

Design of Vacuum Cleaner Cum High Pressure Washer

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Abstract: Cleaning has been day to day a challenging task if we remove technology from life. Vacuuming and pressure washing has been more frequently used among the significant population. Clean surroundings enhance the thought process & help to have a more evident mindset. So, cleaning is a significant ritual amongst people. The vacuum cleaner & Pressure washer are listed above on the list. In this project, I have worked on a tool kit that enhances cleaning efficiency by combining two powerful tools using a single motor. The project aims to design a vacuum cleaner and pressure washer for households and automobiles based on usability and functionality. The design process involves using Software like Photoshop for 2D renders, Catia V5 for 3D modeling, and keyshot for virtual rendering. The final concept is developed using a mimic bio trend with the main focus of using a single motor to combine vacuum cleaner and pressure washer.

Keywords: Cyclonic dust canister, immix, pressure washer, universal motor, vacuum cleaner.

1. Introduction

Vacuums are not new. They have been with us since 1860[1], which was initially used as carpet cleaners, but today we see that it helps us clean multi surfaces (carpets, floor, automobiles, etc.), multi-state (wet, semi-dry, day), and multi areas (corners, wide floors, walls, ceilings, etc.) and evolution of this tool has never stopped.

Pressure washers were born little later than vacuum cleaner and have been in use since 1980[2], and have also been among the top priorities. A pressure washer was used in fire extension by firemen. Still, today occupies the more extended group of people by helping clean various surfaced such as windows, dry pool, parking lots, and yet been enclosed to meet many use cases.

Surface Vacuum cleaners and pressure washers have their own advantages, and disadvantages like vacuum cleaners are used mostly in dry areas, and pressure washers are used when surfaces are ok to be wet, vacuums are used in light cleaning, and pressure washers are used in deep cleaning but having both the devices occupy a lot of space and put a load on the pocket. So, in this project, a deep analysis of the different products in

the market has been made and a new mechanism that could integrate both vacuum cleaner and pressure washer in one device. This amalgamation would save a lot of money for the users while there is no compromise on the cleaning.

2. Literature Survey

The literature survey involved a study on technical details of pressure washers and vacuum cleaners, the types of vacuum cleaners and pressure washers, and their work. There are various vacuum cleaners such as upright vacuum cleaners, stick vacuum cleaners, hand-held, and bagless vacuum cleaners. These vacuum cleaners use a universal motor that runs on a DC and is attached to an axial flow fan for suction power [3]. From the reference [3], using a vacuum cleaner that runs on a universal motor coupled with an axial fan generates a 17 KPa of the suction pressure. This pressure was sufficient for the suction of garbage [3].

In the year 1978, James Dyson invented the first cyclonic vacuum cleaner [1]. Since then, a lot of research has improved the efficiency of cyclonic vacuum cleaners. All vacuum cleaner comes with a paper filter, pre-filter and exhaust filter from which clean air is exhausted to the atmosphere. Cyclonic vacuum cleaner generates a centrifugal force that helps separate the dust particles from the air. From the reference, a tangential inlet flow cyclone design has a greater efficiency for dust collection. A spiral vane helps to separate larger particle dust with significantly less pressure drop [4]. A Wobble plate pressure washer pump is an entry-level pump consisting of 4 pistons connected to a drive shaft containing a wobble plate. Their life span is about 200 to 400 hours. This kind of pump creates a maximum pressure below 2500 PSI [5].

1) Product Study

Product study involved the study of the pressure washer and vacuum cleaner available in the market. This study focused on the specification, form, and features that are currently available in the market.

2) Summary of Literature Survey

The literature survey study and the data collected from

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various sources showed that an axial flow fan coupled with a universal motor could give sufficient suction pressure for a vacuum cleaner. The dust separation from the air happens effectively using a tangential inlet flow cyclonic vacuum canister. A wobble plate pressure pump is used to couple with the universal motor to generate a high-pressure water flow.

3. Problem Definition and Objective

To Design a Vacuum Cleaner come High-Pressure washer for cleaning automobile and household uses based on the usability and functionality of the product by focusing on its efficiency using a single motor. And reduce the cost of the combined effect.

4. Methodology

The methodology involved in the design process includes:

- To conduct a study on existing vacuum cleaner and pressure washer
- To conduct brainstorming to derive parameters for ideation.
- To ideate and explore concepts.
- To develop 2D renders and 3D model with digital renders.

A. Brainstorming and Mind mapping

Brainstorming is one of the creative techniques used to understand the broader spectrum of the problem. Using this technique, Different methods of combining the vacuum cleaner and pressure was derived.

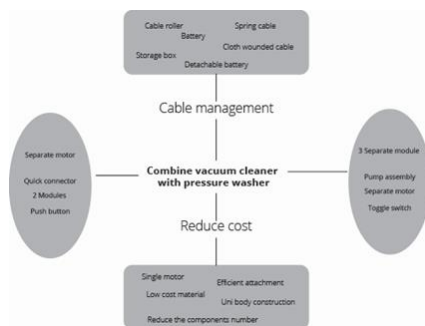


Fig. 1. Brainstorming

B. Concept generation

Based on the data gathered from literature survey, User study and mind mapping following 4 concepts were generated.

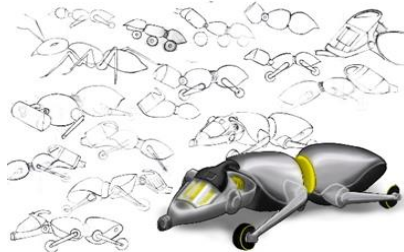


Fig. 2. Concept 1

1) Concept 1

This concept was inspired from an Ant because the

functionality part of the device consists 3 major parts like vacuum cleaner, pressure washer and a mechanism to join these two devices. since ant has 3 divisions in its body its form was developed further to achieve the functionality.

2) Concept 2

This concept was developed by doing some unique form exploration based on the press fit mechanism. In this concept two devices were coupled by pressing the top part as shown in the figure 3.



Fig. 3. Concept 2

3) Concept 3

This concept was developed by the inspiration from the penguin since penguin is one of the human friendly animals its metaphor was selected to develop the concept as shown in the figure 4.

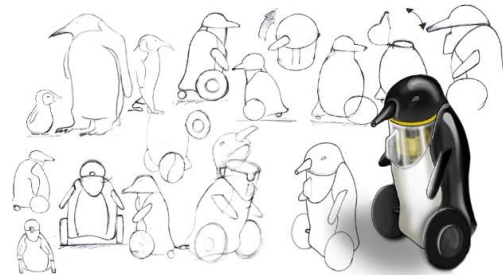


Fig. 4. Concept 3

4) Concept 4

This concept was derived from the inspiration of a Frog this concept contains the functionality of the vacuum cleaner and the pressure washer in two separate container and user need to attach the required container for the use.

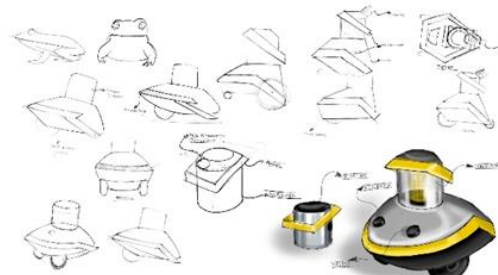


Fig. 5. Concept 4

5. Results and Discussion

Pugh's matrix was used to narrow down to the final concept. Each concept was scored based on various criteria. The concept 1 received the highest net score in the process as shown in table 1.

Table 1
Pugh's Matrix

Criteria	Concepts			
	1	2	3	4
Aesthetics	5	4	3	4
Compact	3	5	4	2
Mechanism	5	3	2	5
Usability	3	3	2	2
Features	4	2	3	3
Reliability	2	3	3	2
Total	22	20	17	18

All weightage were measured out of 10.

1) Final Concept "IMMIX"

A detailed 2D render of the final concept was designed as shown in figure 6. Using the same theme board from the final concept, different Attachments was developed as shown in figure 7. 3D model of the concept was developed in Catia V5 and was rendered in Keyshot.

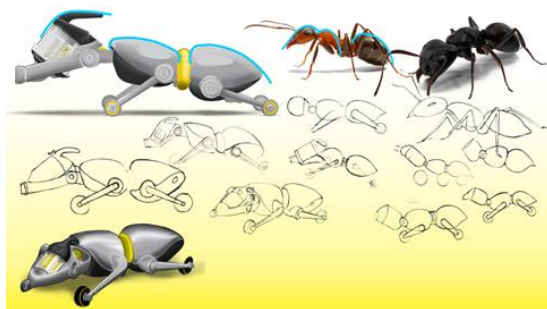


Fig. 6. 2D Digital Rendering



Fig. 7. 2D Digital Rendering Attachments

2) Product Parts

The final concept had a cyclonic canister with a flexible head the body was divided into 3 parts like vacuum cleaner pressure washer and the connecting mechanism more as shown in the figure 8

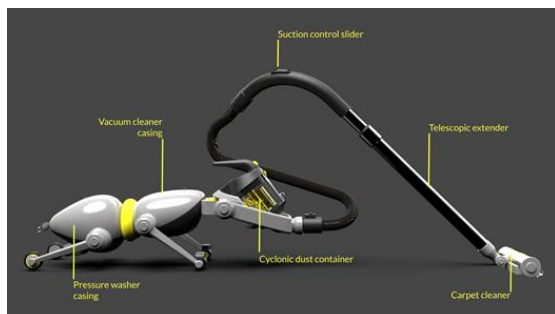


Fig. 8. Parts

3) Features Involved

Immix is having features like a touch bar for motor speed control, automatic wire rewind, cyclonic dust container, easy

connecting mechanism, LED light strip as shown in figure 8 and figure 9.

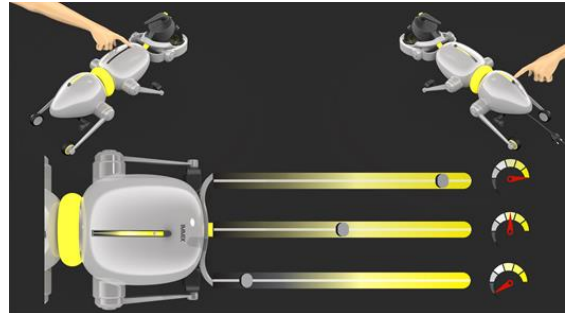


Fig. 9. Features 1

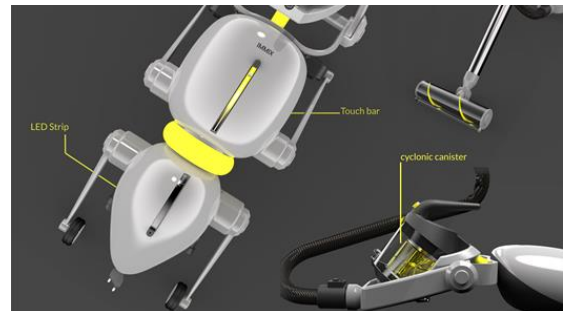


Fig. 10. Features 2

4) Basic Dimensions

The model had basic dimension length of 580mm, height 240mm and width of 200mm as shown in figure 11.

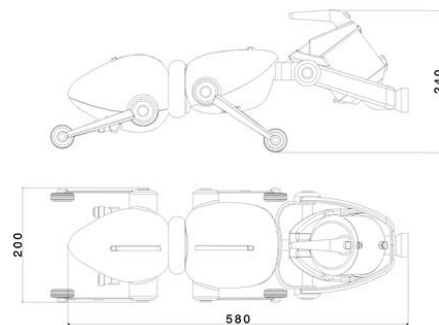


Fig. 11. Basic Dimension

5) Internal components

The different internal components are shown in figure 12

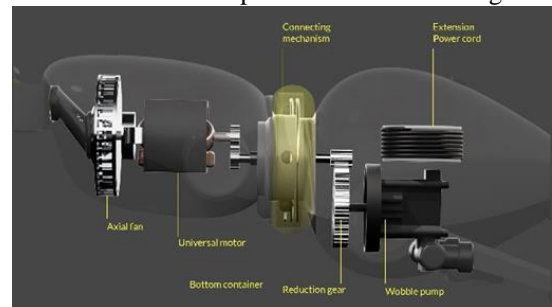


Fig. 12. Internal Components

6) Coupling Mechanism

The mechanism was developed based on the quick connector mechanism. In this mechanism it contains two springs which

resist the motion of the body parts, A ring with 4 balls were mounted on to the body of vacuum and the tail part has a groove to lock with those balls as shown in figure 13.



Fig. 13. Connecting Mechanism 1

The ring in figure 14 is pulled towards left which makes some space for tail part to slide in and the two springs resist this motion when outer ring is released the mechanism is locked and the two shafts from motor and pump are connected.

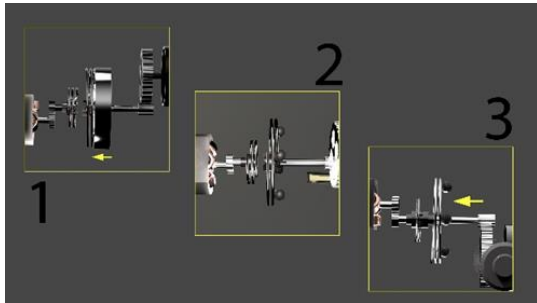


Fig. 14. Connecting Mechanism 2

7) Context of Products in Use

The below figure shows the real examples for the product usage.



Fig. 15. Context

6. Conclusion

The final concept “Immix” was designed to stand out from the existing vacuum cleaner and a pressure washer by combining them using a single motor. Inspired to make this more cost effective and easy to used device. In order to develop this concept, the material study, product study and user study were conducted. The concepts selected was designed on the basis of aesthetics quality and ergonomic parameters. The concept was 3D modelled using a Catia V5 and rendered using keyshot for a better visual representation.

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