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REVIEW OF RYNO MONOBIKE

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Abstract: **In this paper monobike RYNO made by Portland based engineer chriss hoffmman has been reviewd with some advancements that can be used on basic level to construct the monobike. With regards to self-adjusting individual transportation gadgets, it's resemble the Solo wheel, Honda U3-X, Uno and Segway could all be in for a little challenge. Portland, Oregon based RYNO Motors is as of now during the time spent propelling its own entrance in the cool-little-electric-vehicles race, which it properly calls the RYNO. It has only one wheel. Of nothing else, that component will get riders took note. In contrast to a portion of its potential rivals, the RYNO is expected to replace a cruiser. With a top speed of 25 mph and a scope of up to 30 miles, it's expected for short separation, low speed side trips, conceivably notwithstanding being ridden among people on foot. The RYNO has a lithium phosphate battery that is said to revive in only 90 minutes. The heaviness of RYNO is 160 Lbs and the conveying limit is upto 250 Lbs. It's diverting sweep ranges from zero to three feet (0.9 meters), and it can oversee tendency up to 30 percent. It's auto balance framework will as a matter of first importance gives cautioning to the client, and afterward incidentally assume responsibility for machine. RYNO Motors is presently during the time spent hand building 50 restricted version pre-generation bicycles.**

Keywords: Monowheel, RYNO, Lbs, lithium phosphate battery.

1. INTRODUCTION

A **monowheel** is a one-wheeled single-track vehiclesimilar to a unicycle. Instead of sitting above the wheel as in a unicycle, the rider sits either within the wheel or next to it. The wheel is a ring, usually driven by smaller wheels pressing against its inner rim. Most are single-passenger vehicles, though multi-passenger models have been built.The idea may sound extreme, but the science behind monowheel is solid, at present, because of the surging consciousness of pollution and energy shortage crises, automobiles and motorcycles are no longer the best for transportation. As the price of petroleum products growing nowadays, there is a need for a cheaper and more efficient form of transport. In addition, saving energy in order to determine the problem of fuel depletion is becoming increasingly important. Even industries and manufacturing companies that spread over huge areas restrict the usageof means of transport by their employees within their area to avoid the risk of pollution due to emissions of harm air. To meet those needs, research on eco-friendly transportation has been increased. Electrical vehicle technology has a step towards fulfilling these goals.

Therefore RYNO is created, what is an RYNO? Well, in some ways it’s less than a motorcycle, but in other ways, it’s so much more. One-wheeled, electric-powered-vehicle. A machine that has no greater footprints than you do. Capable of operating at speed up to 25 miles per hour. The first personal mobility device that’s lets you mix and mingle into a crowd, naturally..

Electrical details

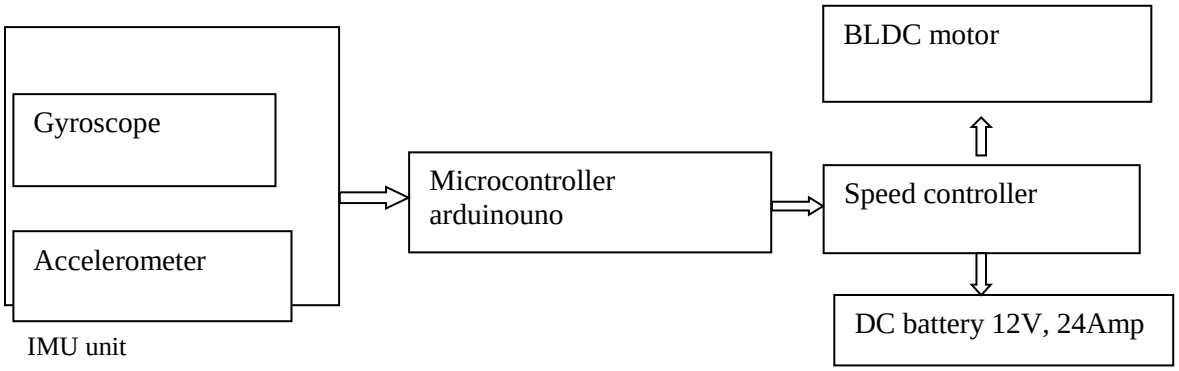

Fig.1 block diagram of the model

RYNO or monobike moves with the help of a BLDC (brushless DC motor) and DC battery. The stability and control part of the monobike is maintained with the help of microcontrollerArduinouno, MEMS gyro sensor and accelerometer and PID controller [1]. In this speed controller is used to controlling the motor speed so as to not reach at the dangerously high speeds. The description of various elements used in monobike is as follows:

1.1 BLDC hub motor

BLDC motors are the best suitable motors for electric bikes. The specifications of the BLDC motor used in experimental hardware can be described as follows:

Fig.2 BLDC Hub Motor

Table 1. Motor specifications of BLDC Hub Motor

S. NO.	PARAMETERS	SPECIFICATIONS
1.	RATED POWER	250WATT
2.	RATED VOLTAGE	48 VOLT
3.	RATED SPEED	260RPM
4.	NO LOAD SPEED	300RPM
5.	FULL LOAD CURRENT	≤13.7 AMP
6.	RATED TORQUE	45N
7.	STALL TORQUE	0.50 N.M (50 KG.CM)
8.	NO LOAD CURRENT	≤2.2A
9.	EFFICIENCY	≥ 80%
10.	WEIGHT	4.5KG / 9.9LB

1.2 Speed Controller

Speed controller in an electric bike is needs to control speed as well as to provide dynamic brake required for most of the times.The speed controller is simply an electronic circuit made up of few ICs and MOFETS etc.

1.2.1 Specifications

Specificationsof speed controller are as follows:

- Rated voltage- 48volt
- Rated power- 250watt
- Rated current-25Amp
- Under-voltage protection: DC41.5V+-0.5V
- Current limited:30A±0.5A
- Efficiency: ≥83%.
- Consumption: <1.5W

1.2.2 Functioning

Speed controller sends a signal to the motor hub in a different range of voltages. These signals are detected with the help of hall sensor mounted inside the BLDC hub motor. Hall sensor helps to determine the exact orientation of the rotor.However, when the controller is used in high power levers, the heavy current will cause some power loss. In order to improve this problem, MOSFET tube resistance can detect the current and then this signal is amplified with the help of differential amplifier to increase the signal accuracy. Speed controllers are basically put inside the aluminum base board.

1.3 DC-DC Converter

As the onlystator have windings and due to the absence of windings in the rotor part, BLDC motor can be employed in high-speed drives. The need of front end converters for BLDC motor drive disturbs the power quality and compensation of power factor is necessary. DC to DC converter basically works as a single stage power factor correction converter for BLDC motors. Hall effect sensor is employed for the controlling.

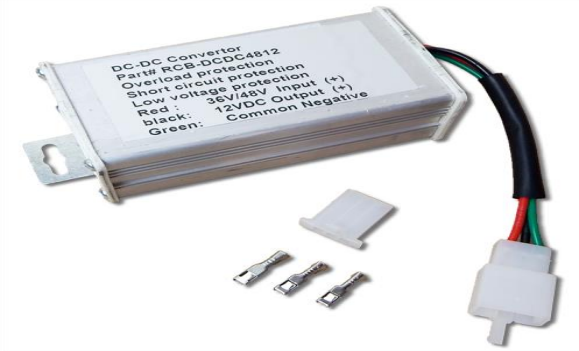

Fig 3. DC to DC converter

1.3.1 Specifications

Input voltage-48volt

Output voltage-12volt 25Amp out

1.4 IMU Sensor

The inertial measurement unit works by having a combination of accelerometer and gyroscope. The work of the IMU unit is to sense the category, rate and direction of motion. Main work of IMU unit is to determine the rate of acceleration, and calculation of angles such as roll, pitch and yaw or x-axis, y-axis and z-axis.

IMU used here is MPU6050 that contains three DOF gyroscopes and three DOF accelerometers in it so as to provide better accuracy in orientation and acceleration of the object and that's why it is to be named as 6 DOF IMU i.e. it gives six values as its output.

Fig 4. MPU 6050 gyroscope and accelerometer

1.4.1 MPU6050 specification

Table 2. MPU6050 data from InvenSense product specification Data Sheet et al (2013)

S. NO.	PARAMETERS	SPECIFICATION
1.	VDD	2.375V-3.46V
2.	VLOGIC	1.71N to VDD
3.	SERIAL INTERFACES SUPPORT	I2C
4.	PIN 8	VLOGIC
5.	PIN 9	AD0
6.	PIN 23	SCL
7.	PIN 24	SDA

1.4.2 Connection Arrangement

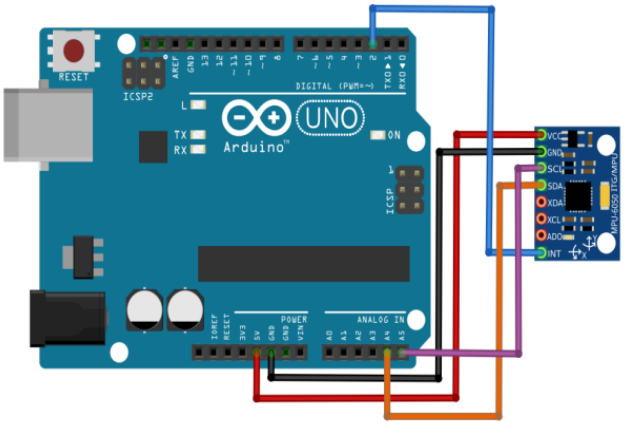

Fig 5. Connection with Arduinouno

1.6 PID Controller

As it is to know that the PID controller stands for the proportional-derivative integral controller. Basically this type of controller is used in applications where there is a need for regulation of speed,temperature ,flow pressure and other process variables.Here we will use this technique for self- balancing purpose so as to stable the single wheel monobike.

1.6.1Functioning

For controlling from the PID controller techniques to get the real-time data from the monobike IMU sensor is used and respected values regarding angles and acceleration are being provided. PID controller calculates the steady state error with reference to the set point whatever has been setup. The PID controller then applies its control over PWM values of the motor so as to correct the error to provide stability. PID controller gives its response according to three constant values Kp, Ki and Kd.

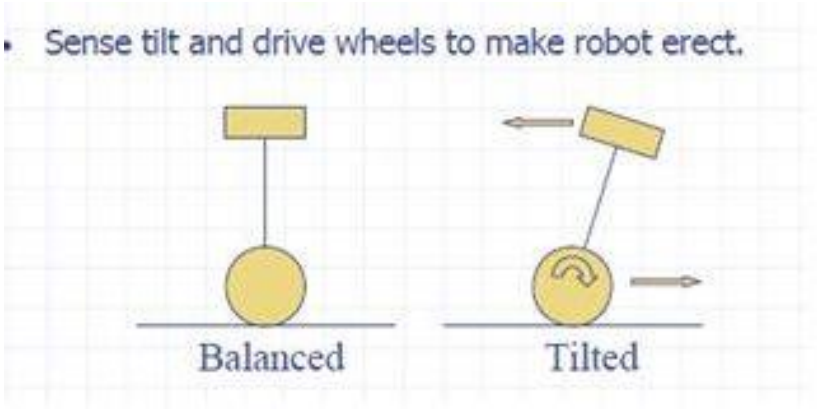

Fig 6. tiltation scenario of monobike

1.6.5 PID tuning

PID tunning can be done in any software so as to get optimum value for self-balance. PID tunning requires changing the values of Kp, Ki and Kd constants that's why it would be better to do this on software like MATLAB so as to be able to put the exact value of these contents.

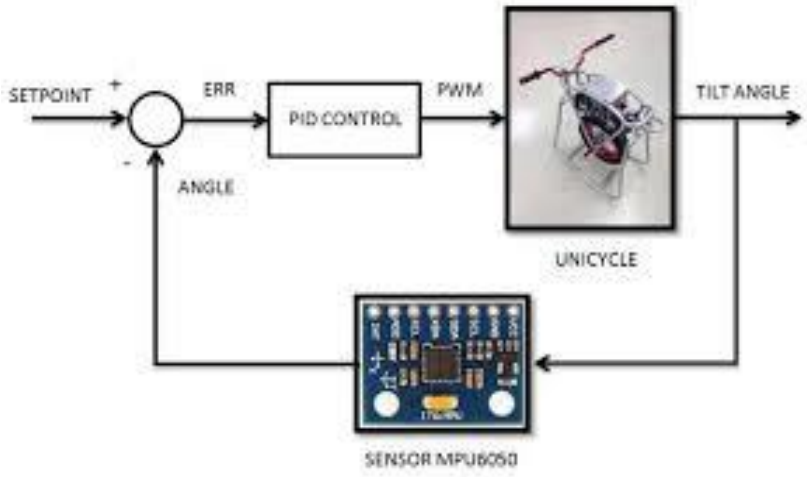

Fig 7. closed loop system for PID control technique

1.7 handle and steering mechanism

Basically handlebars are directly coupled to bike, the bike is coupled to wheel forks, and wheel forks are coupled to the wheel.Steering linkage is attached between handlebars and wheel forks. When a rider turns handlebars the center of mass of the rider/monobike combination changes, and this also affects the direction of travel. Turning handlebars to the right or left respectively push or pulls on wheel forks thereby exerting forces to change the direction of travel

1.8 Battery

One of the most important components of the monobike electric vehicle attached with BLDC motor is Battery. The energy source of the vehicle should be very efficient so as to maintain the better speed of the system. Batteries are best suitable as they provide eco-friendly environment without any pollution .

1.7.1 Battery specification

Table 3: Battery specifications

S NO.	PARAMETER	SPECIFICATION
1.	Capacity	24 Ah
2.	Voltage	12V
3.	No. of batteries	As according to need
4.	Architecture	Series

2. MECHANICAL DETAILS

2.1 Wheel

The very next important thing for mono wheel bike is to select the appropriate wheel so as o maintain better stability. It should be noted that the thickness of the wheel should be wide regarding stability factor. RYNO bike usually uses 25 inches diameter tire.

2.2 Frame of the bike

The frame of the bike should be such that the center of gravity for bike can be maintained perfectly otherwise the bike will face problems regarding its suitable stable position. The frame should be made up of light material such as stainless steel.

2.3 Dynamic analysis of the system

The dynamics of the Inverted Pendulum so as to model the proposed monowheel system. The figure is an illustration of the inverted pendulum .

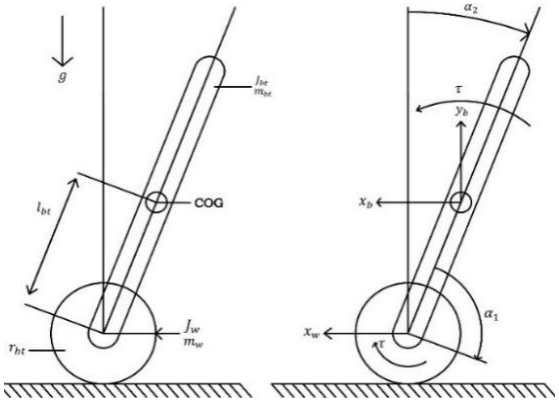

Fig 8. Inverted pendulum system

2.4 CONNECTION MANAGEMENT

The figure shows the circuit diagram of the work. We are connecting the MPU 6050 sensor which contains the combined pack of accelerometer is used to sense the vibrations and gyro meter is used to sense the angle this sensor is connected to the analog pin no A5 and A4 of microcontroller which is internally analog to digital converter pins by executing each step of the program the microcontroller will give the output by sensing the to the motor driver. The motor driver is connected to the digital pins 4 and 5 of the microcontroller which will act as the gate by receiving the 1bite as the output from the microcontroller it will give 48v to the motor and receiving 0bite as the output it will not provide output to microcontroller. This motor driver is also used to move .

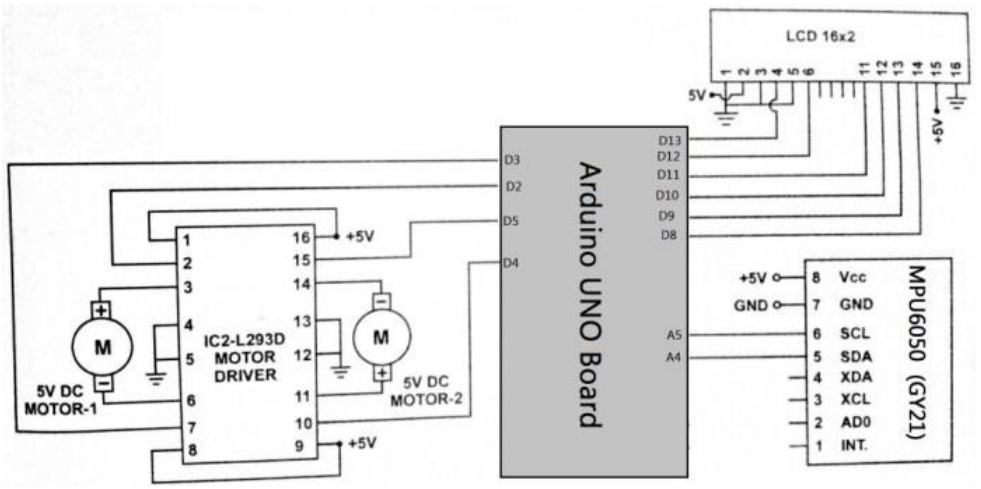

Fig. 9

2.5 PSEUDO CODE

STEP-1: MPU-6050 sensor will gauge both point and increasing speed.

STEP-2: Output from the sensor is gathered by smaller scale controller as info.

STEP-3: Microcontroller will modify the point and increasing speed as per the set esteem is given.

STEP-4: If the point is "0" no yield is given, if the edge is under 180 it will push ahead, if the edge is more prominent than 180 it will go in reverse.

STEP-5: Motor jumper will gather the yield from the microcontroller and give the expected voltage to the engine.

STEP-6: Motor will get voltage from engine driver and push ahead or in reverse as request given from microcontroller.

2.6 CONCLUSION OF THE PROJECTED WORK

RYNO is self-adjusting individual transporter which has the capacity to convey an individual to move to start with one spot then onto the next inside the enormous grounds. The vehicle will adjust itself by moving the gadget forward way or reverse way base on the readings from sensors. In this way the monowheel is much useful in the enormous grounds like air terminals, colleges, space focuses and in huge ventures and so forth. This framework lessens crafted by people just as no contamination it gives eco-friendly condition.

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