

Automata

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Abstract

An Automata is a self-operating machine, or control mechanism designed to automatically follow a predetermined sequence of operations, or respond to predetermined instructions. As of now, animatronics are the modern type of automatons, with the use of electronics. Most people now are too focused on the new advancements of technology that they forget how old original automatons work. As such, this project is aimed to create an automaton to help people understand the basic concepts on automatons and how they work. Basing the automaton from the Singapore National Day Parade, making the automata to be a souvenir of the iconic National Day parade. The final product used a variety of materials, from plastic to wood, which are in the form of cogwheels and crank shafts etc. However, due to the ongoing pandemic, during the June holidays, we were not able to meet up in school to work on our project. Therefore, we decided to do our own mini automatons. However, due to the Covid-19 pandemic we decided to stop working on the original automata and decided during the HBL, to make our own automatons, each with only 1 mechanism, but with their own unique mechanism. These materials were made out of materials that we had found in our home such as cardboard. However, the HBL turned out to be a blessing in disguise as with more automatons showcasing only one mechanism, the people who want to learn more about automatons would be able to comprehend more slowly and clearly.

1. Introduction

The problem being addressed is that people have forgotten or did not know what are the uses of simple mechanisms like cams and pulleys. Our main goal for the automata is to educate people on how these mechanisms work. The automata will contain several of these mechanisms which will be openly displayed so that people can see the mechanisms in action as they spin the crank. By watching the mechanisms, they will be able to understand clearly how the mechanism works.

2. Solution Design

The product would contain 3 different mechanisms all in the same box, featuring some of the shows in the National Day Parade, such as the wave, the national flag and some boats. However, due to the Covid-19 pandemic, we created our own individual automatons. The first automata was to showcase the mechanism known as cams. It's design was based on boats travelling in the sea moving up and down due to the waves of the ocean. The second automata was to showcase the mechanism known as right

bevel gears. It's design was based on the cartoon show known as "Tom & Jerry". It showed Tom, the cat, chasing Jerry, the mouse around a table with a block of cheese placed on it. The last automaton also showcased how cams work. It's design is based on a ghost showing and hiding itself through a vent.

3.1: Our First Prototype



Our first prototype is mainly made from cardboard and it is held together by glue from a glue gun. The prototype has 3 mechanisms, the gears, cams and a lever. The prototype had several problems. Firstly, the movements of the lever were jerky which resulted in the flag dropping down very quickly instead of gradually which was the effect we had intended. The solution we devised for the problem was to create less tension on the rubber bands by making the cam smaller. The second problem was that the gears were not smooth. It got jammed after some time. Our solution was to use straight bevel gears which would be smoother than the regular gears. However, due to Covid-19, we were not able to execute these changes on the second prototype so we decided to make each on our own.

3.2: Our Second Prototype (First Final Product)

There are 3 prototypes as we each made our own prototype.



This first prototype consists of 4 cams which move “boats” up and down. The prototype is made from cardboard and glue. How this prototype works is by using the cams, the boats move up and down to create a wave like motion. The issues with the prototype were mainly aesthetic as the boats went too high which made them appear to be floating. This was solved by making the sticks attached to the boat shorter.

3.3: Our Third Prototype (Second Final Product)



This is our third prototype. This prototype consists of 2 gears, known as the right bevel gears, controlled by one a wooden crankshaft. The diameter of the gears are 8cm long and the width is 1cm. At first, both the gears had teeth which were 1.3 cm in length. However, after several observations, we found that the mechanisms did not run smoothly as there was not enough room for the teeth of both gears to catch onto one another. Therefore, we decided to increase one of the gears' teeth to be 1.5 cm in length. With this change, the mechanisms had more room to hook onto one another, allowing the mechanisms to run more smoothly.

3.4: Our Fourth Prototype (Third Final Product



This prototype consists of a cam pushing a stick which has a “ghost” attached to it. When the crank is turned, the ghost moves up to appear from the vent. In order for the ‘ghost’ to be able to go back down so that the motion can be repeated, a rubber band is put through the ice cream stick which is holding the ‘ghost’ and the 2 ends of the stick will be stuck on the cardboard. Hence the stick will be pulled down by the rubber band. In order for the vent to open and close, a rubber band is also used such that it will be pulled back down and will close up.

4. Results and discussion

To ensure that our automatons were working properly, we held meetings frequently with one another to check on each other. We also tested our automatons and discussed how we could improve them.

4.1: Testing of the automata’s smoothness

When we got together, we realised that the automata showcasing the right bevel gears, the characters at the top would often get caught in the “leaves” at the top of the automata. Therefore in order to solve the problem, we decided to trim the “leaves” in order to allow the automaton to run more smoothly. As for the one where it involves the ‘ghost’, we realised that the cam was not able to push the stick up at times as the

tension of the rubberband was restricting it. Hence, we lowered the rubber band so the tension would be reduced and the 'ghost' would be able to rise higher. Lastly, for the automata representing the cams, we found that the boat was too high above the "waves" and had to lower the boats down to make it look more realistic.

Conclusion

We managed to build our automatons showcasing a mechanism each. During this project work, we learnt a lot about the different mechanisms, how automatons worked and the toys the people from the olden times played with. The mechanisms include gears and cams. The automatons are successful in showing how the respective mechanisms work as they are clearly visible and easy to understand when they are in motion. Although we still managed to meet our aim of showcasing how the gears function, we felt that our group product (which was not able to be done due to Covid-19) would have been better in fulfilling our goal. Apart from showing how the individual gears work, we hoped to be able to show how the different mechanisms affect one another and function as a whole to move different objects at the same time.

Possible future work would be to complete the original automata we intended to do at the start of the year, but couldn't due to the Covid-19 pandemic.

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