proportional Term + Integral Term + Differential Term

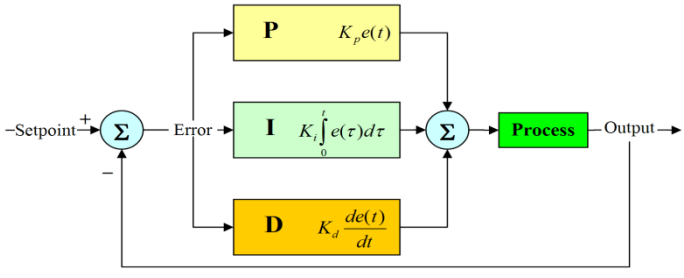

Figure 2: PID Controller

Figure2 shows the working principle of PID controller. To Tune the PID controller K and ,Kd must be set to zero first and the Kp is slowly increase until the system start to oscillate. Next, Ki is slowly increased until the system start to oscillate again then the Kd is slowly increased until the system is stable and is not oscillating. The output of the motor PWM is shown in above equation about will be used as the set point for the motor.

Error of motor speed = set-point of motor – current speed reading of motor.

Output proportional term of motor = Kp*error of motor speed
Output differential term of motor = kd* (error of motor speed- last error of motor speed)

Output integral term of motor = Ki*sum of error for motor speed Motor speed = propotinal term of motor + differential term of motor + integral term of motor For tunning PID control of motor speed, the value of Kp,Ki and Kd is get by trial and error method. Although this is not efficiency error but it can control the speed of motor very well.

IV. RESULT

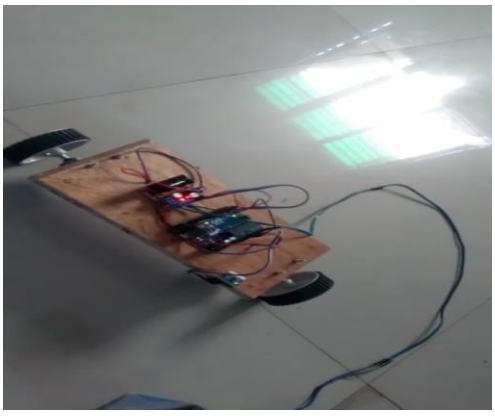

Figure 3: Balancing process in robot

V. CONCLUSION

This undertaking was effective in accomplishing its plans to adjust a two-wheeled self balancing robot in view of the inverted pendulum demonstrate .It can adjust easily with a most extreme tilt mistake of 6 degrees and the significant impediment was the detecting of adjust. The time taken to accomplish the steady position is done inside restricted time and exactness after the load is being put. The security of the two wheeled self adjusting robot might be enhanced if an appropriately composed gearbox. Additionally the self adjusting robot can be utilized as a part of a few applications like self-sufficient trolleys in hospitals, transportation in shopping centres, workplaces, airplane terminals and so forth.

VI. REFERENCES

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