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Fabrication and Design of Hyperloop Model: A New Mode of Transportation

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ABSTRACT - The conventional transportation modes consist of four types that are road, rail, water and air. These modes are either slow, or expensive. Hyperloop new mode which overcomer the following problem. There are many driving methods for hyperloop technology. In this paper we going to propose something new driving method for hyperloop. Which is the combination of mechanical and electrical part.
Keywords – Magnetism, Hyperloop, Pod

I. INTRODUCTION

Hyperloop means the vehicle travel in the low air drag or in completely vacuum. Hyperloop is proposed by Elon musk and a team of engineer from Tesla Motors and the Space Exploration Technologies Corporation in August 2013. There are many driving methods for hyperloop technology. We are going to propose the new driving method which can be simple, effective and also inexpensive. Basically hyperloop is train which runs inside a long tube or pipe which consists of low air pressure and capsule that is transported at both low and high speeds.

II. LITERATURE REVIEW

In 2014 N. Kayela discussed about the railway track for the hyperloop, stations for the hyperloop. Also, discussed about the two version of capsule that is one is passenger only version and another is passenger plus vehicle version.

In MAY 2016 Ahmed Hodaib, Samar F. Abdel Fattah discussed the design of a hyperloop capsule with linear induction propulsion system which is used to accelerate and decelerate the capsule.

In 2016 Mark Sakowski Discussed the current maglev technology along with the theoretical evacuated tube technology and they concluded that the hyperloop is feasible and if properly designed, has the potential to be much more efficient in terms of energy usage of pods traversing down the tube.

III. PROBLEM DEFINITION

To drive the hyperloop there is no effective and simple driving mechanism. Presently the driving mechanism for hyperloop is very complex system. The gap preparation between pod and tunnel is not properly achieved. Our project is helpful to reduce that problem in driving mode of hyperloop and provides better and simple operating mechanism.

IV. OBJECTIVES

Hyperloop has worldwide objectives:

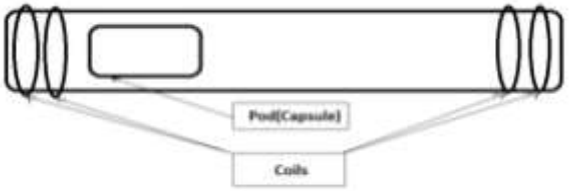
- To develop technology which reduces traveling time and increases the traveling speed.
- To insure effective and inexpensive driving model of hyperloop.
- To reduce the air resistance offered in front of pod when travelling at high speed.
- To reduce air resistance between Pod and Tunnel.
- To reduce air pollution.

V. BASIC PRINCIPLE

In our design and fabrication of hyperloop model the pod travelled based on mechanical concepts as well as electro-magnetism.

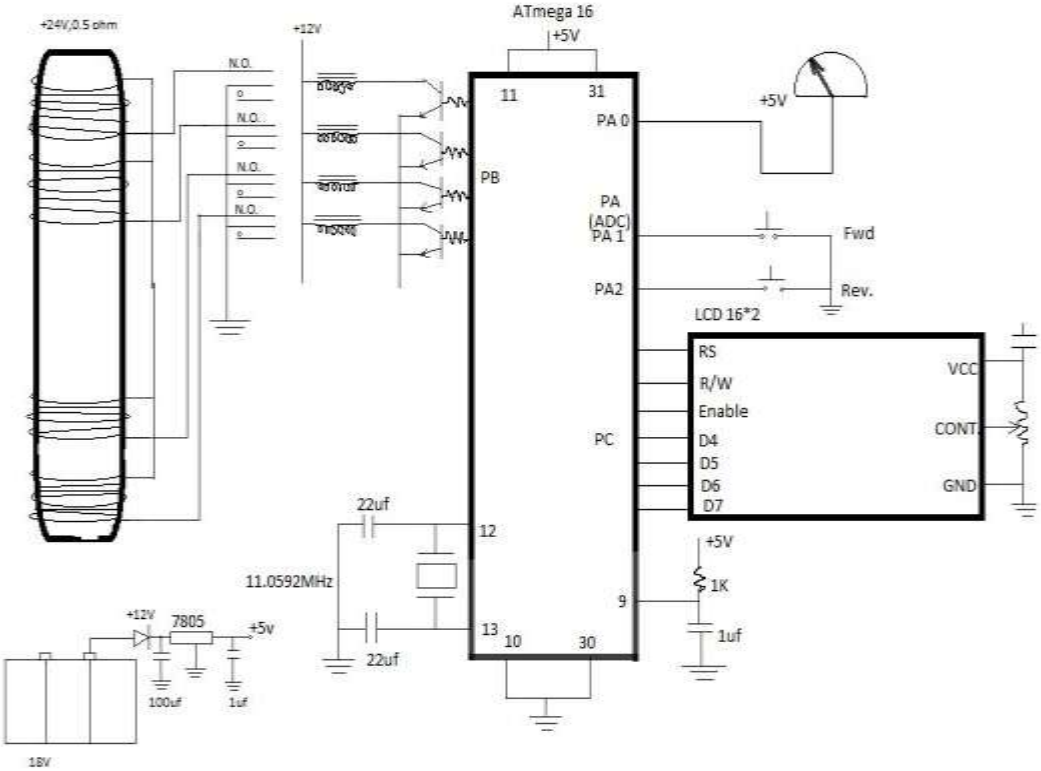
When supply is given to the circuits it start to work, supply is on current will start to flow through coils of copper which are wound on tunnel i.e. pipe, when current will flow through coils, coils will starts to magnetized and produce repulsive force with another pole i.e. pod which will kept inside the pipe . This force

will produce motion and pod will get moved from one to next station . Also there is keep exhaust fan that will decrease drag resistance to the pod while moving and also fan will create slightly low pressure inside the pipe.



VI. CONSTRUCTION

The constructional arrangement are shown in the figure. There are lots of components are used in this concepts. In this we use microcontroller, LCD, Filter,Capacitor,Diode, Resistor,Voltage,regulator,Variable resistance,Wire,pipe,Metallic Pipe, Battery and so on and also we use exhaust fan to decrease the pressure inside the pipe.



CONSTRCTION DETAILS OF PROPOSED MODEL

A. Magnetic coils

Magnetic coils are used to create magnetic field between pod and the capsule which causes creation of gap between pod and capsule which reduces friction.

B. Booster coils

These coils are used to balance continuous velocity of pod inside the tunnel. These coils are mounted at middle of two coils ends. If speed is reduced due to any reason the coil will help to achieve the constant speed.

C. Suction pump

Suction pump is used to create vacuum inside tunnel. Suction pump sucks air inside the tunnel and send it to atmosphere. Because of suction pump the pod inside the tunnel also get pull force which also helpful in increasing the traveling speed.

D. Tunnel
The tunnel is a low pressure cylinder in which pod can travel. The inside the tunnel is removed with help of suction pump to minimize air resistance to the pod.

E. Diode
It acts as a bridge. It adjust the polarity of current flow. If mistaken the power flows reverse it will convert it and conduct it into straight.

F. Relay
Relay used runs on 12v. These are electromagnetic and single port double through circuit. It is used to actuate coils one by one.

G. LCD
We have used 2x16 Serial LCD Display. Which shows coil actuation timing and the position of pod.

H. Variable resistor
It helps in adjusting ON timing of coils.

I. Resettable fuse
If heavy current flows from relay circuit it will get heat and opens the supply to avoid damage of circuit.

J. Filter
It converts harmonic waveforms into pure DC straight line waveform.

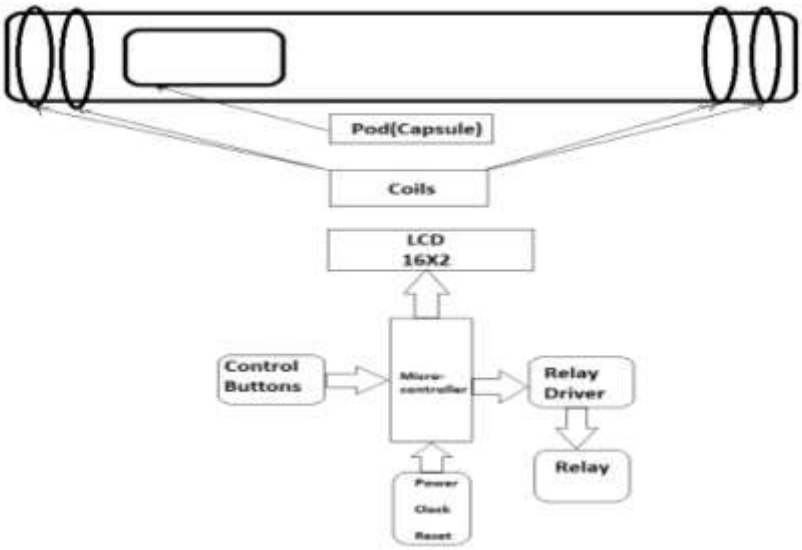
K. Capacitor
It converts the supply of 18v to 16v for supplying to relay coil and 5v to circuit.

L. Transistor
It is acts as switch.

M. Microcontroller
We have used microcontroller ATmega16. Which helps to run logic programming. Which control coil actuation position.

N. Crystal oscillator
To provide clock to microcontroller the crystal oscillator is used.

VII. WORKING



Our hyperloop model is run on 18v electric supply. So, we are going to used three batteries with series arrangement. The power supply of 18v is directly given to the magnetic coils. But relay circuit runs on 12v supply. So, supply from battery given to diode which acts as a bridge. That supply again given to filter and capacitor which converts 18v to 12 volts to run relay circuit. Again to run the microcontroller it wants 5v current which supply from battery to voltage regulator which converts 18 v to 5v. The logic program written in BASCOM software runs with help of ATmega16 microcontroller. There are four ports on microcontroller A,B,C and D. At port A there are switches which controls the forward and reverse position of pod. At port B there is a relay circuit which control the actuation of magnetic coils. At port C there is a LCD display which shows the information of actuation timing of coils and position of pod. At port D there is a crystal oscillator which provides the clock to the microcontroller it helps to reset the microcontroller and start the program from zero location. When supply from battery given to the microcontroller it control the relay coil actuation timing which ON the magnetic coils and gives forward motion to the pod at high speed. The suction pump at ends sucks the air and send it to the atmosphere. Which creates low air pressure or completely vacuum in tunnel. Hence pod will not be subjected to air drag which send pod to high velocity.

VIII. CALCULATION

Power supply design :

Power supply is the first and the most important part of our project. For our project we require +5V regulated power supply with maximum current rating 500mA.

Size of core :

Size of core is one of the first considerations in regard of weight and volume of transformer. This depends on type of core and winding configuration used. Generally following formula is used to find area or size of core,

$Ai = P_1 / 0.87$

Ai= Area of cross - section in Sq. cm. and

P_1= Primary voltage.

In transformer $P_1 = P_2$

For our project we required +5V regulated output. So transformer secondary rating is 12V, 500mA. So secondary power wattage is,

$^{-3}$

$P_2 = 12 \times 500 \times 10w.$

$Ai = P_1 / 0.87$

$= 2.62$

Generally 10% of area should be added to core to accommodate all turns for low Iron losses and compact size.

So Ai = 2.88.

Turns per volt :

Turns per volt of transformer are given by relation

Turns / Volt = 10000/4.44 f Bm Ai Here,

f is the frequency in Hz

Bm is flux density in Wb/m^2 Ai is net area of cross section.

Generally lower the flux density better be quality of transformer.

For project for 50 H_z the turns per Volt for 0.91 Wb/m^2 from above table.

Turns per Volt = 50 / Ai
=50/2.88
 17
Thus for Primary winding = 220 x 17 = 3800.
& for Secondary winding = 12 x 17 = 204
Wire size :
As stated above size depends upon the current to be carried out by the winding, which depends upon current density of 3.1 A/mm^2. For less copper losses 1.6 A/mm^2 or 2.4 A/mm^2 may be used. Generally even size gauge of wire are used.

Rectifier Design :
R.M.S. Secondary voltage at secondary of transformer is 12V, So maximum voltage Vm across Secondary is

= Rms. Voltage x 2
= 12 x 2
= 16.97

D.C. O/p Voltage at rectifier O/p is,
Vdc = 2Vm/ = 2 x 16.97/ =10.80V PIV rating of each diode is , PIV = 2 Vm. = 34 V and maximum forward current which flow from each diode is 500mA. So from above parameter we select diode IN 4007 from diode selection manual.

Design of Filter Capacitor :
Formula for calculating filter capacitor is,
C=1/ 4 3 r f R_L.
r = ripple present at o/p of rectifier.

(Which is maximum 0.1 for full wave rectifier.) F = frequency of mains A.C.
R_L= I/p impedance of voltage regulator IC.
C=1/4 3 x 0.1 x 50 x 28 = 1030 f 1000
And voltage rating of filter capacitor is double of Vdc

i.e. rectifier o/p which is 20V. So we choose 1000 f
/ 25V filter capacitor.

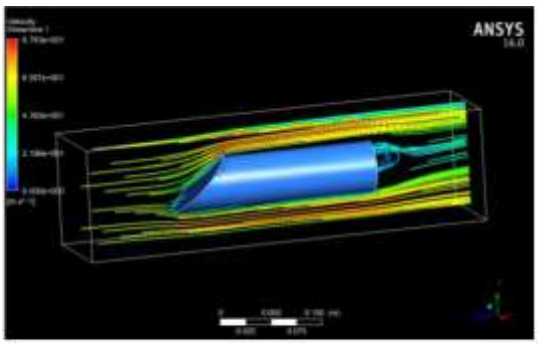
IX. CAD DESIGN

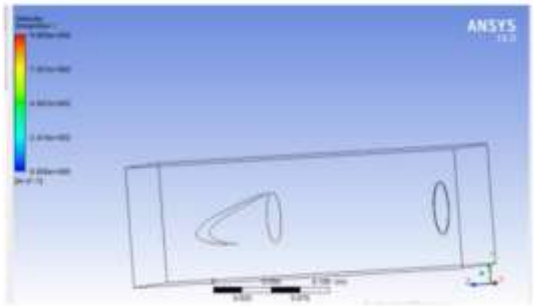
 SUPPORT

ASSEMBLY

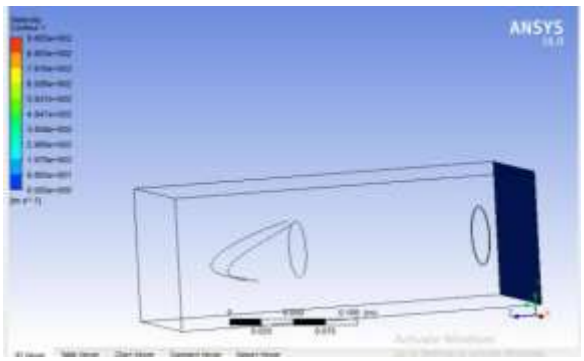
X. ANALYSIS

TUNNEL





PODS WITH DIFFERENT SHAPES



XI. ADVANTAGES

1. This technology is not complicated
2. This technology is easy to handle.
3. It can be powered by the solar panels.
4. It can travel in both direction.
5. Cost of this driving technology is less.
6. More convenient.
7. Stopping problem of pod can be handled.

XII. LIMITATIONS

1. Turning of pod can be difficult.
2. Less movable space for passenger.
3. Starting High speed jerk might cause dizziness in some passenger.
4. Leak of air in tunnel could cause shock waves.

XIII. FUTURE SCOPE

In future there is huge possibilities to build a hyperloop because hyperloop gives a too high speed than normal vehicle that are maglav train, bullet train, and so on. Also time is getting increasing importance day by day and after some year this concept will comes into our daily life definitely.

XIV. CONCLUSION

Hence to overcome the limitations and to increase the advantages, we proposed the new constructional driving model for hyperloop technology. This can be effective driving method for hyperloop technology.so we can say that this can be future of hyperloop.

Here we concluded that the concept hyperloop is come into reality after some days or by some years. Here we used differents shapes of pod from that the pod with aerodynamic shapes will get negligible drag force and offered less resisting force hence in this case we get the maximum speed than others. Because of time is very important thing in our daily life and our aim is to save the time and utilized it for some other means. Hence we concluded again here that hyperloop concept is comes in our life definitely.

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