

# Design and Fabrication of Treadmill Bicycle

Kirtish Bondre<sup>1</sup>, Sanket Beradpatil<sup>2</sup>, S. J. Thorat<sup>3</sup>

Student, Department of Mechanical Engineering, NBN Sinhgad School of Engineering, Pune, Maharashtra, India<sup>1</sup>

Student, Department of Mechanical Engineering, NBN Sinhgad School of Engineering, Pune, Maharashtra, India<sup>2</sup>

Professor, Department of Mechanical Engineering, NBN Sinhgad School of Engineering, Pune, Maharashtra, India<sup>3</sup>

**ABSTRACT:** This paper deals with conversion of a conventional bicycle into treadmill bicycle. In this bicycle the frame of the bicycle is completely modified and the treadmill is placed in between the two wheels, on which user will walk. As the user walks or runs on the treadmill the belt moves to the rear. At the rear roller RPM Sensor is attached to the roller from where Sensor will sense the speed of the roller and accordingly it will send signal to motor. The motion of motor is transmitted to the front wheel by which we can get the motion of wheel and bicycle runs.

**KEYWORDS:** Arduino, BLDC Motor, Chassis Controller, Hall Effect RPM Sensor, Battery, Treadmill.

## I. INTRODUCTION

### Problem Statement

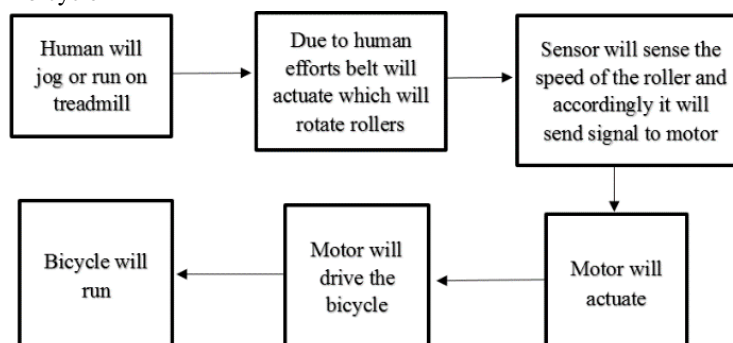
While working out in gym people use treadmill for jogging and running. The main disadvantage of this treadmill is, it is stationary at particular place so sometimes people get bored by jogging at same place without any exposure to natural atmosphere. For travelling over short distances people often use a commercial vehicle which causes pollution and unnecessary wastage of fuel. So, we came to a solution for this type of problem by providing wheels to the treadmill and the concept is termed as walking bicycle.

### Objectives

The treadmill bicycle is a totally new way of moving. With the electric assist it takes less effort to walk than “a walk in the park”. It is the combination of the DC motor, Hall Effect Sensor and amplifier boosting your walking pace up to the higher speed. Increased use of fuel has resulted in increase of pollution and degradation of natural resources. With increasing population and their need, it has become necessary to control the use of fuel and decrease the pollution; so as to make it avail it's important to our coming generation. Due to heavy busy schedule people are not able to give attention to their health and physical fitness. As it uses no fuel so it saves energy simultaneously it can be used as treadmill and Bicycle. No need to use it as conventional treadmill in closed room; you can roam on roads also.

### Working

This is working of treadmill bicycle



# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

## II. METHODOLOGY

We are using DFM for our paper. Design for manufacturability also known as design for manufacturing. DFM is the general engineering art of designing products in such a way that they are easy to manufacture. The concept exists in almost all engineering fields. Depending on the manufacturing technology the application differs widely. DFM describes the process of designing a product for facilitating the manufacturing process and reducing its manufacturing costs. In DFM, the potential problems are fixed in the design phase which is the least expensive place to address them. Other factors which may affect the manufacturability are: type of raw material, the form of the raw material, dimensional tolerances, and secondary processing such as finishing.

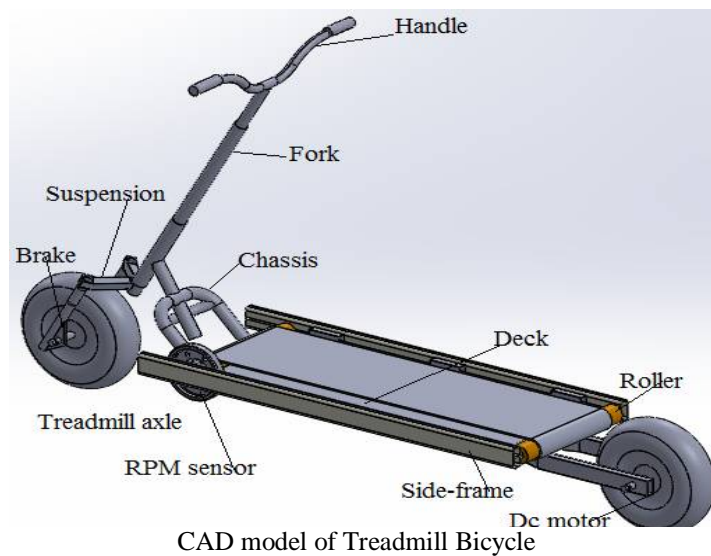
## III. DESIGNED AND STANDARD COMPONENTS

### Designed Components

Chassis  
Fork  
Axle of Bicycle  
Axle of Treadmill  
Bicycle Handle  
Treadmill Roller  
Treadmill Side-Frame

### Standard Components

Brake  
Belt  
Bearing  
Electric Motor  
Wheels



### CAD Model

We designed each component on CAD Software (CATIA V5) and then assembling these components. Thus we designed Treadmill Bicycle on CAD Software.

## IV. EXPERIMENTAL RESULTS

### Designed component

The components that we designed are chassis, fork, axle of bicycle and treadmill, handle, treadmill roller and side frame of treadmill. First of all we studied various types of each components stated above. Then we select particular

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

type of each component. Then we identified specific function of that component. After this we did material selection based on functional requirement. Then we identified material properties from manufacturing catalogue. Then we identified permissible stress using suitable factor of safety. After that we did stress analysis for various components, on Ansys software, then dimensions whose stress in within permissible limit is selected.

Sr no	Components	Material	FOS	Working stress (MPa)	Dimensions (mm)
1	Chassis	Stainless steel 304	3	61.59	35
2	Fork	Stainless steel 304	4	42.09	40
3	Bicycle axle	SAE 1010 Steel	3.5	65.12	10
4	Handle	Cast Aluminium alloy	2.5	83.77	25
5	Treadmill axle	Stainless steel	3	13.14	12
6	Roller	Mild steel	5	38.24	20
7	Side frame	Aluminium alloy	3	10.83	70 x 30

Summary of Designed Components

### Selected Components

The components we selected were brake, belt, bearings, suspension, motor, wheels. First of all we studied functional requirement of each components stated above. Then we select particular type of material of each component based on their functional requirement. We performed various calculations to find out dimensions and capabilities of each components.

Sr No	Component	Type / Material
1	Motor	Brushless DC Motor
2	Bearing	Deep Groove Ball Bearing
3	Belt	Polyvinyl Chloride + Nylon
4	Brake – Front– Rear	Disk - Drum
5	Suspension	Telescopic Fork Suspension
6	Tyre	Rubber

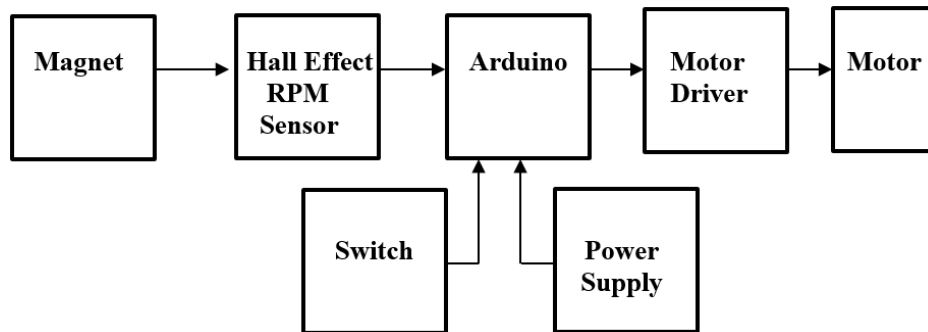
Summary of Standard Components

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

## V. ELECTRONICS CIRCUIT

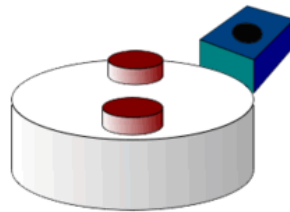


Block diagram of electronics circuit

A piece of magnet is attached on rotating wheel placed on treadmill roller. Hall Effect sensor senses the rpm at which magnetic piece rotates and transfers it to the Arduino. Arduino then sends signal to BLDC motor controller. Motor controller controls the speed of motor according to sensed rpm.

### Magnetic Hall Effect RPM Sensor

A Hall Effect sensor is a transducer that changes its output voltage corresponding to the magnetic field. Hall Effect sensors are used for proximity switching, speed detection, positioning and current sensing applications.



Magnetic Hall Effect RPM Sensor

### Arduino

Arduino is the heart of electronics circuit. A programme is stored in Arduino which controls the current. It also controls the speed of DC motor.



Arduino

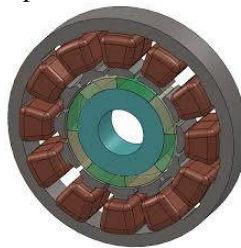
# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

## Brushless DC Motor

Brushless DC electric motor also known as electronically commutated motor ECM. Brushless DC motors are powered by a DC electric source by an integrated inverter or switching power supply, which produces an AC electric signal to drive the motor. In brushless motors, permanent magnets rotate around a fixed armature. Commutation with electronics has large scope of capabilities and flexibility. BLDC motor known for smooth operation, and holding torque when stationary. Additional sensors and electronics control the inverter output amplitude and waveform. Therefore percent of DC bus usage/efficiency and frequency i.e. rotor speed.



BLDC motors

## VI. CONCLUSION

### Exercise

Treadmill bicycle helps in maintaining proper physique. Physical fitness is of utmost importance in day to day life. People often get bored while exercising in a closed room such as gym. By using treadmill bicycle one can exercise outdoors in fresh air.

### Fuel saving

People often use vehicle for travelling over short distance. This causes unnecessary wastage of fuel. Due to use of treadmill bicycle over short distance a large amount of fuel can be saved.

### Travelling

Treadmill bicycle can be used for travelling over short distances. One can also exercise while travelling over short distance.

### Eco- friendly

Treadmill bicycle does not require any fuel. Therefore it does not emit any pollutants. So it is an eco-friendly vehicle.

## REFERENCES

- [1] Dr. Ravikiran Kisan MD, Dr. Swapnali Ravikiran Kisan MD, Dr. Anita OR MD & Dr. Chandrakala SP MD "Treadmill and Bicycle Ergometer Exercise: Cardiovascular Response comparison" Global Journal Of Medical Research, vol. 12, pp. 23-26, June 2012
- [2] Chetan Mahadik, Sumit Mahindrakar and Prof. Jayashree Deka "An Improved & Efficient Electric Bicycle system with the Power of Real-time Information Sharing" Multidisciplinary Journal On Research In Engineering And Technology, vol. 1, pp. 215-222, June 2014
- [3] Prof. V. Sekar and Prof. V. Thiyagarajan had studied on "Controlling of brushless DC motor in electric bicycle using electronic based circuit with 8 bit microcontroller" International Journal of Engineering Sciences & Emerging Technologies, vol. 4, pp. 26-34, Dec 2012
- [4] Prof. Pradeep M. Ingole and Mukund Manas "Ergonomic design of bicycle handle." International Journal of Emerging Technology and Advanced Engineering vol.5, pp. 472-481, April 2015
- [5] Sr. Prof. Lecturer Shivaji Bhandarkar "Vehicular Pollution, their effects on human health and mitigation measures" Vehicle Engineering (VE) vol. 1, pp. 33-40, June 2013
- [6] Larry C. Papadopoulos, North Plains, Jennifer D. Hole, North Plains, "Bicycle Treadmill Having Automatic Speed And Resistance Adjustments" United States Patent Application Publication Pub. NO. US 2005/0164843 Application No 10/682,257 Pub. Date: Jul. 28, 2005
- [7] Pia Hua Lo "Linkage Structure of Treadmill" United States Patent US007306546B2 Patent NO.: US 7,306,546 B2 Application No 10/836,215 Date of Patent: Dec. 11, 2007