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RESEARCH ARTICLE OPEN ACCESS

Design of Self-Balancing Bicycle Using Object State Detection

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ABSTRACT-
Balancing any two wheeled vehicle is always a challenging task for human and robots both form long time. Leaning a bicycle driving is long time process and goes through building knowledge base for parameter decision making while balancing robots. To establish this machine learning phase with embedded system we are proposing the system. This proposed system aimed to make a bicycle bot, powered by an electric motor, which could balance by itself and move along a particular path. This path could be wavy with bumps and varying widths. The primary aim was to make the cycle balance on its own by controlling its handle. In order to turn, a shift in center of mass was achieved. In order to maintain its stability, the bot automatically turned the handle and thus took a turn. Speed, Steering mechanism through mass distribution (leaning), Center of mass location and Gyroscopic effect of its wheel were the main challenges faced by the team. The idea has potential applications in automated transport. Academically, the project provided a platform to integrate control system theory, visual image processing and microcontroller robot programming.
***Keywords* -** Gyroscope-flywheel,3-axis-accelerometer, servomoter-controller.

I. INTRODUCTION

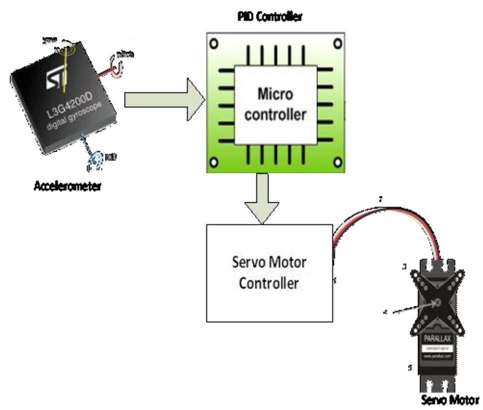
Motorcycle dynamics is the science of the motion of bicycles and motorcycles and their components, due to the forces acting on them. Dynamics is a branch of classical mechanics, which in turn is a branch of physics. Bike motions of interest include balancing, steering, braking, accelerating, suspension activation, and vibration. The study of these motions began in the late 19th century and continues today.

Bicycles and motorcycles are both single-track vehicles and so their motions have many fundamental attributes in common and are fundamentally different from and more difficult to study than other wheeled vehicles such as dicycles, tricycles, and Quadra cyclers. As with unicycles, bikes lack lateral stability when stationary, and under most circumstances can only remain upright when moving forward. Experimentation and mathematical analysis have shown that a bike stays upright when it is steered to keep its center of mass over its wheels. This steering is usually supplied by a rider, or in certain circumstances, by the bike itself. Several factors, including geometry, mass distribution, and gyroscopic effect all contribute in varying degrees to this self-stability, but long-standing hypotheses and claims that any single effect, such as gyroscopic or trail, is solely responsible for the stabilizing force have been discredited machine learning phase and embedded system we are proposing the system. This proposed system aimed to make a bicycle bot, powered by an electric motor, which could balance by itself and move along a particular path. The primary aim was to make the cycle balance on its own by controlling its handle. Machine learning phase and embedded system we are proposing the system. This proposed system aimed to make a bicycle bot, powered by an electric motor, which could balance by itself and move along a particular path. The primary aim was to make the cycle balance on its own by controlling its handle.

DESCRIPTION OF SYSTEM
Main components in proposed system are mainly divided into following section:

- Sensor-based-bicycle-state detection.
- PID controller for logic processing.
- Servo controller based bicycle handle controlling.

Figure 1.0 Reasearch methodology



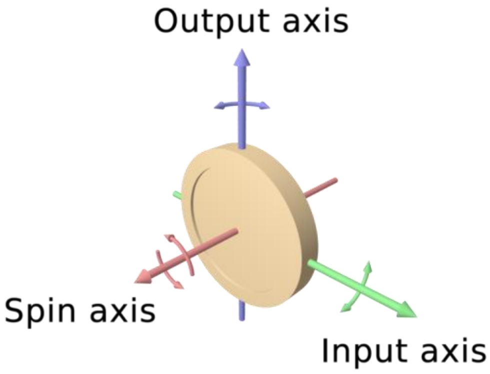


Figure 1.1 Gyroscope flywheel

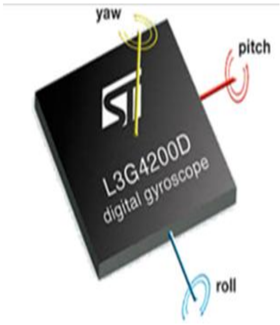


Figure 1.2 : 3 axis accelerometer

An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer. In proposed system it will help to get the travelling motion and also falling angle.

II. RELATED WORK

1: Balance Control of Two-Wheeled Self-Balancing Mobile Robot Based on TS Fuzzy Model
Application : To control more effective for self-balancing robot's balance model, has designed fuzzy controller based on the T -S fuzzy model with the parallel distribution compensator (PDC) the structure.
2: Using Design of Fuzzy Logic Controller for Two-wheeled Self-balancing Robot.

Application. Two-wheeled self-balancing robot is a high order,multiple-variables, non-linear, strong coupling, and instability system. On the basis of building up the system structure model, kinetic equation is built up by using Newton dynamics mechanics theory. After that, the pole placement state-feedback controller and fuzzy logic controller are both designed, both of which have good simulation curves at the same disturbance force. Finally,some simulation experiments be done in the undisturbed and disturbed environment respectively.
3. Dynamic Model and Balancing Control for Two-Wheeled Self-Balancing Mobile Robot -In this paper.The dynamic model was first established using Lagrange method, which was proved correct by the simulation results of its zero-state response and zero-input response. A set of balance equations were then obtained from the kinetic model, and the Lyapunov method was carried out to estimate its stability and controllability
4.LQR Control for a Self-balancing Unicycle robot-The non-linear dynamic equations of the unicycle robot on a slope are analyzed using the Lagrangian dynamic formulation, then a linear model of the robot is derived at the equilibrium point, and 3 linear quadratic regulators (LQR) are designed to control the robot on slopes with the angle of inclination.

III. BALANCING PROPOSED TECHNIQUES

Proposed system is mainly a wireless controlled two wheel bicycle with inbuilt capability to balance itself while driving at particular speed. To achieve this with machine learning phase and embedded system we are proposing the system. This proposed system aimed to make a bicycle bot, powered by an electric motor, which could balance by itself and move along a particular path. The primary aim was to make the cycle balance on its own by controlling its handle.

Figure1.3.-Bicycle-Balancing Technique

Figure describe the technique which can be used to balance the bicycle. Even when staying relatively motionless, a rider can balance a bicycle by the same principle. While performing a track stand, the rider can keep the line between the two contact patches under the combined center of mass by steering the front wheel to one side or the other and then moving forward and backward slightly to move the front contact patch from side to side as necessary. Forward motion can be generated simply by pedaling. Backwards motion can be generated the same way on a fixed-gear bicycle. Otherwise, the rider can take advantage of an opportune slope of the pavement or lurch the upper body backwards while the brakes are momentarily engaged.

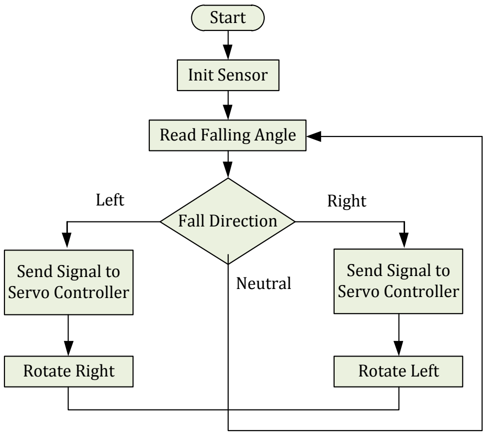


Figure1.4 : Flowchart

IV. OBJECTIVE

Challenges over controlling the bicycle: Balancing the two wheeler bicycle without support of any extra legs or wheels is one of the biggest challenges for human also from long time.

A bicycle remains upright when it is steered so that the ground reaction forces exactly balance all the other internal and external forces it experiences, such as gravitational if leaning, inertial or centrifugal if in a turn, gyroscopic if being steered, and aerodynamic if in a crosswind. Steering may be supplied by a rider or, under certain circumstances, by the bike itself.

One other way that a bicycle can be balanced, with or without locked steering, is by applying appropriate torques between the bike and rider similar to the way a gymnast can swing up from hanging straight down on uneven parallel bars, a person can start swinging on a swing from rest by pumping their legs, or a double inverted pendulum can be controlled with an actuator only at the elbow. A bicycle remains upright when it is steered so that the ground reaction forces exactly balance all the other internal and external forces it experiences, such as gravitational if leaning, inertial or centrifugal if in a turn, gyroscopic if being steered, and aerodynamic if in a crosswind. Steering may be supplied by a rider or, under certain circumstances, by the bike itself. This self-stability is generated by a combination of several effects that depend on the geometry, mass distribution, and forward speed of the bike. Tires, suspension, steering damping, and frame flex can also influence it, especially in motorcycles.

- Motor operated bicycle, Gyro meter sensor kit, Accelerometer Sensor Kit, AVR Development Board, ISP Programmer, LCD screen, Servo motor controller, Servo motors are hardware usein the project. The programming language used for development is ‘C’ (For Atmega16 Programming).

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V. CONCLUSOION

In this paper, we could see the self-balancing techniques based on by maintaining the center of gravity ,done by controlling falling angle based on proportional-integral controller (PID).

A bicycle remains upright when it is steered so that the ground reaction forces exactly balance all the other internal and external forces it experiences, such as gravitational if leaning, inertial or centrifugal if in a turn, gyroscopic if being steered, and aerodynamic.This self-stability is generated by a combination of several effects that depend on the geometry, mass distribution, and forward speed of the bike. Tires, suspension, steering damping, and frame flex can also influence it,especially in Bicycle.If the steering of a bike is locked,it becomes virtually impossible to balance while riding. On the other hand, if the gyroscopic effect of rotating bike wheels is cancelled by adding counter-rotating wheels, it is still easy to balance while riding. One other way that a bicycle can be balanced, with or without locked steering, is by applying appropriate torques between the bike and rider similar to the way a gymnast can swing up from hanging straight down on uneven parallel bars, a person can start swinging on a swing from rest by pumping their legs, or a double inverted pendulum can be controlled with an actuator only at the elbow.

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