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SELF BALANCING ROBOT CONTROLLED BY BLUETOOTH MODULE

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ABSTRACT

To make a robot that can balance on two wheels. There will be only one axle connecting the two wheels, and a platform will be mounted on that. There will be another platform above it. The platform will not remain stable by itself. The functioning of the device is to balance the platform using distance sensors as Gyroscope sensor (Gyro MPU6050) and to maintain it horizontal. Firstly to just balance the robot on its two wheels, if the platform inclines, then the microcontroller (in this case, an Arduino Nano) will send signals to motors such that motors will move forward or backward depending on the inclination direction and extent. Balance of the robot was achieved by using a Proportional-Integral Derivative (PID) controller with inputs from a gyroscope and accelerometer. Stepper motors were used to maneuver the robot. A two wheeled self- balancing robot builds upon the inverted pendulum principle, if F is the force applied, ϕ is the angle from the equilibrium. When a tilt from the equilibrium occurs the motors will generate a torque that drives the wheels in the same direction as the tilt. The wheels will move the same distance as the centre of gravity in order to maintain balance. In order to achieve forward movement, the angle set point will be increased, changing the equilibrium point. A self- balancing robot is creating a robot that is a replica of a human body. Traditional robots consisted of four wheels, were easily stabilized, and were comparatively bigger in size. A traditional robot uses four wheels and four motors for movement, while a self-balancing robot uses only two wheels and motors for movement. A very famous application of the self-balancing robot is the Segway. Segway has been readily available on the market since 2011 and is also termed a "human transporter". It is used mostly to cover shorter distances.

Keywords: Robot, Gyroscopesensor, ArduinoNano, Blue Tooth Module.

INTRODUCTION

Self-balancing robots are a topic of curiosity amongst students, robotics addicts, and hobbyists around the world. The fascinating aspect is the fact that it is a naturally unstable system. The project presents an attempt on

developing an autonomous self- balancing robot. A key element in maintaining the robot in the upright position is estimation of the tilt angle. For this, the Kalman Filter has been implemented and tested to fuse data from a gyroscope and an accelerometer.

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In addition, the methodology in which the hardware was chosen and put together has been justified. Then the software development and challenges in the implementation of the Kalman Filter have also been explained. Project report details the development of a self-balancing robot controlled by a Bluetooth module. Implementation of the robot's hardware and software, including the selection of appropriate components and the programming of the microcontroller. The robot is equipped with an accelerometer and a gyroscope to measure its orientation and a PID controller to adjust its motor speed and maintain balance. The Bluetooth module is used to receive commands from a mobile device and control the robot's movement. The report includes detailed explanations of the design and implementation process, as well as the results of testing and future directions for improvement. Overall, this project demonstrates the feasibility and potential of using Bluetooth technology to remotely control self-balancing robots.

LITERATURE REVIEW

Conducting literature review prior to begin a research project is vital in understanding two wheels balancing robot control technique, as this will supply the researcher with much needed additional information on the methodologies and technologies available and used by other research counterparts around the world. This chapter provides a condensed summary of literature reviews on key topics related to balancing a two-wheeled robot.

J.A. BORJA et al [2020] this paper presents low cost, two-wheels self-balancing robot for control education powered by stepper motors developed at the University of Seville. This design improves a previous model based on DC motors that has been used for the last five years in different courses in which students learn electronics, computer programming, modelling, control and signal processing by means of the construction and control of this robot. The new design improves the performance and reduces the total price of the device. **C.GONZALEZ et al [2017]** Arduino based low-cost self-balancing robot developed at the University of Seville for control education. The main idea is that the students can learn electronics, at the University of Seville for control education. The main idea is that the students can learn electronics, computer programming, modelling, control and signal processing by means of the construction and control of this robot. The resulting model is a multivariable unstable nonlinear system with non-minimum phase zero. Experimental

OBJECTIVES

Balancing: The primary objective of a self-balancing robot is to maintain its balance while in motion. This is accomplished by continuously adjusting the robot's center of gravity using feedback from sensors such as accelerometers and gyroscopes.

Wireless Control: The use of Bluetooth technology allows the robot to be controlled

wirelessly from a smartphone or other Bluetooth-enabled device. This can provide greater flexibility and convenience compared to a wired control system.

Stability and Precision: A self-balancing robot should be stable and precise in its movements. This requires accurate sensor data and precise control algorithms to ensure the robot moves in the desired direction and at the desired speed.

Maneuverability: Depending on the specific application, a self-balancing robot may need to be able to maneuver in tight spaces or navigate complex environments. This requires a combination of agility, speed, and control.

User Experience: The overall user experience is an important objective for any robot. This includes factors such as ease of use, reliability, and responsiveness to user input. Bluetooth

Hardware Components

GYROSCOPE SENSOR

The gyroscope sensor is used to measure the angular velocity of the object. The 3-axis gyroscope sensor can find the orientation and rotation of the person in all three directions with respect to gravity. This provides an angle value θ which is then used to indicate the position of the person during fall. An accelerometer sensor is used to measure the acceleration or motion of the human body. A tri axial accelerometer measures the acceleration in all 3 axes x, y and z respectively. The accelerometer sensor provides a parameter value for measuring the person motion. Both these sensors are used for Fall detection.

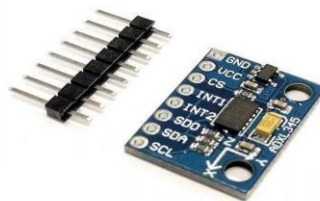


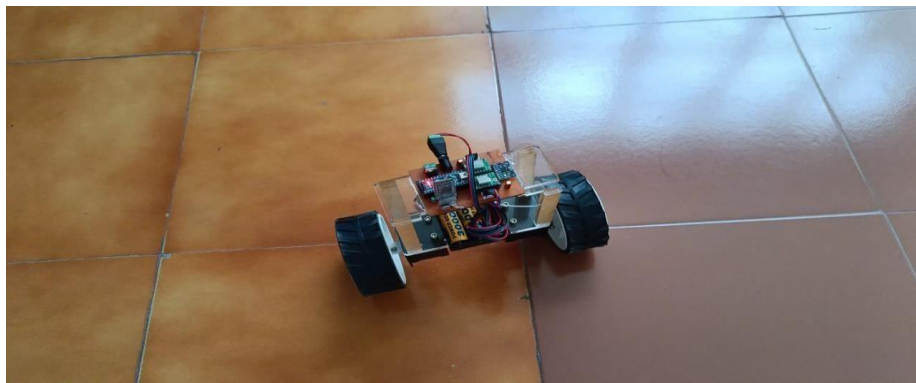
Fig. 1 Accelerometer and gyroscope.

The ADXL345 is a small, thin, ultralow power, 3-axis accelerometer with high resolution (13-bit) measurement at up to ± 16 g. Digital output data is formatted as 16-bit two's complement and is accessible through either a SPI (3- or 4-wire) or I2C digital interface. The ADXL345 is well suited for mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (3.9 mg/LSB) enables measurement of inclination changes less than 1.0° . Several special sensing functions are provided. Activity and inactivity sensing detect the presence or lack of motion by comparing the acceleration on any axis with user-set thresholds. Tap sensing detects single and double taps in any direction. Freefall sensing detects if the device is falling. These functions can be mapped individually to either of two interrupt output pins. An integrated memory management system with a 32-level first in, first out (FIFO) buffer can be used to store data to minimize host processor activity and lower overall system power consumption. Low power modes enable intelligent motion-based power management with threshold sensing and active acceleration measurement at extremely low power dissipation.

WHERE TO USE HC-05 BLUETOOTH MODULE

The **HC-05** is a popular module which can add two-way (full-duplex) wireless functionality to your projects. You can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth supports USART. We can also configure the default values of the module by using the command mode. So, if you looking for a Wireless module that could transfer data from Your computer or mobile phone to microcontroller or vice versa then this module might be the right choice for you. However, do not expect this module to transfer multimedia. Mode where the default device settings can be changed. We can operate the device in either of these two modes by using the key pin as explained in the pin description. It is very easy to

pair the HC-05 module with microcontrollers because it operates using the Serial Port Protocol (SPP). Simply power the module with +5V and connect the Rx pin of the module to the Tx of MCU and Tx pin of module to Rx of MCU as shown in the figure below



CONCLUSION

A self-balancing robot controlled by Bluetooth has the potential to be a valuable tool for various applications. By maintaining its balance while in motion, the robot can be used in environments where stability is critical. The use of Bluetooth technology allows for wireless control, providing greater flexibility and convenience compared to a wired control system. To ensure stability and precision, the robot needs accurate sensor data and precise

speed, making it a valuable tool for tasks that require precise movements. Additionally, the robot needs to be maneuverable to be able to navigate complex environments or tight spaces. The user experience is also an important objective for a self-balancing robot. The use of Bluetooth control provides a user-friendly interface for controlling the robot and receiving feedback on its status. This will ensure that users can easily control the robot and receive the necessary information to complete their tasks efficiently. Overall, a self-balancing robot controlled by Bluetooth has the potential to be a valuable tool for various applications, from industrial settings to personal use. By achieving the objectives of balancing, wireless control, stability and precision, maneuverability, and a user-friendly experience, it can provide an effective solution for many tasks.

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