

# **Hwa Chong Institution**

## **Project Work**

### **Category 3**

#### **Written Report**

**Title of Project: Wear Not Tear**

**Group Name: Group 3-09**

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# 1. Problem Finding

1A A list of problems we have identified

After much brainstorming, we have come up with the following eight problems:

1. A prevalent issue is the excessive usage of mobile devices amongst teenagers nowadays, which could lead to irreversible health problems like bone spurs (growths of bone on back of skull). Due to the magnitude of the problem, we recognised that this problem had to be resolved.
2. A lack of storage space constantly bugs us. Our parents always complain that our rooms are a mess and the root is a lack of space in our rooms, leading to disorganisation. Conserving and using space wisely is essential to avoid such problems.
3. Condensation in food boxes results in the food becoming soggy and unappetising. There have been many instances when we ordered take away only to realise that the food had become soggy and unappetising upon arrival back home. As such, we wanted a solution for this problem
4. Containers that use a pumping action will not have its contents emptied completely and would require the user to open it and use up the remaining soap in order to prevent wastage. When using soap cartons, when the soap is running out, it gets harder and harder to pump more soap out. This makes it very troublesome to scoop up the remaining soap.
5. The volume of plastic waste in the oceans has been rising dramatically, polluting the oceans and harming marine life. There have been countless articles highlighting the severity of the problem. Mankind's irresponsibility has resulted in the loss of much biodiversity in the ocean. For example, Turtles mistake plastic bags for jellyfish resulting in them choking and dying.
6. The risk of slipping and falling is posed to people of all ages. One of the major contributing factors is the wearing out of the shoe soles. This issue came to mind when I witnessed first hand my grandmother nearly slipping and falling. Upon investigation, her shoe soles had worn out which reduced the friction between her foot and the ground, causing her to slip and fall. This possible severity of the incident spurred us to do something about it.
7. A cause of widespread suffering each year is the exposure to bacteria and viruses. This can easily be avoided if one were to wash their hands. People do not wash their hands with soap. Despite the ongoing COVID-19 pandemic and the constant reminders issued by the government, people still insist on not washing their hands with soap as it is quite troublesome.
8. As a result of having to wait for water to warm up, there is a great wastage of water. This is highly concerning for a small nation like Singapore with scarce resources. As such, every drop of water is valuable, reiterating the importance of proper water conservation.

### 1B Our Three Considerations

1. Whether there are already existing solutions in the market
2. Feasibility of solutions
3. How beneficial a potential solution will be (How impactful it would be to people)

### 1C Problem Evaluation Grid

Considerations for Selection	Score for each problem		
	#1 Shoe grooves wear out	#2 People do not wash their hands with soap	#3 Wastage of water as a result of waiting for it to heat up
Existing Solutions	3	1	2
Feasibility of Solutions	1	3	2
How Beneficial Solution Will Be	3	2	1
Total Score	7	6	5

After careful deliberation, Problem 2, where the shoe grooves wear out has emerged on top with a score of 7. Thus, we have decided to embark on inventing a product to tackle this problem.

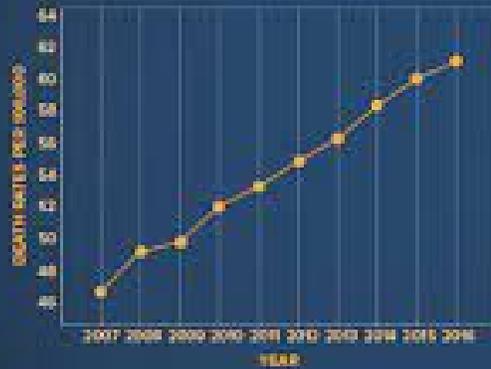
## 2. Define the Problem

### 2A Extent of the problem

Slipping and falling is the leading cause of injury at work and a vast majority of these slip and fall cases are due to a loss of shoe grip. Research has shown that the number of slip and falls cases and their mortality have been on the rise. One slips and falls when there is a lack of friction between the foot and the ground. Due to the constant wear and tear of the shoe's sole, the grooves on the sole will eventually disintegrate and there will be nothing to sustain friction between the ground and the foot. The magnitude of slipping and falling is immense and it accounts for about 1 million emergency room visits annually. Not only could slipping and falling devastate those individuals emotionally and physically, it could also take a toll on them financially. On average, the cost of each accident is \$22 800 which is one thirds of the median annual income in the United States of America. In 2015 alone, the estimated medical expenditures attributed to fatal and non fatal falls was approximately 50 billion dollars. The expenditures as a result of slips and falls highlights the magnitude of the problems and the potential positive impacts of strategies and innovations to combat slips and falls. This can be easily avoided if the root of the problem were to be combatted. The importance of pronounced grooves on the shoe sole has been backed by countless research articles. A study was conducted where a total of 475 workers from 36 limited-service restaurants in the USA were recruited to participate in a 12-week prospective study of workplace slipping. Of the 475 participants, 83 reported changing to a new pair of shoes at least once during the 12-week follow-up. The results show that slip-resistant shoes worn for less than six months were moderately more effective than those worn for more than six months (which grooves would likely be more worn out) . Changing to a new pair of shoes among those wearing slip-resistant shoes at baseline was associated with a 55% reduction in the rate of slipping. The 55% reduction in the rate of slipping would be highly instrumental to the alleviation of financial and emotional strain amongst mankind as a result of slipping and falling. All in all, resolving this issue with such a magnitude would have far reaching effects on humanity. This would be a step in the right direction in order to raise the standard of living.

# Fall Death Rates in the U.S. **INCREASED 30%**

FROM 2007 TO 2016 FOR OLDER ADULTS



If rates continue to rise,  
we can anticipate

**7 FALL  
DEATHS**  
EVERY HOUR  
BY 2030

Learn more at [www.cdc.gov/homeandRecreation/safety](http://www.cdc.gov/homeandRecreation/safety)



2B Compare and contrast the existing or similar solutions.

1. Visiting cobblers



When the soles of shoes are worn out, some people go to a cobbler to get them repaired. Although this may be cheap, the waiting time is especially long and this is also quite wasteful. This is supplemented by the fact that cobblers are becoming more scarce nowadays.

## 2. Sole tape Stickers



Sole tape stickers are attached to the sole of the shoes when the grooves have worn out. However, they wear out easily and have to constantly be replaced.

## 3. Buying new shoes



Many people would buy new shoes if their old shoes were to wear out due to its convenience. However, this could become costly over time and is also quite wasteful.

### 3. Our BIG IDEA

#### 3A Description of proposed invention

The invention we have in mind aims to give worn out shoes a new lease of life by carving grooves into them. The machine is to be plugged into an electrical socket. There will be an on and off switch for the user. The user will have to insert their shoe into the machine and ensure it is properly attached to a clamping system that will clamp onto shoes of all sizes by using stretched springs to bring two sides of the plastic covering together. The blades will be hidden by a layer of plastic, ensuring the safety of the user. Gears beneath the conveyor belt will be spinning at 60 rpm for 5 minutes. This is to ensure pronounced grooves on the shoe sole. Once the grooves have been cut into the shoe, the machine will automatically shut down in order to avoid freak accidents. The rubber scraps will be deposited in a retractable compartment below the machine in order for it to be cleared.

#### 3B Purpose & Benefit

The product aims to give worn out shoes a new lease of life by carving grooves into them. Not only will our product decrease the chances of the user slipping and falling, saving them from the hustle of having to reach out for medical attention, it would also play a part in the sustainability of the environment as waste is reduced.

#### 3C Comparison with Existing Solutions

First and foremost, our invention is more sustainable than the existing solutions. Buying new shoes, using sole tape stickers and visiting cobblers will result in the accumulation of large quantities of waste which could have detrimental effects on the environment. On the other hand, our product will only produce small amounts of waste in the form of rubber shavings.

In addition, our invention is more time and cost efficient. As this product would only require 5 minutes to carve out grooves on the shoe sole, it would save the user from the hassle of having to wait for a cobbler or buy a new pair of shoes. As this product is manufactured to last for tens of years, this product would initially be more expensive. However, looking at the bigger picture, it effectively saves costs over the long run as compared to the existing solutions.

As with every product, our invention has its cons. Although our product carves grooves into the shoes, our product cannot fix the worn down exterior of the shoe. Old shoes with flat soles typically have their exterior torn and tattered. As a result, people may prefer shopping for new shoes instead of using our product.

### 3D Expected Problems

We fear that if the clamps were to loosen, the shoe would slip into the blades and as a result, the shoe may become deformed.

Besides, there is a certain limit for the carving of the grooves. Due to the limited thickness of the rubber sole, there will only be that many times we can carve the grooves and extend the life of the shoe before it is no longer salvageable.

As the blades are already arranged in a horizontal manner, the grooves carved on the shoe would already be predetermined. Any user who wants the original design of the shoe sole to be preserved wouldn't be able to use our product as it would be impossible for them to do so.

### 3E Major Milestones

Making our decision regarding the problem we wanted to resolve was our first major milestone. We eventually settled for the loss of shoe grooves as it appeared to be the most advantageous to resolve. Drafting of the first prototype which would cut grooves into the soles with heated blades was also of great importance as we were later told that it was impractical as the chances of deforming the shoe were high and toxins could be released from the melting of the rubber. Another major milestone was the creation of our 2nd prototype. Through this we realised that the blades by themselves were ineffective in terms of carving grooves into the shoe. This leads us to our final major milestone, which is the creation of the current model which compliments the blades with the conveyor belt.

## 4. Proposed Modelling Process

Our proposed construction process includes ...

### 4 A Materials

The materials that we will be using are plastic (High-Density Polyethylene as it is strong, inflexible, and a less toxic option as compared to type 3 plastic) as the frame of the product, a sheet of rubber for the conveyor belt, lego for the gears, pen knife blades to go on the conveyor belt, a compartment inside the product to store the rubber shavings, a wire to plug into the socket and a switch.

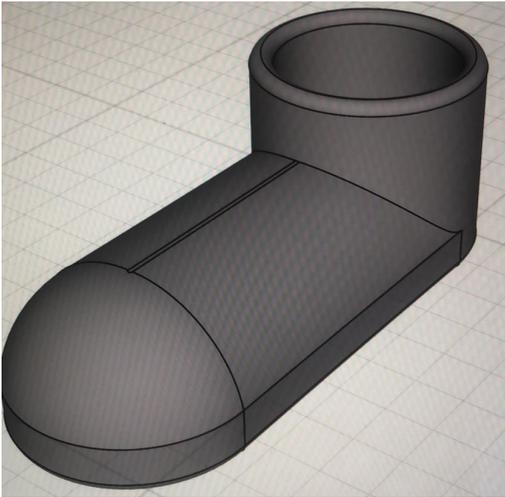
### 4B Construction Considerations

The length, width and height of the product is 30 cm, 12 cm and 6 cm respectively in order to accommodate shoes of different sizes.

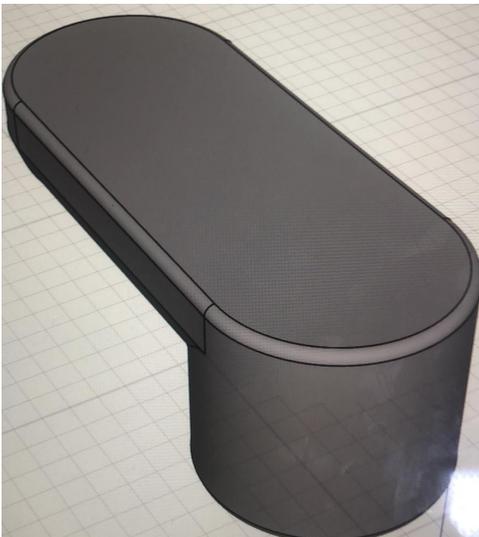
### 4C Proposed Construction

These are images of a 3d model of a shoe with a flat sole.

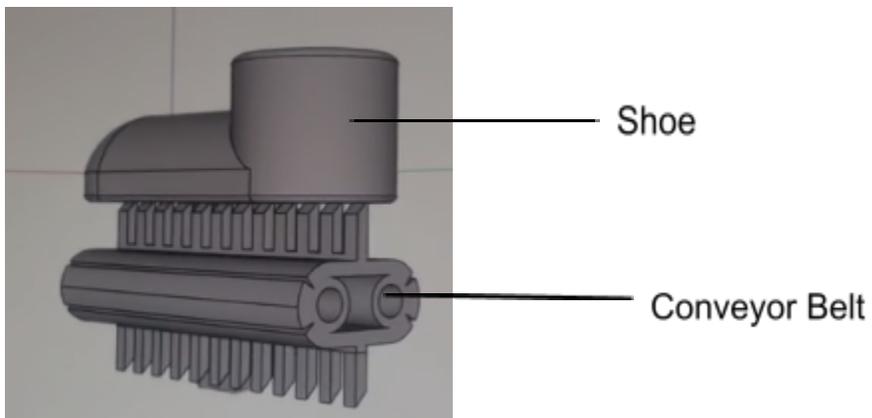
Top view

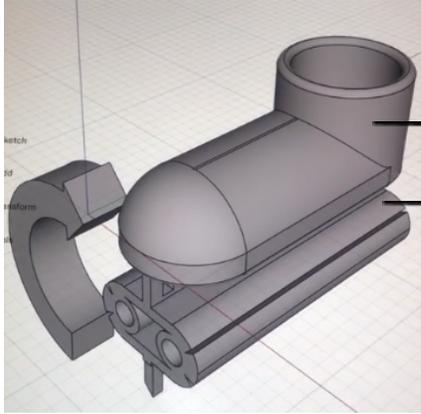


Bottom View



These are our models for the prototype.





Blades

Shoe

Conveyor Belt

4A Explain why construction of a prototype is not possible and the proof of concept is needed in your case.

Amidst the current pandemic where movement has been restricted and group sizes have been limited, we had difficulties meeting up in person in order to construct our prototype. Coupled with the fact that the construction of the prototype involved the handling of dangerous materials which were disallowed in school, we did not have the opportunity to construct the prototype that we had in mind.

4B Briefly explain how the video / animation can effectively show how your invention will work and the different considerations.

Our video is regarding our prototype's model. It has a conveyor belt lined with pen knife blades. A worn-out sole would be placed on top of the conveyor belt and the blades would carve grooves into the sole. This will increase the friction of the sole of the shoe, decreasing the chances of the user slipping and falling. The materials that we will be using are plastic (High-Density Polyethylene as it is strong, inflexible, and a less toxic option as compared to type 3 plastic) as the frame of the product, a sheet of rubber for the conveyor belt, lego for the gears, pen knife blades to go on the conveyor belt, a compartment inside the product to store the rubber shavings, a wire to plug into the socket and a switch. There is also a model of the shoe before it's sole had been cut to give a sense of what we want to accomplish with this product.

## 5. References

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