Honors Physics II Project

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Honors Section 3

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The area within physics that this paper will discuss has to deal with magnetism, electromagnetism, levitation, and the physics behind each of these. Within this paper is also the failed attempt at a project. This project was originally designed as simply a way to have a human levitate by use of magnetism and the useful applications this subject has to offer. Although it was a bust and never even had the opportunity to fail, much was learn about levitation and the means by which it is achieved through magnetism.

The original scope of the project was to create a way to allow someone to levitate anywhere. After searching through resources on the subject, the scope of this project had to be narrowed to achieve any hope of success. The materials of this project were supposed to be: (6) 50 lift pound magnets, (2) wall switches, (2) 9 volt batteries, coil of wire, soldering equipment, soldering iron, (1) pair of old converse, (20) flat, thin surfaces, (1) glue gun, and any materials necessary to secure the materials to whatever surface they will be placed. Everything except for the magnets was bought in person. The magnets had to be bought online. They were purchased about a month ago in preparation. However, the company apparently wouldn’t ship my magnets until Wednesday, April 14th. They are currently en route to Pennsylvania from the company’s warehouse.

So again the scope of the project must change to a discussion of the potential of the project, likely failures, as well as the subject of levitation and successful projects within that realm. These will all be explained using the physics learned throughout this course.

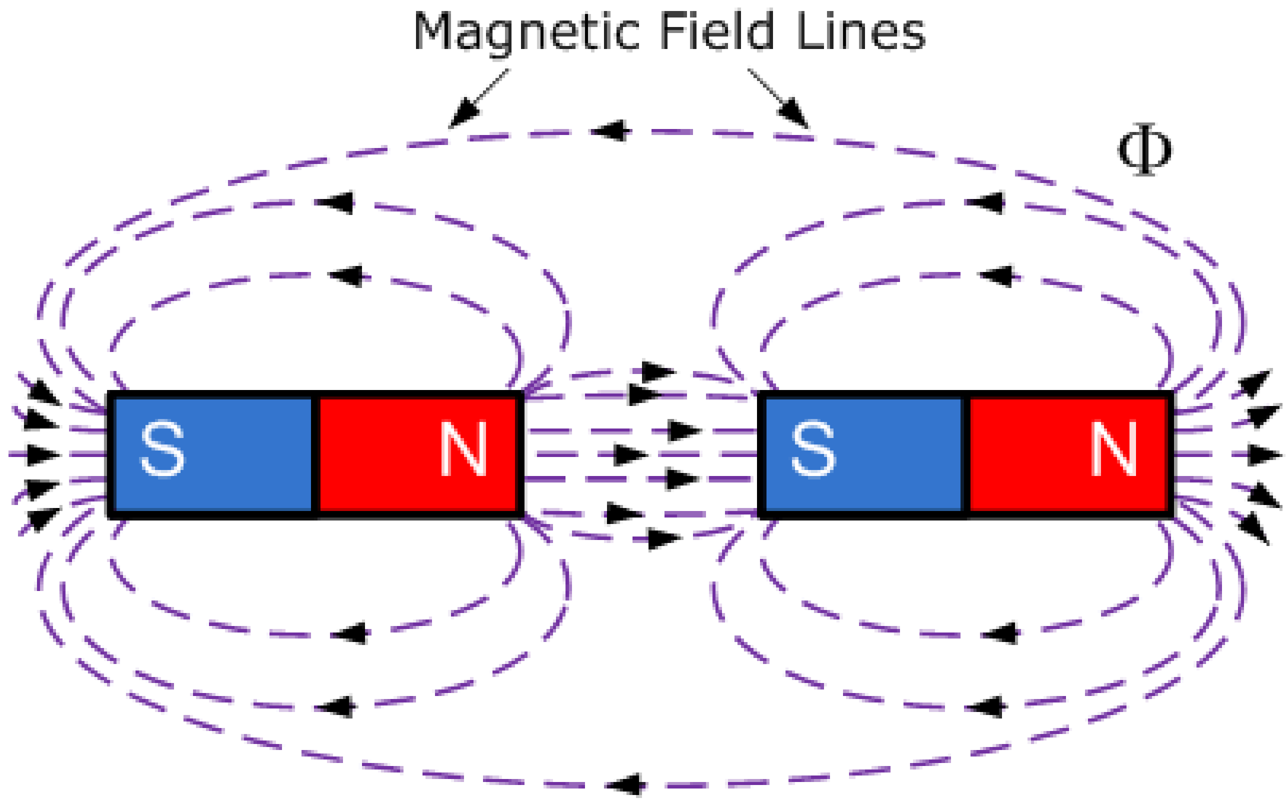
Realizing that the actual experiment could not be performed, the idea of how it could have worked will be proposed and possible short comes will be discussed. A permanent magnet is a material that has been magnetized and persists to have its own magnetic field. This magnetic field is created from the spinning electric field within that material. It has two poles; a north pole and a south pole. When a person has two of these magnets they soon find out that the magnets either repel each other of they attract each other at poles. From class it is known that opposite poles attract each other and like poles repel each other. This is due to the direction that the magnetic field of the two poles travels. So, it could be thought that you could levitate something by attaching magnets so that only the fields of like poles could come in contact with each other. That was the desired aspiration driving this project. First it would be observed and recorded where the poles on these magnets repelled and attracted each other. Then one end of four of these magnets would be glued to a location on the shoes. Make sure that the exposed side of each of these magnets would have the same pole as the others. One magnet would be glued to the heel section and one would be glued towards balls of the feet on the shoe. Note that in both cases the thin, circular magnets are level with the bottom of the shoe. The same process would be repeated for the other shoe. And by wearing these shoes, the desire of these magnets to flip over and attract to other magnets is prevented. Furthermore, by adding both ends of current from the 9 volt battery separately to each of the magnets through wire that has been coiled around the magnet, you can make sure that the magnet is at full power so to speak. Since it is necessary to keep the wire tightly around the batteries and magnets, solder will be used and a switch will go in between the 9 volt battery and the wire that runs to the magnets. This way it could easily be turned on or off. Make sure the battery and switch for either shoe are secured tightly and away from the magnets. At this point the project would not work. If the magnets came in contact with a material that had freely moving electrons, the field of the magnets would move the electrons in such a way as to temporarily magnetize the object. However, no matter what pole is used or if you flip the magnets to the other poles, the material will always align its poles in such a way to attract to the magnets. This presents a problem since the goal is repulsion between the two forces. This is where the other two magnets that are not currently attached to either shoe would be used. First, glue these two magnets to a flat surface, making sure they are adequately spaced out and secure. Then some material would be placed so that it acts as a cover, and connects to the other surface. Then having some way to secure this shoebox looking object to the ground, we would then have a desirable levitating surface. By placing the shoes near this object the like poles of the magnets attached to the shoes would come in contact with the poles on the shoebox like object. Since the object is securely placed to the floor, the magnets cannot flip their poles and attract to the shoes. The shoes would in turn, not be able to flip due to the size and shape of the person wearing the shoes. Because of the added strength of four magnets, the test subjects meager 150 pounds of force acting on the earth by gravity should easily be overcome. This would be if every aspect of the project was successful and many parts could have gone wrong.

Here is what could (and probably would) have gone wrong with the project. First would be that the soldering of the wire to the switches, the 9 Volt battery, or the magnets could result in damage to those pieces of equipment. Not to mention the fact that the current is being run in parallel to each of the magnets. Based on problems arising in experiments, current may run to only one of the magnets. This could be a problem. Problems with the battery could involve short-circuiting. One way to damage the magnets would be to run current which overheats the core of the magnet. Other problems that could arise would be that the weight of the human turns out to actually not be enough and the test subject is flipped, the shoes laces break and the shoe comes off, or many other factors not taken into account. Overall, this project even if successful would not be any kind of answer to "hover shoes" or any sort of viable levitation. It is severely constrained due to the fact that there must be some source of magnets on the surface everywhere. There would be no real way to balance one's self if they became unbalanced. Other possible problems could have included the ineffectiveness of the glue on securing the equipment to either the shoes or to the panel. This could have resulted in the magnets coming loose from their position. This would be extremely dangerous due to the strength of the field these magnets produce.

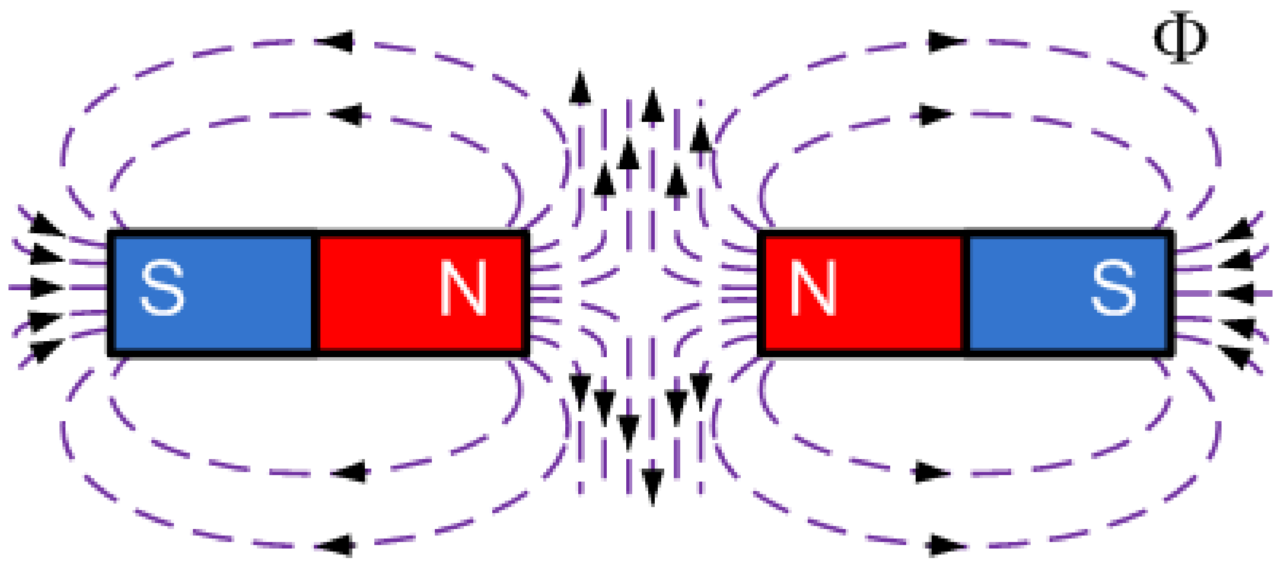
Here is a discussion on the physics associated with levitation and some projects that actually achieve this feat. Levitation is a process by which an object is held by some physical force against the force of gravity. Furthermore, this must be achieved with a stable position and no solid physical contact with other objects. There are several ways to achieve this besides magnetic or electromagnetic forces but they are not important to the goals and topics associated with this physics class. For levitation on Earth, there must be an initial force that opposes and can overcome the force due to gravity in a direction that opposes the direction of gravity’s force. In addition, there must also be a restoring force that is appears to stabilize the object.

In 1839, Samuel Earnshaw introduced the theory that it was not possible to achieve any kind of stable levitation with any possible combination of permanent magnets or electric charges. This was later proved by a Mr. James Clerk Maxwell in 1874 with the use of Laplace equations. The bottom line with this theory said was that there was no restoring force that could be applied to keep the object in any sort of equilibrium. There are no exceptions to this theorem but there are ways to work around the theory. The first way to escape this was through feedback. If a program was created that could sense and react to the opposing forces of the magnets, levitation could be achieved. This is because the magnets would not be fixed but be allowed to move in such a way as to respond to a change in the strength of the forces. One example of this is the train system at the Birmingham airport. Opened in 1984, it was a maglev train that could reach speeds of nearly 42 kilometers per hour. It was however, shutdown due to design flaws. Another way to achieve levitation is through something known as diamagnetism. Diamagnetic is known as any material that is neither Ferromagnetic (strong attraction) nor Paramagnetic (weak attraction).These materials are actually repelled by both poles of magnets. This force is extremely weak and can only show any significant results when used with a superconducting magnet. A superconductor is a material that has zero electrical resistance. A superconducting magnet is created by forming coils of wire from superconducting materials. This allows for much higher levels of current to be run through and ultimately much more powerful magnetic fields. Experiments have proven this by even levitating small animals. Business applications of this process have been used in propelling trains. Due to the lack of friction created by the large number of magnets they are potentially faster, smoother, and quieter than wheeled mass transit systems.

Many conclusions can be drawn from the research and failures of this project. First and foremost is to make sure that all the required materials to create the project are collected in time. Maybe some research should be put into what online companies to buy from. Secondly, without an actual project there are no known results and therefore, no known failures or success. Everything must come from speculation. By definition of levitation and the inclusion of stable position, it is most doubtful that the project design would be able to fulfill those requirements. At best, the project would seem to keep me afloat over the created magnetic panel. But there would be no way to stabilize the magnets to counteract each other in harmony. The result would be that the subject hops to the board, is seen floating over it but continues to move forward eventually leaving the magnetic field of the floor panel. In sight of actual levitation, one of the later discussed methods would have to be implemented. For sustainable levitation to occur, somehow Earnshaw's Theorem would have to be avoided. This could be through diamagnetism and strong magnetic fields, a system to regulate position or field strength of magnetic fields, or something similarly achieved.



Two Unlike Poles Together Attract



Two Like Poles Together Repel

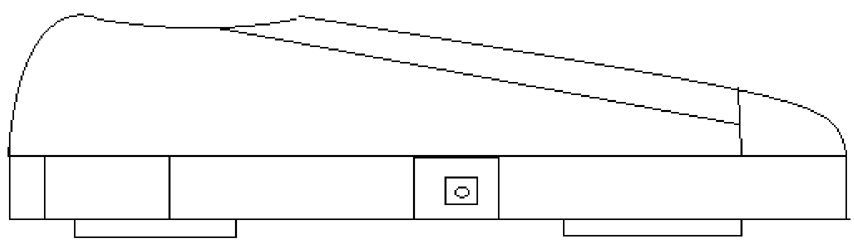


Figure 3. Side View of proposed design of the shoe. Magnets are located under bottom of shoe. Both battery and switch are located along rubber side of the shoe.

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