# Mag Lev Train 1

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Date:

October 28, 2003

The Mag Lev Train 1 project is to design and implement an active levitation, guidance, and propulsion system for a model sized train. The methods to be used will be decided after further research. A sensing and controlling method for each component will be developed and implemented. The entire system must be created from scratch. Therefore, the project might be a multiyear project if all components are not implemented. The end results for each component will be compared with Mag Lev Train Technology 2 to determine which methods work the best.

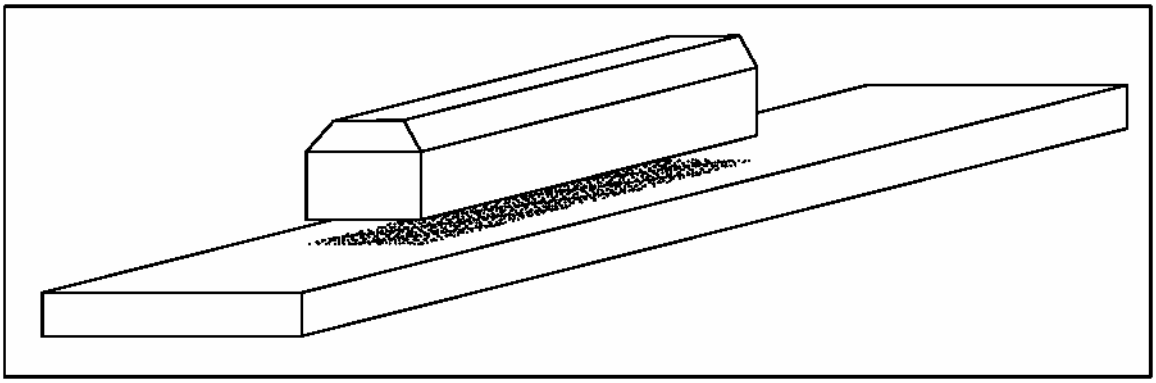

Figure 1 – Mag Lev Train levitating over track.

Figure 1 shows an illustration of the Mag Lev Train levitating. The overall system has two user inputs of velocity, and levitation height. This is shown in figure 2.

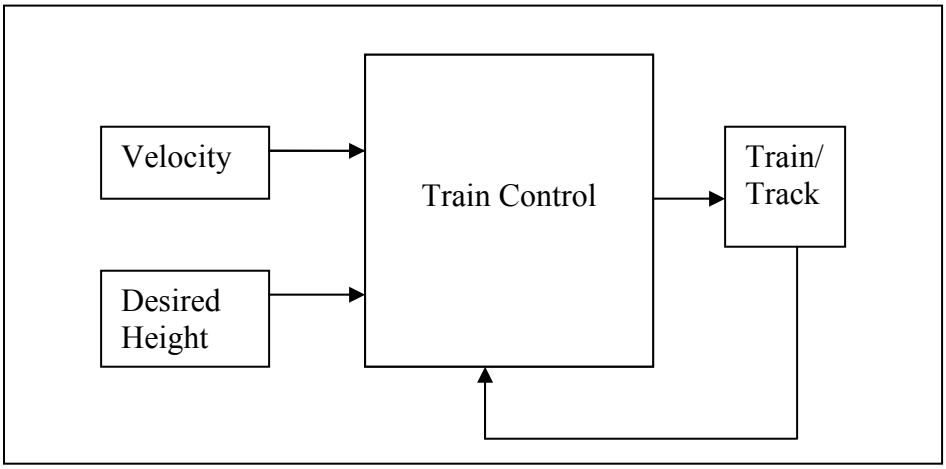


Figure 2 – Overall System Block Diagram

The overall system can be divided into subsystems of levitation, horizontal alignment, propulsion, and positioning.

The methods to be used are currently being researched. A rough overview of the components that may be needed have been determined. The subsystems use sensors as inputs, and the response of the train as outputs. The inputs and outputs are:

**Inputs:**

- Vertical sensors
- Determined height input
- One or two horizontal sensors
- User velocity input
- Positioning sensors

**Outputs:**

- Vertical levitation
- Horizontal alignment
- Train velocity
- Proper portion of track charged

**Levitation**

The levitation of the train will be created by a magnetic repulsion method. This will be implemented either by permanent magnets, or electromagnets. If permanent magnets are used, it will be a free-running system. If electromagnets are used a sensor will be used to determine if more or less current is needed to increase or decrease the height of the train. A possible subsystem levitation block diagram is shown in figure 3.

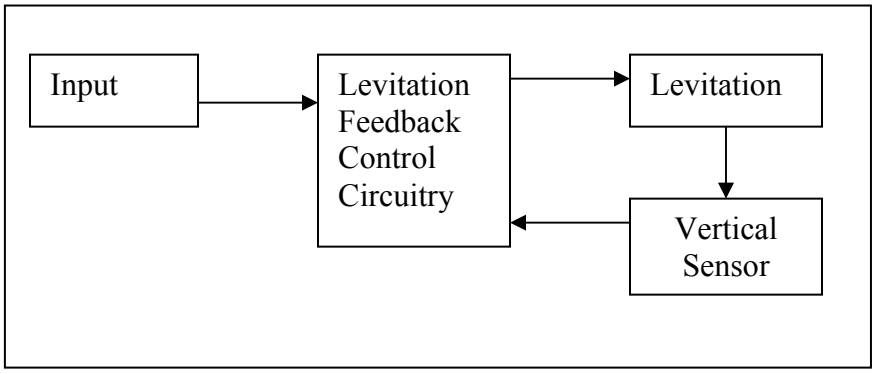


Figure 3 – Subsystem Levitation Block Diagram

**Horizontal Positioning**

The horizontal positioning control may be created by sensing when the train starts to move laterally on the track. Current will be increased to create a greater magnetic field when the train needs to be corrected. The horizontal positioning may be implemented by utilizing a magnetic attraction method. A subsystem horizontal positioning block diagram is shown in figure 4.

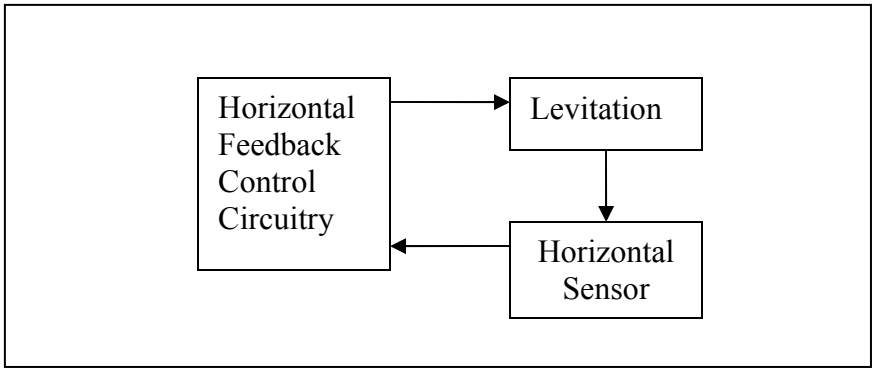

Figure 4 – Subsystem Horizontal Positioning Block Diagram

The horizontal positioning will be a free-running system using negative feedback to determine if more current is needed to center the train on the track.

**Propulsion**

Propulsion will be created by utilizing permanent magnets on the train, and electromagnets along the track. The electromagnets on the track will switch polarity, or switch on and off to pull and or push the train. This is the principle of a linear induction motor. The frequency and amplitude of the electromagnets on the track will determine the velocity of the train. A subsystem propulsion block diagram is shown in figure 5. The linear induction motor may contribute to the levitation of the train.

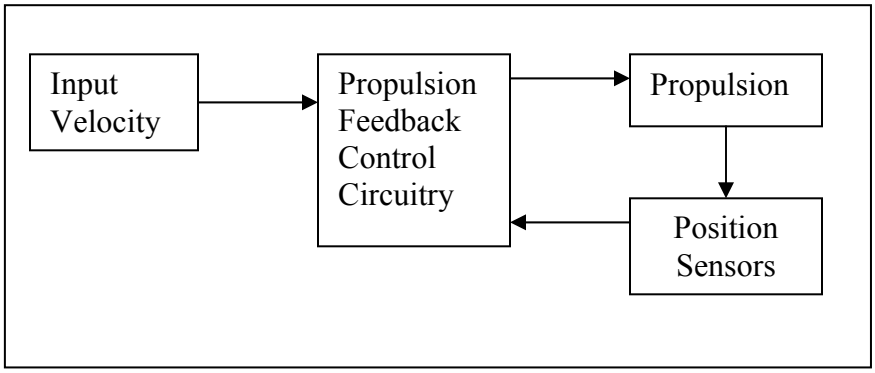

Figure 5 – Subsystem Propulsion Block Diagram

The subsystem is a complex method of propulsion that may be implemented if time allows. An open loop version may work as well to propel the train with less accuracy.

**Positional Track Control**

Sensors will determine where the train is located on the track. Each section of the track will be independently controlled. To save power, each section of the track will be charged when the train is on it. This may be controlled using a microcontroller. The subsystem positional track control block diagram is shown in figure 6.

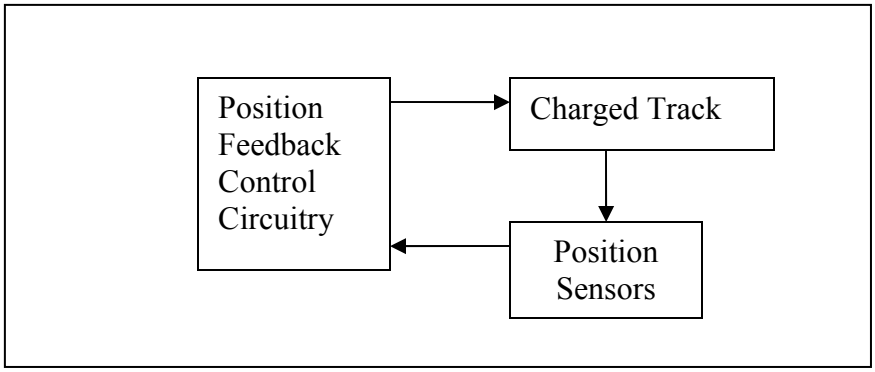

Figure 6 – Subsystem Positional Track Control Block Diagram

The positional track control is a free-running system with no input. This system may not require negative feedback, but feed forward to make sure the portion of the track is charged prior to the train getting to it.