Design Cycle Challenge Week 2013
The Flying Ramp (Group 22)
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Problem

Create a Rube Goldberg machine that contains 3 actions, 2 potential energy sources, incorporates the assigned stimulus and also demonstrates your collaboration and creativity.

Inquiring and Analyzing

Design Brief

Tuesday, November 12th 2013 - Day 1

Today is the day where we do our basic planning, mainly on our first action; and conducting our basic, general research, on how we should proceed with our creations, with the application of our visual stimulus. During our time in the auditorium, we considered the materials that were provided to us by the KIS's community, about how we could utilize them into creating our machines. Although, there may not be much progress made today, as we all still have many questions, and many plans, and more research, that we would like to conduct; therefore the productivity of today's session may not be as productivity as we would like it to be.

Wednesday, November 13th 2013 - Day 2

Today is the day where we work on the machine during all sessions that was provided to us. We gained some more insights as we continued to build our machine; as even though we had designs drawn, many modifications were made in the actual process of our creation. We would all regard this as a productive day, as we did manage to get all 3 actions completed.

Thursday, November 14th 2013 - Day 3

Today is the day where we began assembling our researches, plans, and designs, together, into the report which all groups must complete. Even though, our 3 actions were completed, the consistency of our machine at this state was still quite poor; supported by the fact that we only scored a 1 out of 5 in our consistency test. Therefore, after completing certain portions of the report, what our group did afterwards was trying to improve the consistency of machines, by adjusting the positions and locations of certain objects, while also adding more components to it.

Research

Newton's Three Laws of Motion

First Law

"Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it."

The Law of Inertia, is another name for it. Objects will remain still, with no movement or displacement, change of location; unless there is another force from the outside which is applied onto it.

Second Law

"The relationship between an object's mass m, its acceleration a, and the applied force F is F = ma. Acceleration and force are vectors (as indicated by their symbols being displayed in slant bold font); in this law the direction of the force vector is the same as the direction of the acceleration vector."

The Law used to calculate how much force something has. It simply indicates that mass does in fact have a very significant impact on how much force something could potentially have. Of course, without acceleration; there would be no force. Every object needs both elements if they were to have a force value. It is direction-aware, having the same direction as it's acceleration vector would have.

Third Law

"For every action there is an equal and opposite reaction."

As the quote says straightforwardly, for every action which occurs in our world, there is the same amount of opposite force applied onto it's reaction. For instance, when you hit the wall, the wall technically hits you back. With the same amount of force and "power" which you have applied to it. And it applies the same for how gravity pulls us towards the ground, the "Earth's surface".

Basic Study on Energies (Applicable in our Creation)

Kinetic Energy

"The energy of motion; kinetic energy depends on speed and mass"

A formula that could be applied in calculate an object's potential energy is:

Kinetic Energy = mv^2/2

Where m is mass,
v is velocity (speed).

Basically, the faster something is moving, the more kinetic energy it has. In addition, the more massive something is, the more kinetic energy it will also have. Based upon the formula, an object's velocity (speed) has a much great significance to an object's kinetic energy than mass does, from the fact that it's squared. It can said simply that kinetic energy is nearly all about the energy generated from the movement of an object.

"The energy of motion", is another way to refer to it.

Potential Energy

"The energy of position or shape"

Not all forms of energy depends on the motion of objects. Potential energy is the type of energy which an object has due to it's position and shape. For instance, pulling a rubber band, stretching it; even though there is no continuous movement. By pulling it, we have had added more potential energy to the rubber band due to our stretching of it, changing it's shape.

An important type of potential energy to consider is gravitational potential energy. Can be said simply as when we lift up an object, we are applying a force which opposes the gravitational force of the Earth. As a result of that action, we have gave that particular object gravitational potential energy.

Gravitational energy depends on the object's weight, and it's distance from above the Earth's surface; similar to elements of shape and position.

A formula that could be used to calculate an object's gravitational potential energy is:
Gravitational potential energy = weight x height

Mechanical Energy

"The total energy of motion and position of an object"

Mechanical energy is basically the same thing as the total amount of energy an object has.

Hence, the formula below could be used to calculate an object's mechanical energy:
Mechanical energy = potential energy + kinetic energy

Used to describe the sum of all energies, important in the discussion of energies which comes from movement such as kinetic energy.

The Idea of "Simple Machines"

"Simple Machines" is the term used to refer to basic six types of machines consisting of: a lever, an inclined plane, a wedge, a screw, a wheel and axle, a pulley.

Lever

A lever is basically a simple machine consisting of a bar (straight plane) that pivots at at a fixed point, which is referred to as the fulcrum (center point of the lever).

There are 3 types of levers

First Class Lever

For a first class lever, the fulcrum is between the input force and the load (object for movement). First class levers will always change the direction of the input force, usually the opposite. In addition, depending on the location of where the fulcrum is located, this type of lever can be either used to increase the force, or the distance of a certain object.

Second Class Lever

For a second class lever, the load is between the fulcrum and the input force. Second class levers although do not change the direction of the input force, but instead allow you to apply less force than the amount of force exerted by the load. Since by using a second class lever, the amount of force that is exerted by the load would be applied onto the fulcrum instead of the location where the input force is applied.

Third Class Lever

For a third class lever, the input force is between the load and the fulcrum. Third class levers do not change the direction of the input force. In addition to that, it also does not increase the input force applied onto it. Even though the advantage of a third class lever is not that great, it is still utilized due to the fact that helps increase the distance of where the output will be exerted.

Inclined Plane

"An inclined plane" is a simple machine that is a straight, slanted surface."

Examples of it could be for instance a ramp, a slider.

Inclined planes are designed in order to make movement easier for objects that are massive. Less force needs to be applied to move an object up, in exchange for moving it for a greater distance. This is the type of machine that was greatly utilized by the ancient Egyptians in building the pyramids of Giza.

Inclined planes have been proved as a very useful concept, that many of the other types of machines are derived from it.

Wedge

"A simple machine that is a double inclined plane that moves; a wedge is often used for cutting."

A knife could be an example of a type of wedge greatly utilized in the applications of cutting in humanity.

Screw

"A simple machine that is an inclined plane wrapped in a spiral."

Wheel and Axle

"A simple machine consisting of two circular objects of different sizes; the wheel is the larger of the two circular objects."

In a wheel an axle, when we turn something, such as a wheel, it's axle would then turn to. If we were to turn a large wheel, with a smaller wheel attached on the same axle which the large wheel is attached to. As the larger wheel turns, the smaller wheel would turn to, because the whole axle would then be turning. And because the smaller wheel, is smaller than the larger wheel, which is currently being turned. Treating the smaller wheel as the output force, and the larger wheel as the input force; the output force would then be larger than the input force. Being smaller, the smaller wheel would have a shorter distance for it to travel, therefore resulting more force and speed.

Pulley

"A simple machine consisting of a grooved wheel that holds a rope or a cable."

Design Specifications and Test

- The machine must have at least three actions

It will be tested by simply having members of our group evaluate it visually, and come to an agreement considering the parts that are actions.

- The machine must at least use three types of mechanism

It will be tested by simply having members of our group evaluate it visually, and come to an agreement considering the parts that are types of mechanisms.

A mechanism is basically the components of the machines (not actions though), such as the "simple machines", dominoes, ramps, rolls, etc.

- There must be two existing connections between our neighboring groups, connecting the appropriate ones according to the chronological ordering of the groups. (Group 21 and Group 23)

We can all test this out by simply trying out the machine, although not the whole thing (the starting action and the ending action), to see if the machine can continuously run without any external involvement.

- The machine must represent out group's visual stimulus (Pile of Numbers)

It will be tested by simply having members of our group evaluate it visually, and come to an agreement considering the elements that in fact represents the visual stimulus. An evaluation will contain information about this in our report; that will explain our opinion of why we believe our machine does represent out assigned visual stimulus.

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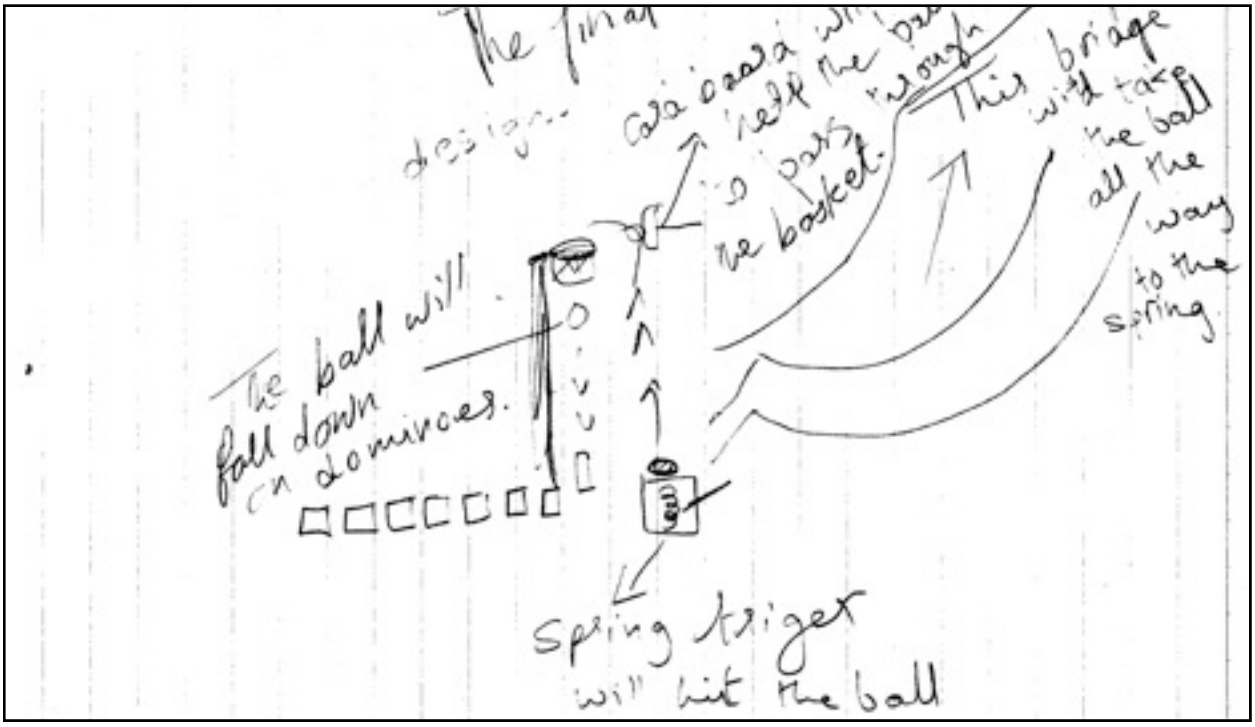
Developing Ideas

Planned Designs

Design 1

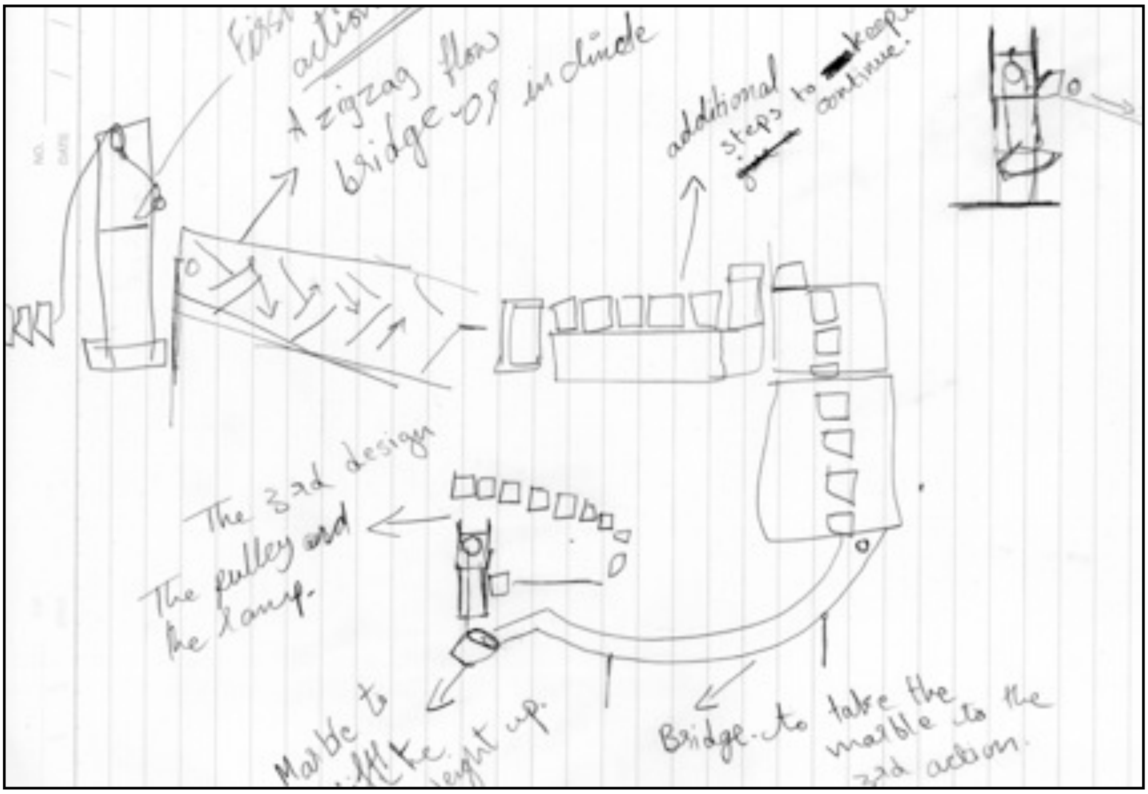
Inspired by one of group mates to is a basketball-enthusiast. It involves a domino which connects to a ball that will launch into a hoop once a domino connects it. After passing the hoop, it



will fall down onto a spring laid on the ground, which will send a ball to a bridge for the rest of the machine's course, hitting a set of dominoes to successfully connect it to the another group's machine.

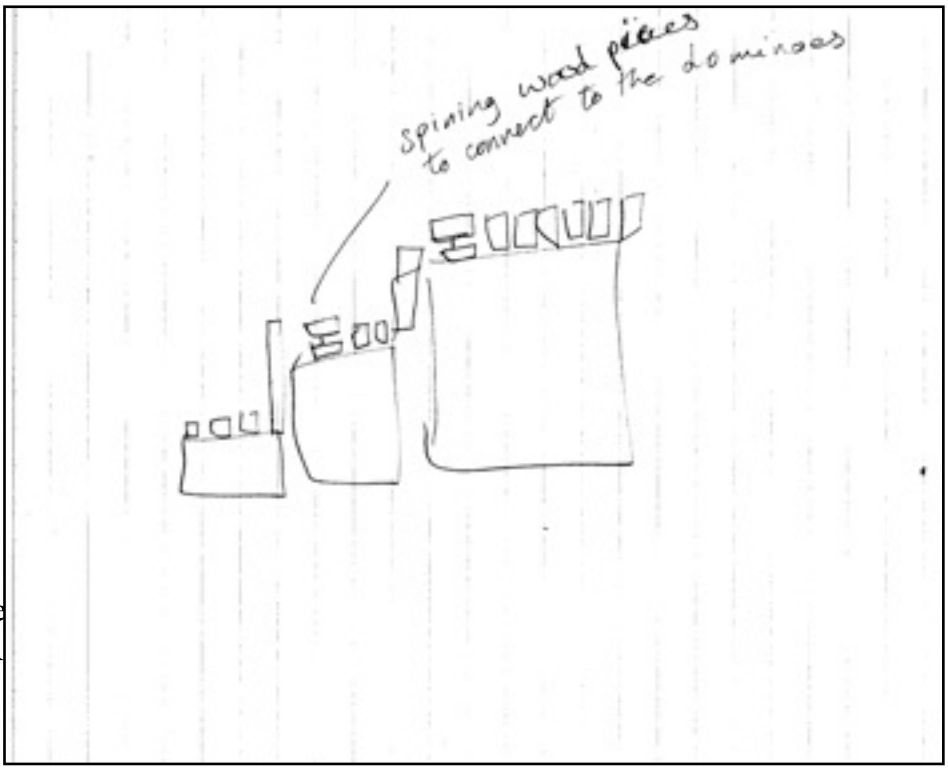
Design 2

Starting off by using a pulley that is powered by the movement of dominoes. Attached to a wood piece using a string which temporarily blocks a ball from falling onto the sliding (zigzag



ramp) until the domino falls. Then proceeds onto the domino "ladder", using baskets as elevation tools. Falls down onto a ramp which will trigger another pulley, that will release a table tennis that will travel down another ramp, hit a domino, which will trigger a set of falling dominoes throughout the remaining course of our group's machine.

Design 3



A short design illustrating how we could change our domino "ladder", in our previous design (design 2), into something more "complex" and interesting. Using the same concepts of elevations, tools can be basket, or other objects that increases height. Spinning wood pieces would be applied, to jointly connect the "steps" (different levels of elevation) together. This is to find an alternative to the seemingly "abusive" uses of dominoes which every group tends to do so.

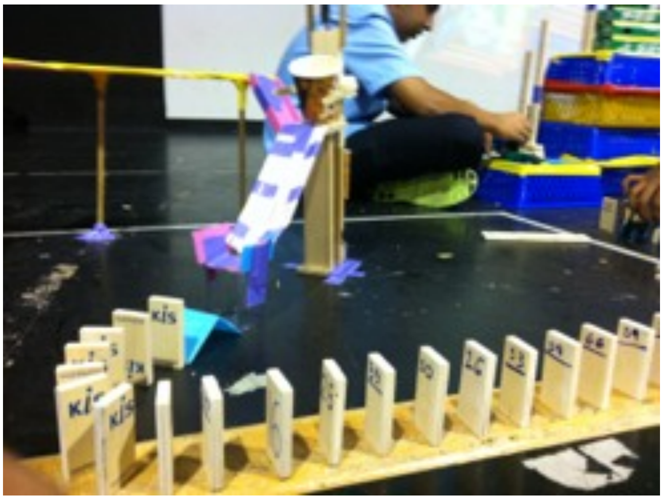
Chosen Design

Design 2

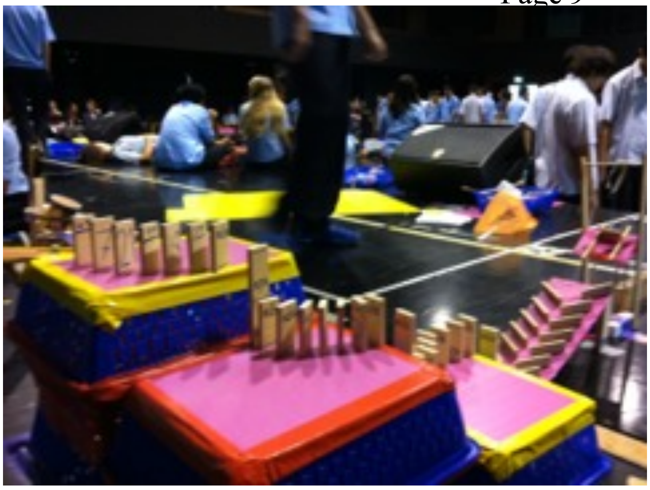
Even though design 1 and design 3 seems to fit our intentions and desires, they seems to probably not work in terms of their practicality in achieving so, and considering our access to resources that we could apply. Time would also in fact be a consideration to what we could achieve, considering our lack of expertise in creating machines like the Rube Goldberg machine. As with that, the more complex the machines get, the more fun and interesting it is. But at that the same time, the machine would become much more likely of having liabilities and faults within it. And these components themselves can be very damaging towards the consistency in the real application of my machine, in testing it. Therefore, we decided to chose design 2; as we all came to an agreement that creating pulleys, that would work, is within out capabilities, as well as being an interesting and an innovative choice. Creating basic dominoes ladder is not difficult, the only important thing required for that would be precise and accurate placing of dominoes, and the patience in placing it. With all of these facts together, design 2 seems to be the choice that we should go for and start applying it.

Creating the Solution

We find that the application of our assigned visual stimulus to our machine became quite a challenge for us. A pile of numbers, could be translated into many things. However, which of those "things", will be able to match up nicely with out visual stimulus. We have decided to approach this matter by writing numbers, using a permanent market, on our domino pieces. That way, the domino would represent those numbers, which would



eventually form a pile from it's fall. In addition to that, the abundance of dominoes, the "abusive" usage of dominoes, would also be an element that will help us represent out visual stimulus more; therefore, using "lots" of dominoes is indeed also a very effective approach to the problem.



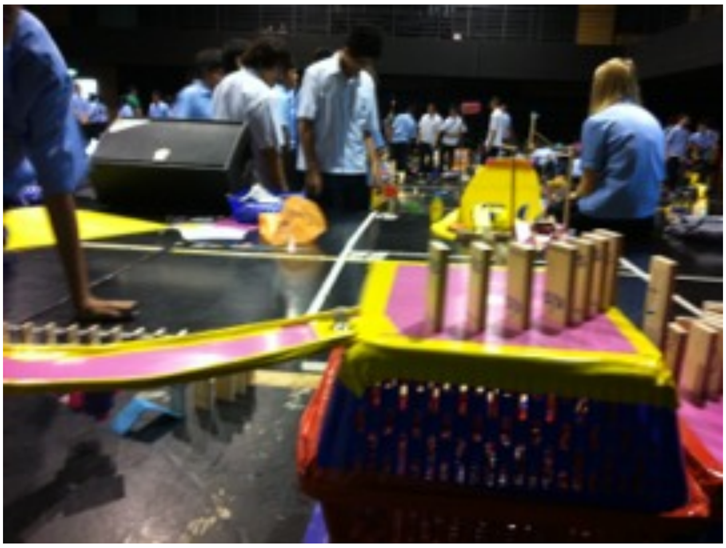


Photo Gallery

Evaluating

In general, we find that the creation process of our machine was quite difficult. Even if we were to analyze the machine's capabilities from the theoretical side of view, in which it seems to be very promising and would in fact work. In the real world, practically; it is difficult to get the machine to work flawlessly without problems. However, overall, we did manage to get a final machine finished and working with the rest of the groups of this grand project. We all agreed that we did meet our expectations and are in fact happy with the experience that we all received during the design cycle challenge week. Although, we would all also agree that if we were to have more time, the machine could really be much better. Our original goal of creating a basketball hoop for the ball to launch into, if something that we all want to do if we had enough time, and resources, of course, to do so. However, it was still a machine which to our expectations, is very well made.