NEW HORIZON
COLLEGE OF ENGINEERING
New Horizon Knowledge Park, Ring Road, Marathalli
Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

Outer Ring Road, Bellandur, Bengaluru – 560103

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

20EEL68 Mini Project IV

Report on

Autonomous Automobile Project (AMP)

Submitted in the partial fulfilment of the VI Semester Mini Project

Submitted by

Dayas A Dixen 1NH20EE029

Dony Snehit P 1NH20EE035

Dheeresh V D 1NH21EE402

Under the Guidance of

Mr. Kartheek Vankadara

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"Jnana Sangama", Belgaum: 590018

2022-23

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CERTIFICATE

Certified that the Mini Project work entitled **"Autonomous Automobile Project (AMP)"** carried out by **Dayas A Dixen (1NH20EE029), Dony Snehit P(1NH20EE035), Dheeresh V D(1NH21EE402)** Bonafide Student(s) of New Horizon College of Engineering submitted the report in the partial fulfilment for the award of Bachelor of Engineering in **Department of Electrical and Electronics Engineering, New Horizon College of Engineering** of Visvesvaraya Technological University, Belgaum during the Year 2022-23.

It is certified that all the corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the department library. The mini project report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for said Degree.

Name & Signature of the Project Guide	**Name & Signature of Head of the Department**
Kartheek Vankadara Assistant Professor	Dr.Sujitha.S HoD EEE Department

SEMESTER END EXAMINATION

Internal Examiner **External Examiner**

ACKNOWLEDGEMENT

we take this opportunity to convey our gratitude to all those who have been kind enough to offer their advice and provide assistance when needed which has led to the successful completion of the project.

We are grateful to the Chairman of New Horizon Educational Institution, **Dr. MOHAN MANGHNANI** for providing us with infrastructural facilities and many other resources needed for our project. we would like to express our immense gratitude to our principal, **Dr. MANJUNATHA** for motivating us to carry out research at the NHCE and **Dr. SUJITHA.S**, Head of the department for their constant support and motivation that has encouraged us to come up with this project and also for providing the right ambience for carrying out the work and the facilities provided to us.

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We wish to thank all the faculty of Electrical and Electronics Engineering department for providing required support throughout the project.

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20EEL68 Mini Project IV

DECLARATION

We, **Dayas A Dixen (1NH20EE029), Dony Snehit P (1NH20EE035), Dheeresh V D (1NH21EE402),** students at New Horizon College of Engineering hereby declare that this project work entitled **"AUTONOMOUS AUTOMOBILE PROJECT (AMP)"** is an original and bonafide work carried out by us at New Horizon College of Engineering in partial fulfillment of Bachelor of Engineering in Electrical and Electronics Engineering of Visvesvaraya Technological University, Belgaum.

We also declare that, to the best of our knowledge and belief, the work reported herein does not form part of any other thesis or dissertation based on which a degree or award was conferred on an earlier occasion by any student.

Dayas A Dixen	**1NH20EE029**	**[**	**]**
Dony Snehit P	**1NH20EE035**	**[**	**]**
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CERTIFICATE

Certified that the Mini Project work entitled **"Autonomous Automobile Project (AMP)"** carried out by **Dayas A Dixen (1NH20EE029), Dony Snehit P (1NH20EE035), Dheeresh V D (1NH21EE402),** a bonafide student(s) of New Horizon College of Engineering in partial fulfilment for the award of **Bachelor of Engineering** in Electrical and Electronics Engineering of the Visvesvaraya Technological University, Belgaum during the year 2022-2023. It is certified that they have completed the project satisfactorily.

Name & Signature of the Project Guide	**Name & Signature of Head of the Department**
Mr.Kartheek Vankadara Assistant Professor	Dr.Sujitha.S HoD EEE Department

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3	Course	UG
4	Department	EEE
5	Mini Projects/Project Reports/ Ph.D Synopsis/ Ph.D Thesis/ Paper Publication (N/I)	Mini Project – IV Report
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We have verified the contents as summarized above and certified that the statement made above are true to the best of our knowledge and belief.

Ms.Anitha.A
Plagiarism - Coordinator

Dr.Sujitha.S
HOD - EEE

20EEL68 Mini Project IV

PROJECT IMAGES

PROJECT TITLE:

AUTONOMOUS AUTOMOBILE PROJECT (AMP)

Dayas A Dixen 1NH20EE029

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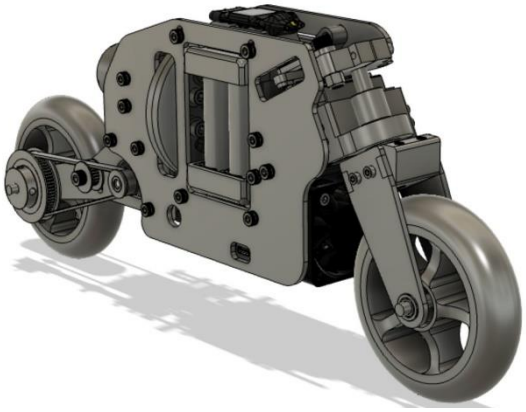
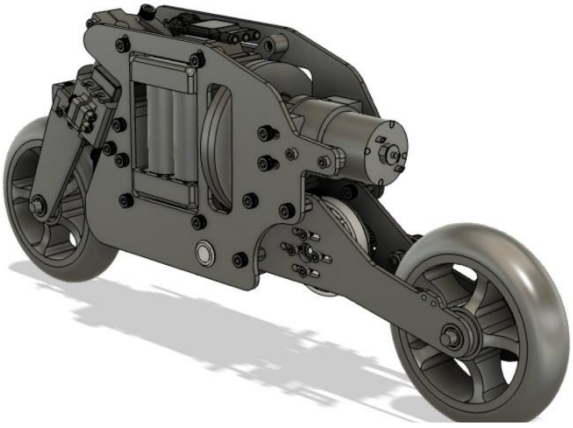
Under the Guidance of

Mr. Kartheek Vankadara.



Front View



Rear View

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Abstract

Bicycles, bikes and other two-wheeled vehicles are abundant and serve a crucial function in mobility, making them an important component of basic human requirements. The transportation vehicles produced today haven't changed much in a long time, thus someone is always needed to ride them or balance them. In the complex system of transportation, a two-wheeled vehicle's stability is crucial, yet in accidents that occur all throughout India, a two-wheeler's lack of stability has been a serious problem. Compared to a four-wheel vehicle, balancing a two-wheel vehicle is challenging. Compare the mechanism for building an Inline two-wheel electric bike that can balance itself via the assistance of a gyroscope and learn how to make transportation much safer and prevent accidents, which discusses the design and analysis of a self-balancing model two-wheeler using the concept of gyroscopic precession. With gyroscope concept, it is also possible to balance a bike on a two-wheeler without the assistance of a person. Gyroscopes have a large number of uses, from balancing massive ships to space transport. Vehicles that are gyroscopically stabilised are safer than standard two-wheelers. The main concept is that a stabilising moment is produced by actively controlling the gyroscope's motion in relation to the body. The autonomous bike would be powered by a BLDC motor and a servo for steering control, and it would include a control system to prevent itself from tumbling over when it was still parked or moving. Building a bike prototype that can balance itself using a reaction wheel is the primary objective. The vehicle takes data from the MPU-6050 sensor, calculates the tilt angle, and responds appropriately to maintain a vertically upright stance on its two wheels to maintain self-balance.

Aim

The primary goal is to ensure the safety of the person riding the vehicle. The benefits of this project are, rider can balance the vehicle and prevent them from falling or having accidents. Due to how difficult it is to control the clutch mechanism and balance it during the time of traffic which plays a vital role.

Objective

- Autonomous Automobile Project (AMP) is a useful strategy for reducing the usage of fossil fuels.
- It increases the vehicle's stability.
- It lowers the number of accidents brought on by poor balance.
- It reduces the energy lost by people in traffic.
- It reduces carbon emissions.

Introduction

From Statistics, it can be observed that more than 150 accidents related to motorcycles happen on a daily basis according to the MRTH (Ministry of Road Transport and Highways). The rider loses their balance due to changing road conditions, casual and rash driving, drinking and driving, speeding and overloading, are the major reasons for these accidents. So, improving the stability of the vehicle is the prime area to focus on and self-balancing bikes are one of the most awaited technologies right now. Vehicles that run on fossil fuels are primarily to blame for the carbon emissions. Nowadays, the majority of cars are electric and include a wide range of safety measures. On the other hand, due to lack of innovation in the field of manufacturing motorcycle, we are still lacking behind when it comes to rider safety. The fix is to develop a self-balancing bike that works on the gyroscope concept so that the rider isn't concerned about losing the balance of the bike and falling. The goal is to create an autonomous balance motorbike that doesn't require human intervention. As the bike balances itself with the help of a gyroscope and some other sensors, it is also safe for people who have certain disabilities. Our system will comprise a gyroscope and a few other sensors that can gauge the motorbike's present tilt and regulate the rotation of the flywheel according to the vehicle's balance. It has the ability to provide large amounts of torque with a faster response by gyroscopic effect. It is simply a two-wheeled vehicle which balances itself even in its initial position. Use of reaction wheels for maintaining the bike’s centre of gravity by generating a counterforce as opposed to the angle of tilt of the bike. Autonomous 2-wheeled vehicles could provide balancing assistance without affecting the experience of riding a bike and this could provide great benefit. The aim of this project is to balance a bike on two wheels. This self-balancing bike model can move forward and backward in accordance with the user using relatively easy commands.

Literature Review

To gain a comprehensive understanding of the many methods by which the bike is self-balanced, several research articles were carefully read. The information is condensed and the reaction wheel is investigated, and the bike is built to balance with or without the rider. It will use a control mechanism that prevents the bicycle from tipping over in both stationary and moving situations. The robot needs an IMU sensor to keep its equilibrium by calculating the angle of tilt and responding.

Methodology

Gyroscope:

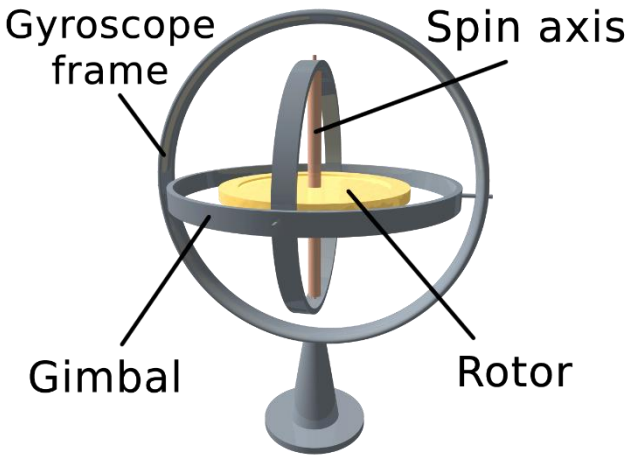

Figure 1

A spinning wheel or disc known as a gyroscope allows the rotational axis to freely in any direction. Consider a body that is spinning on an axis. If we apply an acceleration perpendicular to the axis of spin, the body will experience an angular acceleration about a third perpendicular axis. This is called gyroscopic motion and this acceleration's necessary torque is known as gyroscopic torque.

Principles of Gyroscope:

- 1st Law of Gyroscope: "If a rotating wheel is so maintained as to be free to move about any axis passing through its centre of mass, its spin axis will remain fixed in space."
- 2nd Law of Gyroscopes: "When a torque acts on a spinning mass with an axis perpendicular to that of spin, then the latter will process about an axis perpendicular to both aforementioned axes, at an angular velocity, Ω, = $T/I\omega$."

Gyroscopic Effect:

For the disc to process in the horizontal plane, the active gyroscopic couple which stands for the rate of change of angular momentum must be applied across the spin axis. Reactive gyroscopic coupling is applied to the shaft on which the disc is placed when the axis of spin processes itself or is caused to process. The gyroscope has now created a reactive gyroscopic pair that is equivalent to the external disturbance but is moving in the other direction. This pair stabilises the item and cancels out the influence of the disturbance. **(Active couple) = - (Reactive couple)**

Block Diagram

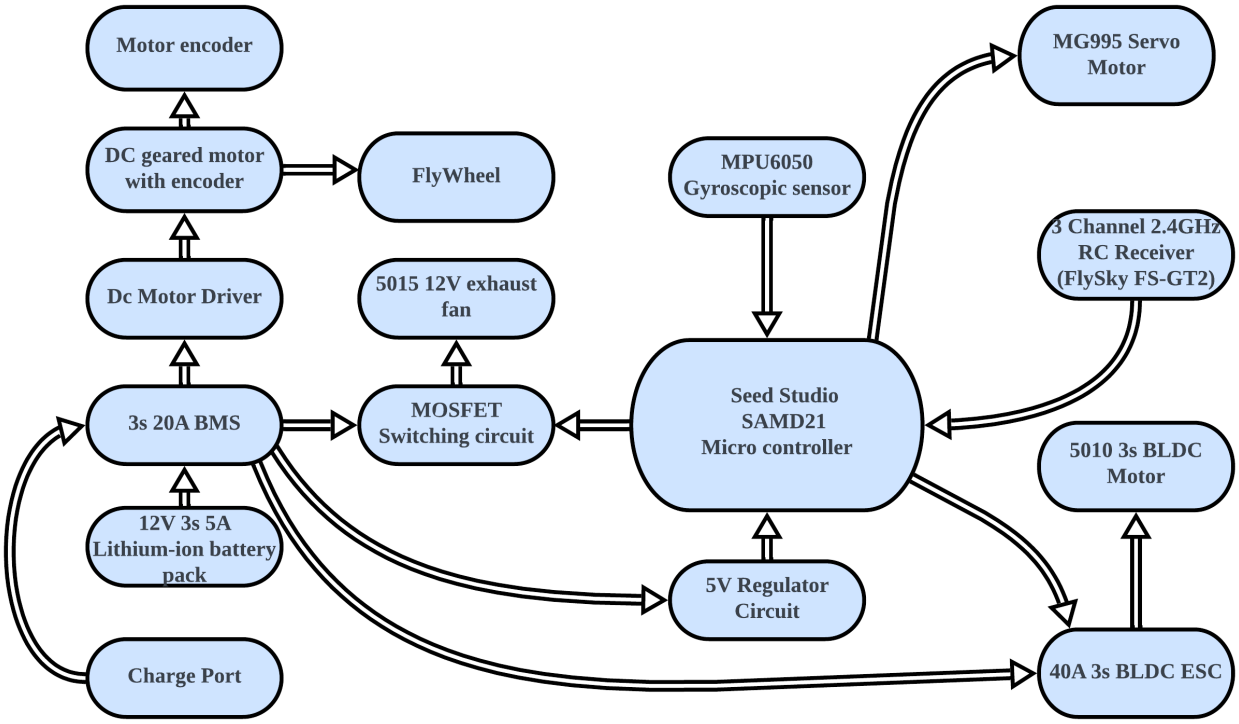

Figure 2

Model / Construction

The model was created using the FUSION360, to achieve self-balancing, the bike's major component, the flywheel, must have a significant moment of inertia and spin at a fast speed. The frames connecting the wheels were composed of 3mm aluminium, while the wheels themselves were made of rubber. All of the component elements, including the flywheel, motors, supports, and frame, are sketched before being joined to create the final product.

Steering Mechanism:

Figure 3

The steering mechanise is done using Servo motor. The case of the servo motor is 3D printed with the material called Polyethylene terephthalate glycol (PETG), it is a thermoplastic polyester commonly used in manufacturing. The spokes of the front wheel are made of 2 plates of Aluminium of dimension 3mm. The screws are fixed by using “Heat Threaded Inserts”. The front wheel is made of rubber and the dimension is of 100mm.

Figure 4

Battery Pack:

The cells utilized are of litium-ion 18650 of rating 3.7V and 2500 mAh. The manufactures of this cells is a company called orange. We are using 6 cells in this project and we are connecting 2 cells in prarallel of 3 sets and those 3 sets are connecting in series. The top rating of this cells after connecting is 11.1V and 5000 mAh. The cell holder which gives a mechanicals support to the cells is designed and then 3D printed. The cell holder is mounted to the main body with the help of 8 screws of dimension M4.

Reaction Wheel:

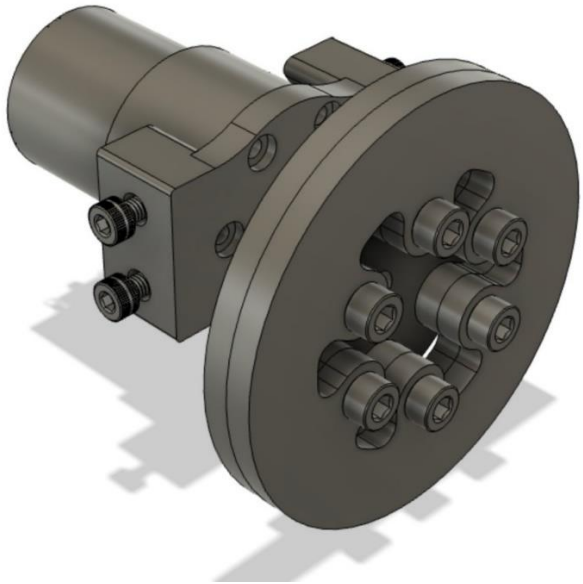

Figure 5

The reaction wheel is made if mild steel and is connected to a DC motor of rating 12Vand 1000 rmp with an encoder. The rear wheel and a 5010 BLDC motor is connected with pulley and belt mechanism. The back wheel has 60 tooth and the pulley has 20 tooth so the ratio of back wheel to the pulley is 1:3. The pulley is of GT2 series it is generally used for linear motion. The motor has a sliding mechanise for sliding of the belt. The motor is mounted by M4 standoffs.

Body:

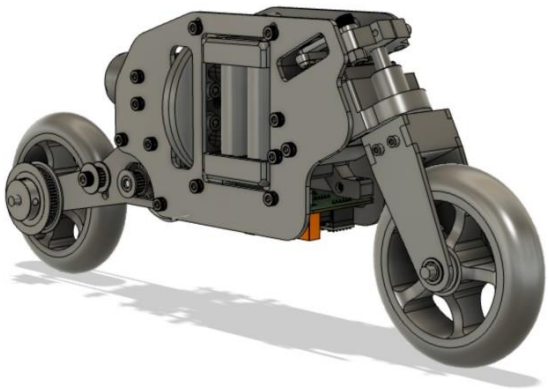

Figure 6

The external frame is of 2 pieces of lazer cutted parts which are of aluminium and the dimension is of 3mm.

PCB:

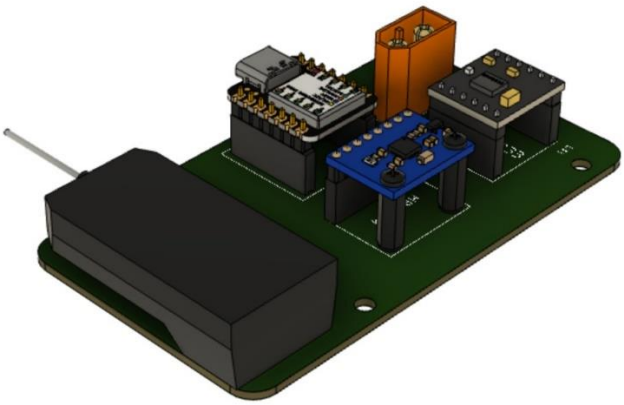

Figure 7

The PCB was designed and sent for printing. The PCB is placed at the bottom of the bike. It consistes of three components, they are :

- MPU 6050 is a six axis gyroscopic sensor and accelerometer, also a motion tracking sensor.
- DRV 8833 is a device which provides a duel bridge motor driver. It has 2 H-bridge drivers and can drive 2 DC brush motors, a bipolar steper motor, solenoids and etc.
- SAMD21 it is a ARM based microcontroller with low power and high performance.

Hardware

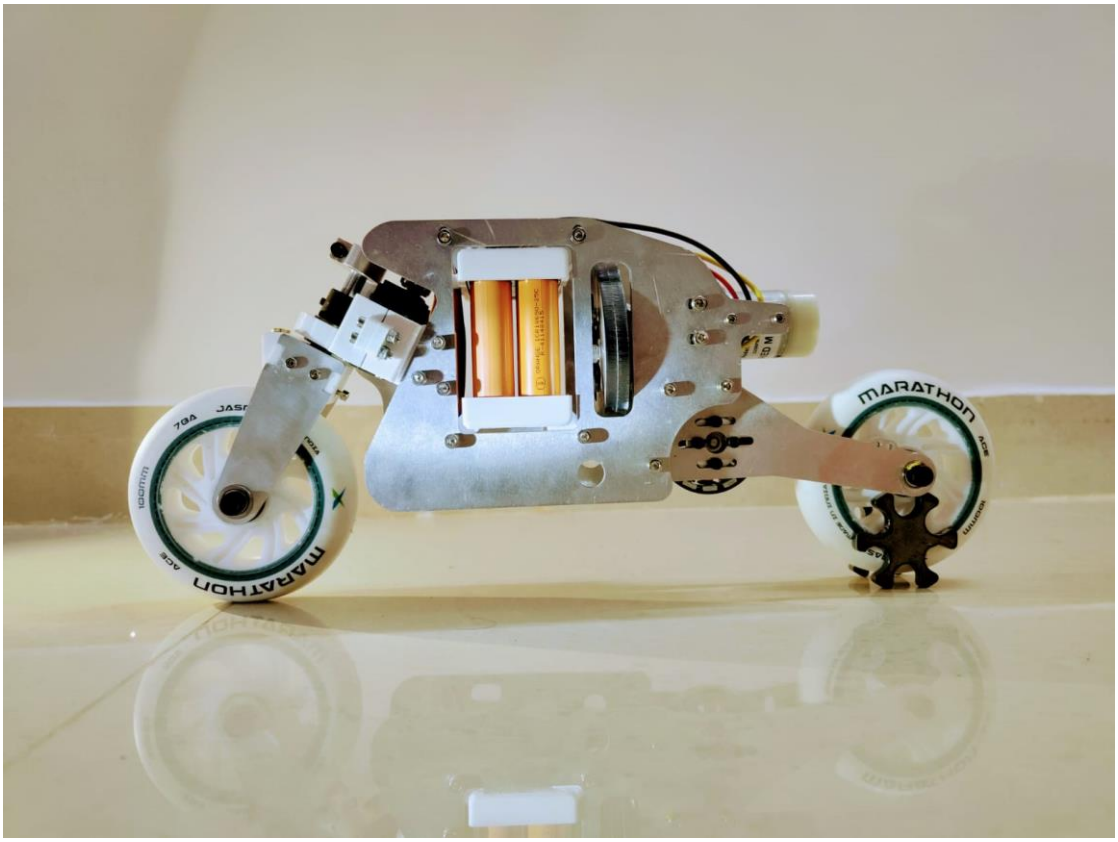

Figure 8

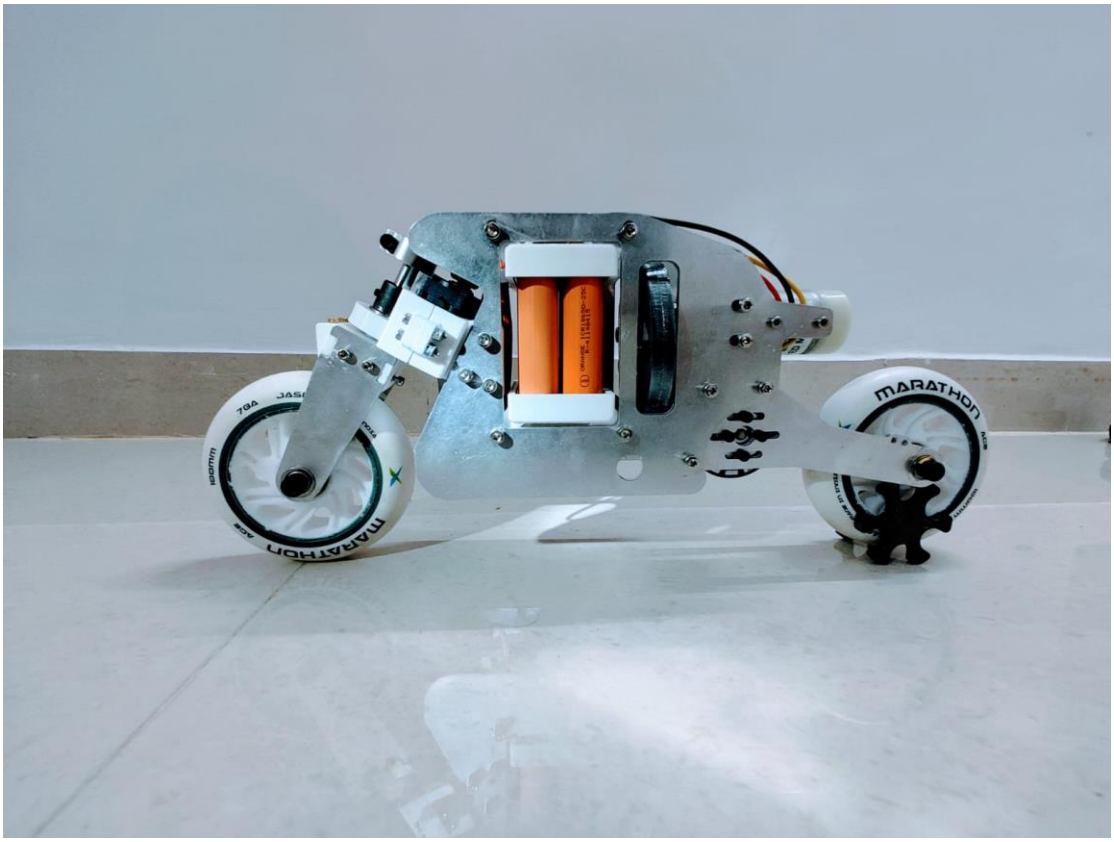

Figure 9

Conclusion

The design and construction of a two-wheeled self-balancing vehicle are presented. This vehicle, which can balance itself while being subjected to loads and external forces, can be used for personal transportation and is one of the safest varieties of two-wheeled vehicles. To balance the bike around its axis and to achieve good stability, the simplest PID controller is used. A self-balancing bike would be an ideal solution in such situations as it may encourage people to switch to self-balancing two wheelers and further there would be many research & design optimisations to develop a pollution free and environment friendly e-bike. Many campus environments also experience traffic congestion and parking difficulties. Thus, a self-balancing two-wheeler that requires the flywheel to spin for balance was developed. This may be very useful for two-wheeled vehicles by lowering accidents or unintentional falls and enhancing rider safety. This method both minimises human labour requirements and creates environmentally favourable conditions.

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