

# Prototype Model of Hyperloop Transportation System based on BLDC Motor and Permanent Magnet

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**ABSTRACT** - There are four modes of transportation like rail, road, water & air. But, they are either relatively slow or expensive. To overcome this difficulties hyperloop concept is develop. In this project, explain the concept of hyperloop transportation system. It is high speed ground transportation system used for passenger & freight transportation. It uses the pod like vehicle which travel at high speed more than airline speed in low pressure vacuum tube. It works on the principle of magnetic levitation. Two permanent magnets are used one for the track and other for pod. So, pod is suspended on track due to the force of repulsion & propelled by the Brushless DC motor.

**Key Words:** Hyperloop, Magnetic Levitation, Capsule, BLDC Motor, Embedded System, Bearing, Vacuum Tub

## I. INTRODUCTION

The Hyperloop is a concept for high speed ground transportation, consisting of passenger pods traveling at high speeds in a low pressure vacuum tube. The hyperloop concept was originally proposed in a white paper published by SpaceX in 2013. And it currently developed between Los Angeles and San Francisco, which was more expensive and slow. The hyper loop concept required for alternative transportation mode for short-haul travel. For short routes, such as Los Angeles – San Francisco the time required for traveling is more at the speed is relatively low as compared to overall end-to-end travel time. Now days KPMG Company published hype loop concept on the Helsinki–Stockholm. Which carried out the analysis on this route. The time required to cross this distance 28 minutes. Also the market share for high speed transportation system is increasing rapidly in the day by day. The effect of Hyper loop concept on the airline & road transportation system.

The hyper loop is now emerging concept more companies are research on this concept. The spaceX is Organise competition for student and also give the sponsorship for student. This is start from June 2015. More than 1,000 teams submitted their hyperloop concept in competition and more than 100 teams design the hyperloop prototype model last Week of January 2016. The student team from the Massachusetts Institute of Technology the MIT Hyperloop Team won 1st prize in the spaceX competition last week of January 2016. In hyperloop concept the main focused in academic research mostly on the system

integration. A conceptual sizing too using the Open MDAO framework focuses primarily on the aerodynamic and thermodynamic interactions between the pod and tube, with recent work focusing on the energy consumption of the system. The pods for the SpaceX Hyperloop Competition were the rest physical prototypes of the Hyperloop concept.

Hyperloop Transportation System (HTS) was founded for the to reduce the crowd collaboration as an integral component of its business model, from the first day of inception to becoming a multi-billion dollar company. More companies started investment in the hyperloop transportation system so fund rises rapidly .The crowd has power, offering opinions and expertise that are difficult to come by easily unless harnessed through collaboration,. The crowd sourcing model has proven itself in a variety of contexts, and has shown that it can beat even the brightest scientists and supercomputers that energy.

## II. SPECIFICATION OF COMPONENTS

1. **Battery**- Lead acid Battery (2200mAh 11.1V)
2. **BLDC Motor**- 12V, 1400 rpm
3. **POD Dimension**- 2.5 inch width, 2.5 inch length
4. **PVC Pipe**- 3 foot, 4 inch diameter
5. **Electronic Speed Controller**-( simonk 30A)
6. **BluetoothModule**- HC-05
7. **Microcontroller**- ATMAGA16A



Fig.1: Prototype model of Hyperloop Car

### III. BLOCK DIAGRAM

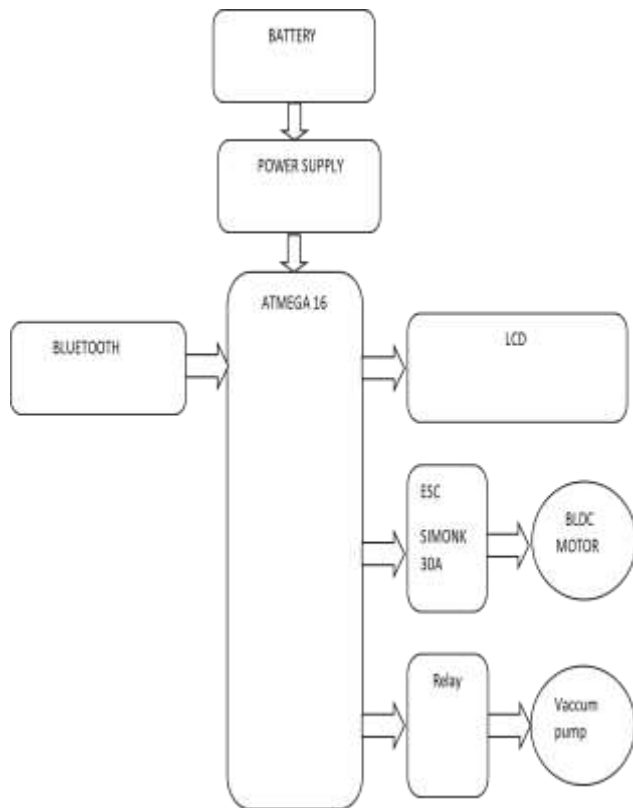


Fig.2: Block Diagram

### IV.SYSTEM DESCRIPTION

#### A) Basic Principle

The Hyperloop concept is based on a principle of magnetic levitation. The principle of magnetic levitation is that a vehicle can be suspended on the track due to the force of repulsion between the two permanent magnets. The vehicle is on the top of the track may be propelled with the help of a Brushless DC Motor.

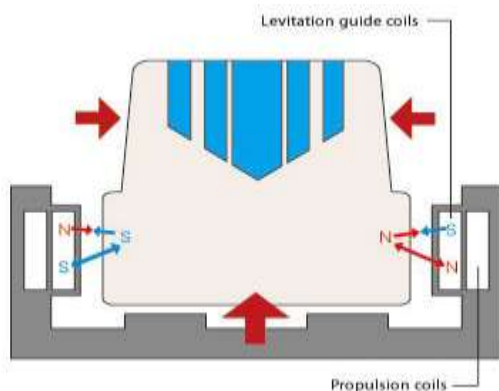


Fig.3: Construction Diagram of Hyperloop

#### B) Working of Hyper loop System

Working of hyperloop system is based on the magnetic levitation principle. As we know that the passenger pod travel through low pressure tube. In hyperloop system an air compressor fan is fitted on the front side of pod which is sucks the air. It transfer high pressure air front side to the back side of capsule (pod) and it propel the pod. There are two permanent magnets are used one for the track and other for below the pod. Due to the force of repulsion between the two permanent magnet pod is suspended on the track. On the basis of magnetic levitation principle the pod will be propelled by the Brushless DC motor. By the Brushless DC motor the capsule send from one place to another place to a high velocity that is slower than the sound speed. The pod will be self-powered. Solar panel also used which is fitted on top of the vacuum tube.

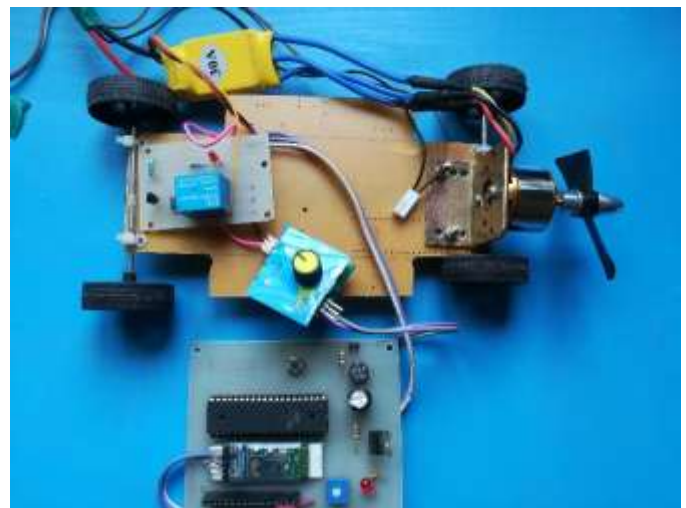


Fig.4 Project Model

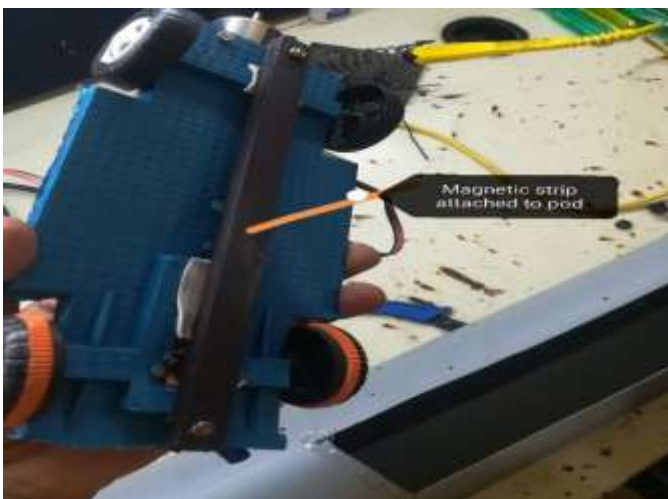
The solar panel energy is used for the charging of the battery. The battery is used for night as well as cloudy weather condition for the some periods. This energy is also is stored in the form of compressed air. The air between the capsule acts as a cushions and it prevent two capsules from colliding within the tube. In above figure it shown that the air through the compressor is send to a bypass nozzle at the back end of the capsule. If capsule cover too much area of the tube then, the air is not flow around the capsule and ultimately the entire column of air in the tube is being pushed ahead of the capsule and because of this there is friction between the air and tube walls is increases tremendously high. Therefore, to avoid this problem the compressor is fitted at the front side of the capsule through which the air is flow which will not flow around the capsule and send it to bypass nozzle. Following parts of hyper loop system.

**V. MAIN PARTS OF HYPERLOOP SYSTEM:**

1. Capsule
2. Tube
3. Propulsion
4. Vacuum Pump
5. Microcontroller (ATMega 16A)
6. Bluetooth Model( HC-05)
7. Speed Controller
8. Relay
9. BLDC Motor
10. Permanent Magnet

**1. CAPSULE**

- a. Sealed capsules carrying 28 passengers each that travel along the interior of the tube depart on average every 2 minutes from Los Angeles or San Francisco (up to every 30 seconds during peak usage hours).
- b. A larger system has been sized that allows transport of 3 full size automobiles with passengers to travel in the capsule.
- c. The capsules are separated within the tube by approximately 23 miles (37 km) on average during operation.
- d. The capsules are supported via air bearings that operate using a compressed air reservoir and aerodynamic lift.



*Fig.5: Magnetic Strip Attached To Pod*

**2. TUBE:**

- a. The tube is made of steel. Two tubes will be welded together in a side by side configuration to allow the capsules to travel both directions.

- b. Pylons are placed every 100 ft. (30 m) to support the tube.
- c. Solar arrays will cover the top of the tubes in order to provide power to the system.



*Fig.6: Pod with Magnetic Strip*

**3. PROPULSION:**

- a. Linear accelerators are constructed along the length of the tube at various locations to accelerate the capsules.
- b. Stators are located on the capsules to transfer momentum to the capsules via the linear accelerators

**4. VACUUM PUMP:**

One important feature of the capsule is the on board compressor, which serves two purposes. This system allows the capsule to traverse the relatively narrow tube without choking flow that travels between the capsule and the tube walls (resulting in a build-up of air mass in front of the capsule and increasing the drag) by compressing air that is bypassed through the capsule. It also supplies air to air bearings that support the weight of the capsule throughout the journey

The compressor is fitted at the front side of the capsule. It supplies the air to the air bearings which supports the weight of the capsule. The compressor allows the capsule to traverse to the low pressure tube without choking the air flow that travels between tube walls and capsule.

**5. MICROCONTROLLER (AT MEGA 16A):**

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more about RISC and CISC Architecture) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. ATmega16 can work on a maximum frequency of 16MHz.



ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively. ATmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD. ATmega16 has various in-built peripherals like USART, ADC, Analog Comparator, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals



Fig 7. Microcontroller

6. RALAY

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph. Circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers perform logical operation.

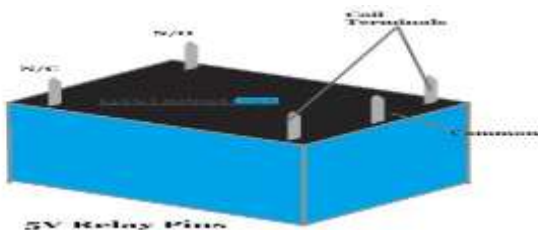


Fig 8. Relay

7. BLDC MOTOR:

In hyperloop transportation system main part is BLDC motor. BLDC Motor is used for thrust producing. This motor is operated on 12v and it is operating speed 1400 RPM. When pod is levitated and motor start due to this levitation and motor speed due to this pod is travel from one point to

another point. We are using BLDC motor for high speed achievement and also bldc motor reduce the electrical losses. The bldc motor is connected to back side of pod and it produce the force to travelling the pod.

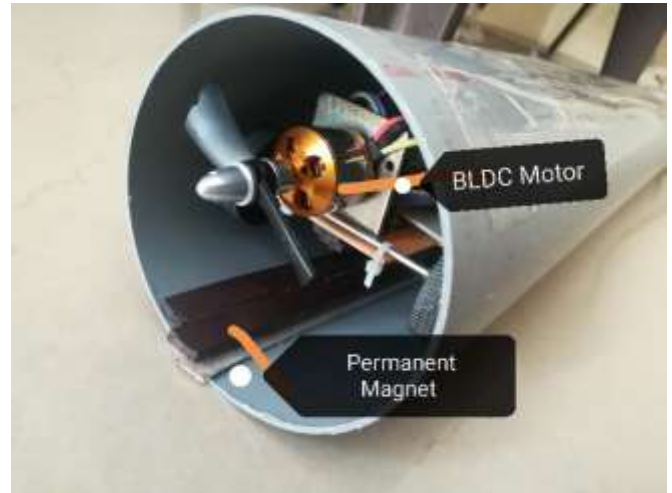


Fig 9. BLDC Motor connected to pod

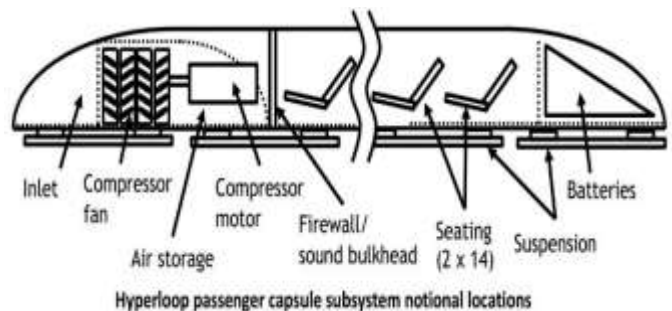


Fig.10: Hyper loop System

VI. CONCLUSION

The hyperloop is high speed ground transportation system this concept developed in this project. Instead of the conventional mode transportation system like air, road, rail & water there are hyperloop transportation system is used. It has very high speed so time as well as cost required is less. By reducing the pressure of the air in the tube enables the capsule to move faster than through a tube at atmospheric pressure.

VII. REFERENCES

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