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ROBOT THAT MANAGES ITSELF USING A BLUETOOTH MODULE

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ABSTRACT

The goal is to create a bipedal robot. The two wheels will be connected by a single axle, which will then support a platform. A higher platform will be present thereafter. On its own, the platform will lose its stability. Using distance sensors such as a gyroscope (Gyro MPU6050), the gadget balances and keeps the platform level. At its most basic level, the robot can only travel on its two wheels. However, when the platform tilts, the microcontroller—an Arduino Nano in this example—sends signals to the motors, causing them to advance or retract in response to the angle and magnitude of the tilt. A Proportional-Integral Derivative (PID) controller, which takes data from an accelerometer and a gyroscope, was used to keep the robot balanced. The robot's movement was controlled by stepper motors. If F is the applied force and χ is the angle from the equilibrium, then a two-wheeled self-balancing robot may be constructed using the inverted pendulum method. The wheels are driven in the same direction as the tilt by the torque generated by the motors when the equilibrium is disturbed. To keep everything in its proper place, the wheels will travel the same distance as the centre of gravity. Raising the angle set point shifts the equilibrium point, allowing for forward motion. An artificially balanced robot is one that mimics the human form. Conventional robots were larger, had four wheels, and could be readily stabilised. In contrast to self-balancing robots, which employ only two wheels and motors for locomotion, conventional robots use four wheels and four motors. As an example of a self-balancing robot, the Segway is a well-known product. A "human transporter" in its own right, Segway has been selling like hotcakes since 2011. Shorter distances are its primary application. 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 willgenerate a torque that drives the wheels in the same direction as the tilt. The wheels willmove the same distanceas 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 isused 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 tiltangle. For this, the Kalman Filter has been implemented and tested to fuse data from a gyroscope and an accelerometer.

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 theselection 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 forcontrol education powered by stepper motors developed at the University of Seville. Thisdesign improves a previous model based on DC motors that has been used for the last fiveyears in different courses in which students learn electronics, computer programming,modelling, control and signal processing by means of the construction and control of thisrobot. 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 theUniversity of Seville for control education. The main idea is that the students can learnelectronics, at the University of Seville for control education. The main idea is that the students can learn electronics, computer programming, modelling, control and signalprocessing by means of the construction and control of this robot. The resulting model isamultivariable unstable nonlinear system with non-minimum phase zero. Experimental

OBJECTIVES

Balancing: The primary objective of a self-balancing robot is to maintain its balance whilein 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.

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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 needto 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

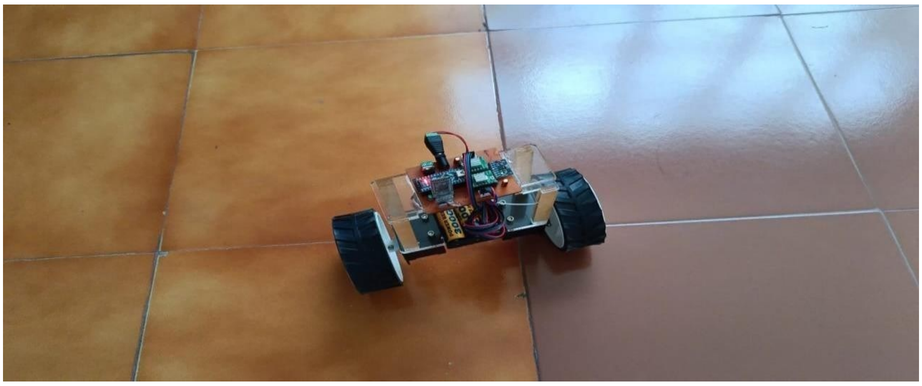
The gyroscope sensor is used to measure the angular velocity of the object. The 3-axis gyroscope sensor can find the orientation and rotation of the person in all three directions with respect to gravity. This provides an angle value ɵ which is then used to indicate the position of the person during 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 twos 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 accelerationresulting 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 canbe 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 modulemight 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 MCUas shown in the figure below



CONCLUSION

There are several possible uses for a self-balancing robot that is controlled via Bluetooth. The robot can function in settings where steadiness is important since it can keep its equilibrium while moving. Bluetooth enables wireless control, which is more convenient and flexible than a cable control system. The stability and accuracy of the robot's movements depend on precise sensor readings and speed, which makes it an excellent tool for jobs that need pinpoint accuracy. The robot's manoeuvrability is also critical for its ability to handle confined places or complicated surroundings. One of the main goals of a self-balancing robot should be to improve the user experience. A simple way to interact with the robot and see its current state is via the Bluetooth control. Because of this, users will have no trouble controlling the robot and will have all the data they need to get their jobs done quickly and effortlessly. The general public and businesses alike may benefit greatly from the employment of a self-balancing robot that is operated via Bluetooth. It may be a great answer for a lot of things since it balances well, is easy to operate wirelessly, is stable and precise, is manoeuvrable, and is easy for users to use.

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