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Effortless Personal Transporter

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Abstract: ***Thispaper deals with the construction of a personal transporter at a very low cost, high efficient rate and easy to handle. It will eventually be widely used and accepted as a form of transportation. This effortless personal transporter is one of the several low speed transportation devices that, under certain circumstances, travel on sidewalks, roadways, and other shared-used paths. It will be more economical and accessible to people in their day to day life. In this paper, we present an effortless Segway based onself balancing mechanism using Accelero-Gyro sensor (IMU MPU6050) along with a microcontroller (Arduino Uno) and use of mechanical and electrical hardwares. This Segway is absolutely eco-friendly mode of transport which causes zero pollution. The main objective is to build a vehicle capable of transporting a person weighing upto 70 – 80 kg and capable of travelling some km distance with varying speed. The design of effortless personal transporter is such that it covers less space and gives more comfort to the user.***

Keywords: Segway, Accelero – Gyro Sensor, Arduino UNO, Microcontroller

I. INTRODUCTION

A Segway is a two-wheeled vehicle which was introduced by Dean.L. Kamen in 2001.It can self-balance itself as well as the weight of the rider. It is provided with a control handle bar, vertical to the platform, which is pushed front or pulled back and accordingly the motion of the segway is noticed. This device is primarily driven by the dynamics of the rider either forward or backward. This is an eco-friendly mode of transport for short distances since no fuel is consumed and rechargeable batteries are used. A Segway consumes very less space and helps reduce the extreme traffic to quite some extent. In our paper, the prototype demonstrates the mechanism of the segway by balancing itself. A rider's motion makes changes in the angle of inclination of the device which is sensed by the MPU 6050 and sends the data to the arduino which in turn controls the motion of the Segway. For the rider's convenience, we have also introduced remote sensing, implementing it using the HC – 05 from a certain distance.

The rest of this paper organized as follows; Section 2 describes the identification of the problem and offers solution. Section 3 describes the mechanical and electrical components of the model. Section 4 presents the working principle of the model. Finally in section 6 conclusion and reference section for future work are presented.

A. Self Balancing Mechanism

Self-balancing mechanism is a mechanism by which a system achieves and maintains a steady state by internal forces. It is capable of achieving equilibrium or equality of its element by processes inherent within it. Initially, the equilibrium state is achieved by inverted pendulum but nowadays various stages of developments are made.

II. PROBLEM IDENTIFICATION AND SOLUTION

A. Problem identification

We have identified that, in many industries, the workers and supervisors face the problem of getting tired very soon due to various reasons. Due to their tiredness, they can't work effectively and efficiently. They lose concentration and fail many times. The major reason of being tired is due to their travelling within and also outside the department areas.

B. Solution

To solve this problem, we came up with an idea to reduce their travel time and do the work with ease. This lead us to come out with a solution called personal transporter (Segway). By using this segway, the supervisors and quality crackers can do their work effectively and efficiently. In 2011, the Segway was being marketed to the emergency medical services community. In 2018, the police of Stockholm adopted Segways as permanent transportation method for the patrollers of the old town. Thus, Segway can be used as a solution in various ways.

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III. DESCRIPTION OF COMPONENTS

A. Mechanical Components

The major mechanical components are base plate, handle bar, shafts and bearings, wheels and safety wheels.

B. Electrical & Electronically Components

The major electrical components are motor, Arduino Uno, L298N motor controller, IMU (MPU 6050), battery and wires.

IV. MECHANICAL COMPONENTS

A. Base Plate

In manufacturing of our segway, the initial step is making a strong base plate. Base plate is the part which has to be designed in a such a way so as to withstand all load types. So it is the strongest part of our segway. It is made up of mild steel which is machinable and weldable . The grade of steel used to manufacture the base plate is FE330 (IS3589).

B. Handle Bar

In most of the vehicles, handle bar will act like a steering system. Our segway runs on various control systems attached to it. These control systems are attached to the handle bar so that the rider can control the segway easily. Our handle bar is made up of stainless steel which is a high corrosive resistant one, has light weight and more life. The grade of steel used to manufacture handle bar is Grade 304 (Stainless steel).

C. Shafts and Bearings

Shafts and bearings play a major role in controlling the operation of segway. They are the essential one because shafts are used to transmit power from one part to another and bearings are used to reduce friction between moving parts. It also helps in the safe operation of mechanical parts used in segway. The shafts used here are made up of carbon steel and the bearings are SKF 6205.

D. Wheel

A wheel is a disc or circle shaped mechanical device. Its main purpose is to allow things to roll; in other words, the wheel spins and the objects on the wheel move more easily along the ground. The wheels used in our segway is a rubber moulded one which is connected to the motor shafts through bearings. The wheels have a diameter of 30 cm.

E. Safety Wheels

These safety wheels are undriven one. It is designed to be attached to the bottom of a larger object to enable that object to be moved. As its name indicates it is used for the safety purpose of the segway. If the electrical components of the segway fail, the rider should be safe and avoid any injury. So safety wheels play a vital role in rider safety.

V. ELECTRICAL COMPONENTS

A. Brushless DC Geared Motor

A motor is a device or electrical machine used to convert electrical energy into mechanical energy. Here, we are using a brushless DC geared motor.

A geared motor is a component whose mechanism adjusts the speed of the motor, leading them to operate at certain speed. Thus, we can achieve the needed speed through this geared motor. This geared motor have the ability to deliver high torque at low speeds, as the gear head functions as a torque multiplier. In addition, they are brushless so that the motion control, positioning and actuation systems are done. They have high power density, good speed torque characteristics, high efficiency, wide speed range and low maintenance.

B. Arduino UNO

Arduino is an open source electronics platform based on easy to use hardware and software. Arduino boards are able to read inputs like activating a motor.

The Arduino UNO board we use here is equipped with sets of digital and analog input / output pins that may be interfaced to various expansion boards and other circuits. It can be powered by USB cable or by an external 9 volt battery, though it accepts voltages between 7 to 20 volts.

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C. L298N Motor Controller

This L298N motor controller or motor driving module is a high power motor driver module for driving DC and stepper motors. It can control upto 4 or 2 DC motors with directional and speed control. It is powered by 5V and 30mA to drive upto 35V and 2A. It can operate at maximum power of 25W. It is a high voltage and high current dual H bridge, called so far the structure of its circuit. It can control the motors bidirectionally.

D. IMU (MPU 6050)

The MPU 6050 is a 6 DOF (Degrees of Freedom) or a six axis IMU sensor, which means that it gives six values as output. Three values from the accelerometer and three from the gyroscope. The MPU 6050 is a sensor based on MEMS (Micro Electro Mechanical Systems) technology. This helps us to measure acceleration, velocity, orientation, displacement and many other motion related parameters of a system or object.

F. Battery and Wires

Lead – acid batteries, also known as lead storage batteries, can store a lot of charge and provide high current for short periods of time. Lead – acid batteries are capable of being recharged, which is important for their use in cars. Wires are used to bear mechanical loads or electricity and telecommunications signals. Wire is commonly formed by drawing the metal through a hole in a die or draw plate. Wire gauges come in various standard sizes, as expressed in terms of a gauge number.

VI. WORKING PRINCIPLE

A. Working

This effortless personal transporter has been designed to work on both modes.

If any failure occurs in automation mode, the rider can use manual mode to operate the transporter.

1) *Automation Mode:* In automation mode, the motors of the effortless personal transporter is connected to Arduino UNO, via L298N Motor controller, IMU (MPU 6050) and Bluetooth module HC – 05. (Arduino programming is attached below). The rider can access the transporter by downloading any Bluetooth related apps like “EZ – GUI” in their smartphone. When the device get paired with transporter, the rider can control the transporter with his/her own smartphone.
2) *Manual Mode:* In this manual mode, the rider can achieve two speed modes in this transporter. To turn the transporter right or left, the rider should press the right or left indicator so that the power gets on specific motor to which direction the rider has to turn his/her transporter. The speed control modes and direction controls are successfully achieved by rider with the use of regulators placed inside the battery box. This entire manual mode control system is shown in figure1.

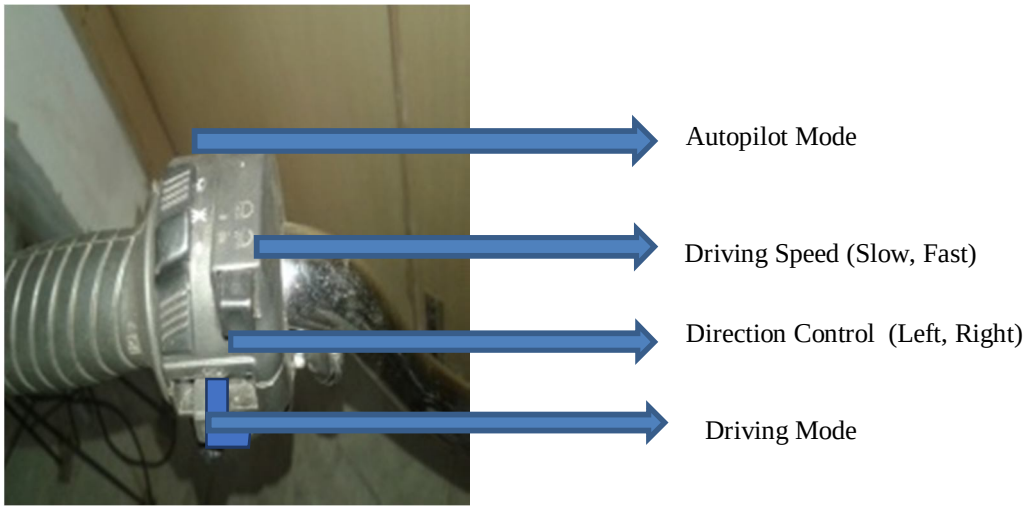

Fig. 1 Control System

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VII. COMPLETED MODEL

Figure 2 shows, the fabrication of welding work of our completed model. This is the rear view photography of our transporter. Alsofigure 3 shows our completed model of personal transporter. This is the completed front view photography of our transporter.

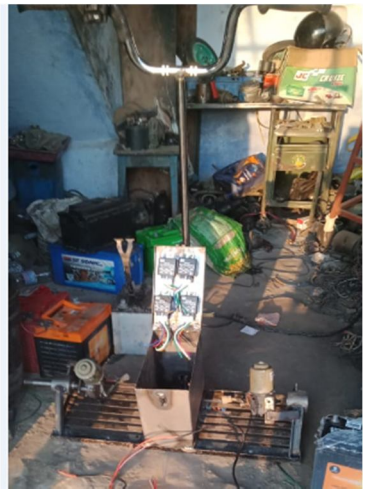

Fig. 2 Rear view

Fig. 3 Front view

VIII. CONCLUSION

As we said earlier, first we have identified the problem during our research and then concluded with the solution called personal transporter (Segway). We discussed with our team mates and have included various transformations in this personal transporter. This transporter works with a micro controller called Arduino UNO and also use various sensors like accelerometer, gyroscope, etc., We have studied the program involving Arduino Uno and implemented it. Being different from other Segways, we have also attached the safety wheels and battery operation as an emergency servicewhen Arduino fails.

During the research, we have faced various hiccups and gaps in exploring the plan and design. We handled it and did the research efficiently. The final model is a user friendly one. The person can ride and use this transporter without any fear and dauntless because we have focused on the safety wheels by prioritizing the safety of the riders. This transporter can be used extensively since it can be handled easily. Future developments will include new control technique andperforming a comparative study among them.

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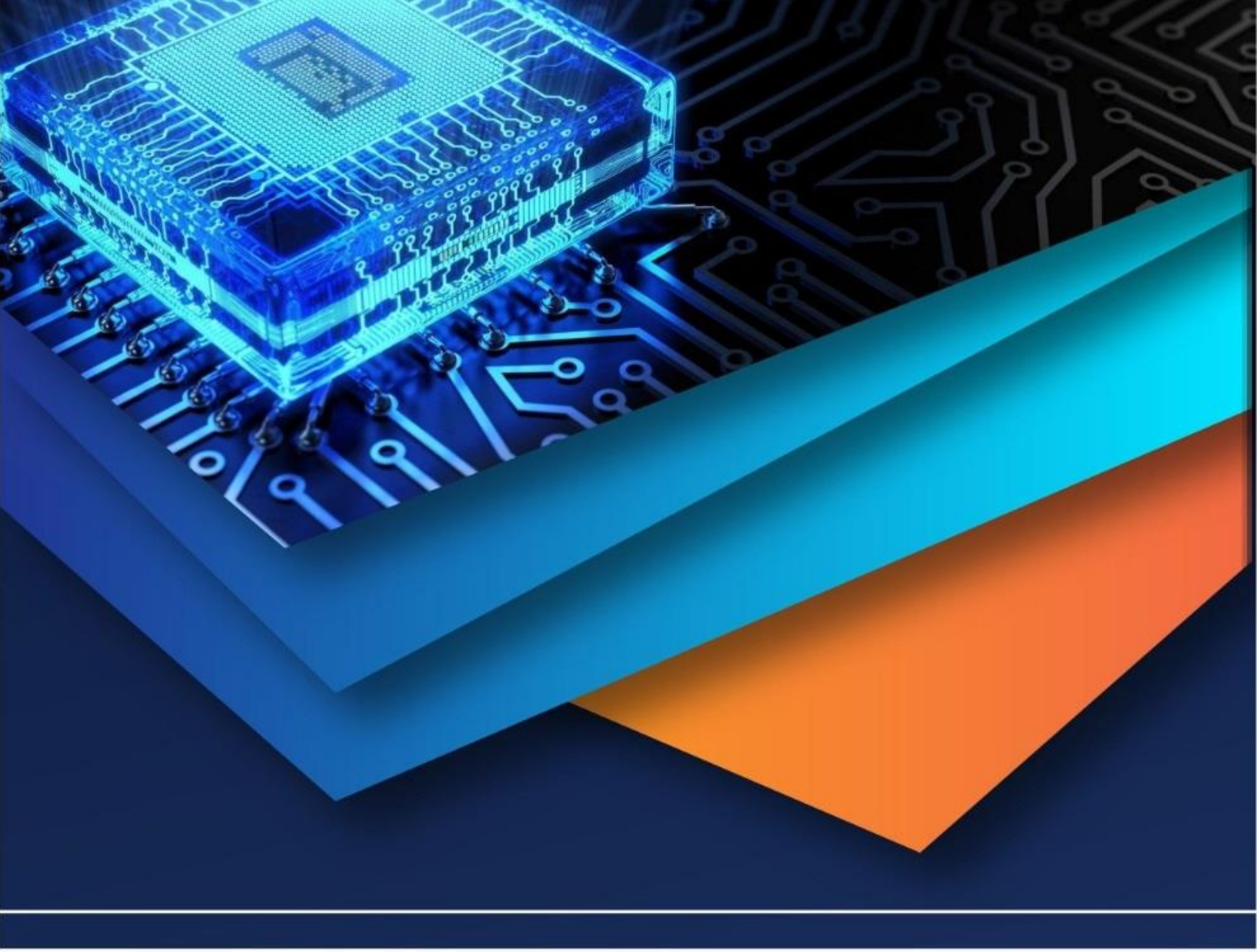

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