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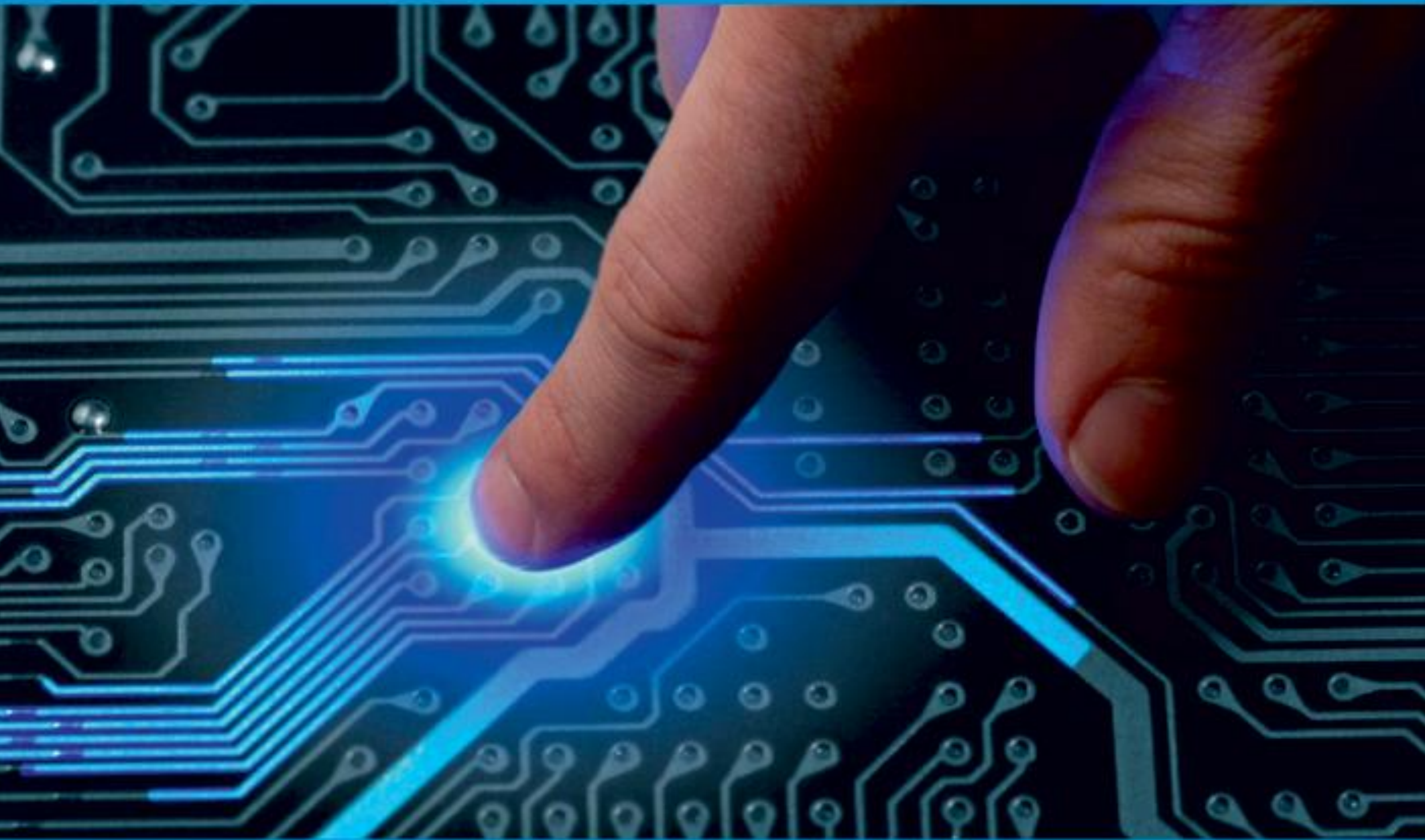

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Self Balancing Bicycle

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ABSTRACT: The project Self-Balancing Bicycle The Self-Balancing Bicycle Project is a groundbreaking endeavour aimed at revolutionising the world of urban transportation. This project seeks to develop an innovative, two-wheeled solution that incorporates cutting-edge sensor technology and control systems to achieve autonomous balance. The core concept revolves around advanced components such as the MPU6050 sensor, Node mcu, L293D motor driver, servo motor, transistors, N20 motor, DC motor, LM7805 voltage regulator, and batteries, all or- chest-rated through a comprehensive control algorithm. The primary objective of this project is to enhance rider safety and promote inclusivity by reducing the risk of falls and accidents, particularly for those with limited cycling experience. Furthermore, it strives to provide a convenient and eco-friendly last-mile solution in congested urban areas, thereby addressing the challenges of urban mobility. The motivation behind this project is the belief in the transformative potential of accessible and safe transportation. It envisions a future where cycling is a joy accessible to everyone, regardless of age, experience, or physical challenges. The project not only promotes health and wellness but also aligns with the goals of sustain- ability and smart cities. The self-balancing mechanism integrates sensors, control algorithms, and actuators, working together to detect the bicycle’s orientation and make real-time adjustments to maintain stability. User input is also taken into account to create a seamless and enjoyable cycling experience. The Self-Balancing Bicycle Project is more than just a mode of transportation; it’s a step towards a safer, more inclusive, and sustainable urban landscape. Through this project, we are committed to harnessing technology for positive change in our communities, fostering confidence in riders, and reducing the environmental impact of transportation. The successful implementation of this project promises to be apioneering achievement, demonstrating the seamless integration of advanced technology into the realm of autonomous urban mobility. The self-balancing bicycle showcases innovation, promotes health, and holds the potential to redefine the way we navigate our cities.

KEYWORDS: Self Balancing Bicycle, Node MCU, Sensors, Gyro sensors, Safety System, Ease to use, Accelerometer, Wheel Motor.

I. INTRODUCTION

The” In a world driven by innovation and the growing need for sustainable urban transportation, the Self-Balancing Bicycle Project embodies visionary progress. Our core mission is to transform traditional bicycles into cutting-edge, self-balancing marvels, prioritising safety and inclusivity. Traditional bicycles, while beloved, pose stability and safety challenges, especially for novices, the elderly, and those with physical limitations. Urban environments exacerbate these issues. The project leverages advanced sensor technology, microcontrollers, and a sophisticated control algorithm, uniting components like the MPU6050 sensor, Node-mcu, L293D motor driver, servo motor, transistors, N20 motor, DC motor, LM7805 voltage regulator, and batteries for autonomous equilibrium. Our objectives encompass enhancing rider safety, promoting inclusivity, and advancing urban transportation solutions.

Imagine a two-wheeled vehicle that glides effortlessly, defying gravity’s pull and main- raining its upright stance eve when the rider takes their hands off the handlebars. This marvel of engineering is the self-balancing bicycle, a revolutionary mode of transportation that stands poised to transform urban mobility and redefine our perception of personal conveyance. At the heart of a self-balancing bicycle lies a sophisticated interplay of sensors, actuators, and algorithms. Embedded gyroscopes and accelerometers continuously monitor the bicycle’s orientation, detecting even the slightest deviations from a vertical position. This real-time data is fed into an intelligent control system, which initiates precise adjustments using powerful motors located in the wheels or handlebars. These adjustments, imperceptible to the rider, counteract any imbalances, keeping the bicycle gracefully balanced and stable. The result is a riding experience that transcends the challenges of traditional bicycles. No longer must riders grapple with the art of balancing, their hands glued to the handlebars. Instead, they can enjoy the ride, manoeuvring the bicycle with intuitive movements, their focus on the surrounding environment rather than the precarious act of maintaining equilibrium. This newfound freedom of handling extends to navigating crowded sidewalks, traversing uneven terrain, and even executing smooth turns. The self-balancing bicycle adapts seamlessly to varying conditions, ensuring a smooth and enjoyable

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ride. Beyond its groundbreaking riding experience, the self-balancing bicycle offers a host of practical advantages. Its inherent stability makes it accessible to a wider range of riders, from novices to those with limited mobility. The absence of complex balancing manoeuvres reduces the risk of accidents, making it a safer option for both riders and pedestrians.

Motivation

The Self-Balancing Bicycle Project stems from a deep-seated belief in the transformative potential of accessible and safe transportation. Recognising the universal need for a mode of travel that empowers individuals of all abilities, this project aspires to revolutionise the way we approach urban mobility. The quest for safer, more inclusive cycling experiences drives our commitment. We envision a future where the joy of cycling is attainable for everyone, regardless of age, experience, or physical challenges. By harnessing cutting-edge technology, we aim to break down barriers and in still confidence in riders, young and old. Furthermore, in an era where sustainable transportation solutions are paramount, the self-balancing bicycle stands as a beacon of eco-conscious progress. Its potential to seamlessly integrate into existing transit networks presents a viable alternative to conventional modes of travel, reducing congestion and environmental impact. The Self-Balancing Bicycle Project embodies our dedication to innovation and the belief that technology can be a force for positive change in our communities. We are driven by a shared vision of a more accessible, safer, and sustainable urban landscape, and we embark on this journey with passion, determination, and a commitment to making this vision a reality.

II. LITERATURE REVIEW

Authors: Deng, W., Moore, S., Bush, J., Mabey, M., Zhang, W. Journal Year: Dynamic Systems and Control Conference, 2018

The study focuses on dynamics and control systems. It employs mathematical modelling and control algorithms to maintain balance. This research provides in-depth insights into the mathematical models and control algorithms used to achieve balance in self-balancing bicycles. It contributes to the theoretical foundation of our project. The challenges mentioned include the need for precise sensor data and complex control algorithms to ensure stability.

The paper highlights various smart water management strategies, such as demand- side management, real-time monitoring, and leakage detection. These strategies aim to optimise water usage patterns, identify and address leaks promptly, and adapt to changing water demands and climate conditions.

The authors also address the challenges associated with implementing smart water management systems. The high initial investment required for infrastructure upgrades and the specialised technical expertise needed for system operation are significant hurdles. Additionally, ensuring data security and protecting sensitive information collected by these systems is crucial.

Authors: He, J., Zhao, M. Journal Year: Proceedings of the 2015 Chinese Intelligent Automation Conference The research primarily explores intelligent automation systems and control algorithms while not specific to bicycles, this research provides insights into control algorithms and sensor technologies that can be adapted for self-balancing bicycles. It broadens the understanding of control systems.

Challenges may include adapting the presented control methods to the bicycle’s specific requirements.

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III. METHODOLOGY

A. Traditional methodology

Figure 6. Traditional Methodology

Traditional bicycles, also known as standard bicycles, are human-powered, two-wheeled vehicles that have been around for centuries. Here's a detailed overview of their key components and uses:
Frame: The frame is typically made of steel, aluminium, carbon fibre, or titanium. It provides the structural support for the bicycle.
Wheels: Most traditional bicycles have two wheels with pneumatic tires filled with air for shock absorption and traction.
Handlebars: These are the horizontal bars attached to the stem at the front of the bicycle. They provide the rider with steering control.
Saddle: Also known as the seat, the saddle is where the rider sits. It's usually adjustable in height to accommodate different riders.
Drivetrain: This consists of the pedals, crankset, chain, cassette (or freewheel), and derailleurs (if present). The rider uses the pedals to turn the crankset, which rotates the chain and propels the bicycle forward.
Brakes: Traditional bicycles typically use rim brakes or disc brakes for stopping power. Rim brakes apply pressure to the wheel rims, while disc brakes use a rotor attached to the wheel hub.
Gears: Most bicycles have multiple gears, controlled by shifters, to make it easier to pedal uphill or to go faster on flat terrain.
Uses of traditional bicycles include:
Transportation: Bicycles are commonly used for commuting to work or school, running errands, and getting around town due to their affordability and eco-friendliness.
Recreation: Many people enjoy riding bicycles for leisure, whether it's a casual ride around the neighbourhood or a more adventurous mountain biking excursion.
Exercise: Cycling is an excellent form of cardiovascular exercise that also helps strengthen leg muscles and improve overall fitness.
Competitive Sport: Cycling competitions range from road racing and track cycling to mountain biking and BMX racing, providing opportunities for athletes to compete at various levels.
Touring: Bicycle touring involves traveling long distances by bike, often camping along the way. It's a popular way to explore new places and experience the outdoors.
Overall, traditional bicycles are versatile vehicles that serve a variety of purposes, from practical transportation to recreational pursuits and competitive sports.

B. Proposed Methodology

Self-balancing bicycles typically work based on the principle of gyroscopic precession and the conservation of angular momentum. These bicycles are equipped with gyroscopic stabilization systems, which utilize spinning wheels to create angular momentum. When the bicycle tilts to one side, the gyroscopic effect causes a torque that counteracts the tilt,

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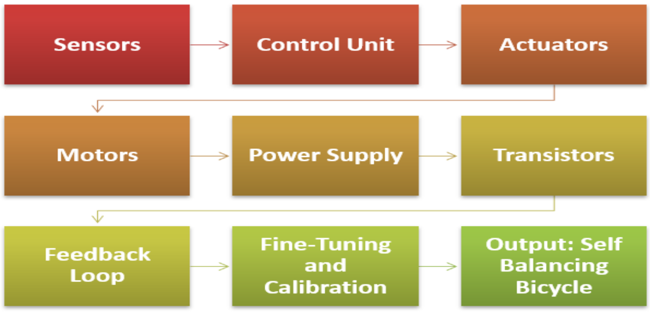
helping to maintain balance. Additionally, the conservation of angular momentum ensures that the system remains stable as long as there are no external torques acting upon it.



Flow Chart Explanation:
Start the program
Then we initialise node MCU, L293D driver, N20 motor, MPU6050 sensor, DC motor
Connect battery
Sensor MPU6050 will read the data.
Node MCU will process sensor data using control algorithms and calculate required adjustments for balancing
send control signals to motors
Continuous feed back loop for maintaining data
If any deviations occurs adjust motors motors out to correct balance
Check for stop exit process.

Block Diagram

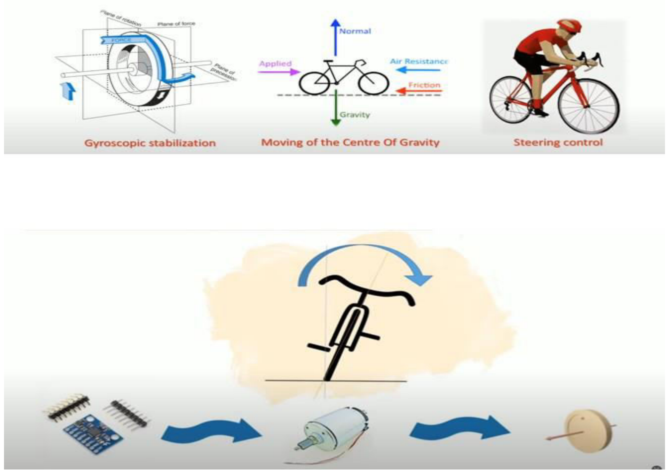


Figure 9. Block Diagram

Block Diagram Explanation:
A self-balancing bicycle, also known as a ”balancing robot” or ”self-balancing scooter,” uses a combination of sensors, control algorithms, and actuators to maintain its balance while in motion. Here is a simplified explanation of how it works:
Sensors: The bicycle is equipped with sensors, typically gyroscopes and accelerometers that measure the tilt and orientation of the vehicle in realtime Microcontroller: These sensors transmit data to a microcontroller (like an Arduino, Rasp- berry Pi, or specialised control board) which processes this information quickly.

Control Algorithms: The microcontroller employs control algorithms, often a PID (Proportional- Integral-Derivative) controller, to analyse the sensor data. It calculates necessary adjustments to keep the bicycle balanced.

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Actuators: Based on the calculations from the control algorithms, the microcontroller commands actuators, usually electric motors or servos, to adjust the position of the wheels or other stabilising components.

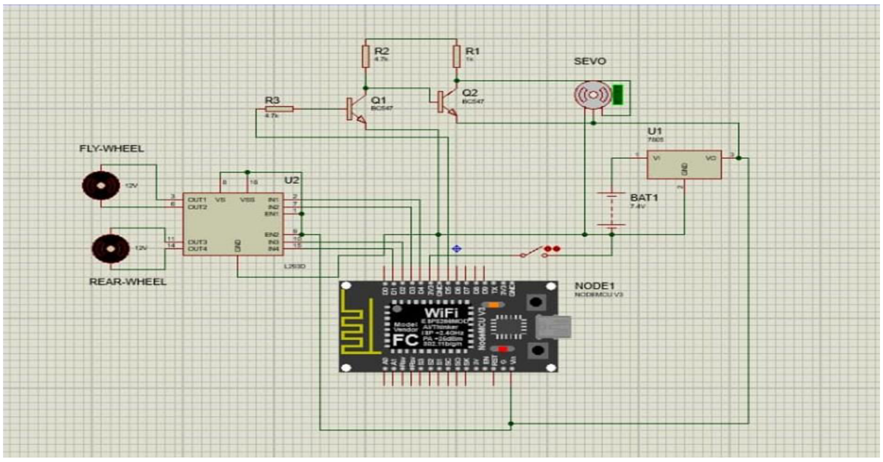
Balancing Corrections: If the bicycle begins to lean in one direction, the control system instructs the motors to counteract the lean and bring the bicycle back to a balanced position.

User Input: In most self-balancing bicycles, the rider provides input through handlebars or a control interface. These inputs are also taken into account by the control system to make necessary adjustments.

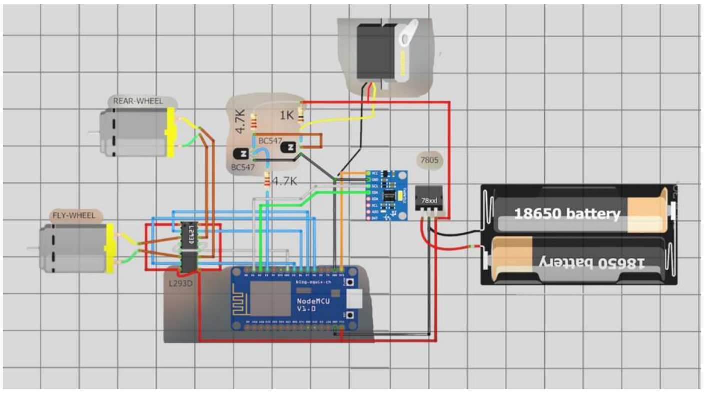
Feedback Loop: The process of sensing, processing, and actuating occurs in a continuous feedback loop. This allows the bicycle to make rapid adjustments to maintain balance.

Fine-tuning and Calibration: The system may require initial calibration and fine-tuning to adapt to specific conditions or rider preferences

IV. ANALYSIS AND APPROACH



V. RESULT



PROTOTYPE

IMPACT / BENEFITS

Focus on stability: The primary goal of a self balancing bicycle is to maintain its balance even when the rider leans or the terrain is uneven. This requires careful design and implementation of the sensors, actuators, and control algorithms.

Ensure stability under various conditions: The bicycle should be able to maintain its balance even in the presence of external disturbances, such as wind gusts or sudden changes in speed.

Consider user comfort and safety: The bicycle should be comfortable and easy to ride, and it should have features that enhance the rider's safety.

Optimise performance and efficiency: The bicycle should be lightweight, energy efficient, and capable of operating for extended periods on a single charge.

VI. CONCLUSION

The self-balancing bicycle project successfully demonstrated the integration of sensors, control algorithms, and actuators to maintain balance. Fine-tuning and calibration were em- ployed for optimal performance. This project enhanced skills in electronics, programming, and mechanics, showing promise for future improvements and applications.

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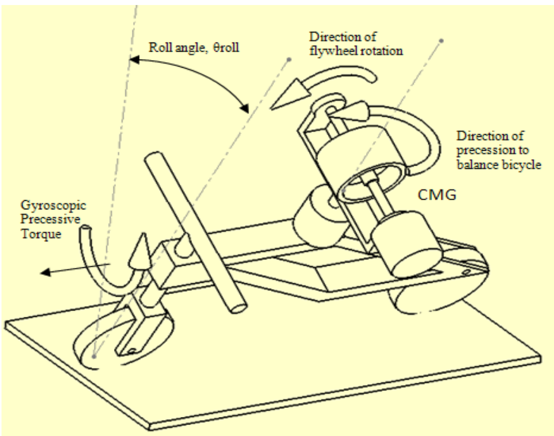
It gives us great pleasure in presenting the project report on 'Self Balancing Bicycle'. We would like to take this opportunity thank our internal guide Mr. B.N.Rajole for giving us all the help and guidance we needed. We are really grateful to them for their kind support. Their valuable suggestions were very helpful. We are grateful to Dr. V. M. Birari, Head of Electronics and Telecommunication Engineering Department, Maratha Vidya Prasarak Samaj's Karamveer Adv. Baburao Ganpatrao Thakare College of Engineering, Nashik-13 for his indispensable support and suggestions. We are also grateful to Management of Maratha Vidya Prasarak Samaj, Nashik and Respected Principal Dr. S. R. Devane for providing all necessary facilities and sup- ports to complete our project within stipulated period. We are also grateful to Vice-Principal, Project Coordinator, all teaching and non-teaching staff for their valuable



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