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ROBOTIC VACUUM CLEANER

Introduction

Robotic vacuum cleaner is a floor cleaning vacuum to work with minimal human intervention. It is built with sensors and robotic drives with programmable controllers. The most common generic trademark for Robotic vacuum is Roomba or Robovac. **Some of the best robot vacuum cleaners in the market** are **iRobot, Neato, Dyson, Shark, and Samsung.** (Refer Figure 1)

Figure 1: The Robotic Vacuum Cleaner

History of Robotic Vacuum Cleaner

In 1956, the concept of robotic vacuum cleaner came in a science fiction. **The first Robotic vacuum Cleaner, the Electrolux Trilobite was introduced by Swedish company Electrolux in 1996.** In the year 2002, iRobot launched Roomba. Roomba was the first successful robotic vacuum. In 2010. Dyson and iRobot introduced camera based mapping in 2015. In 2022, ECOVACS launched BEEBOT_X1 Family featuring YIKO Voice Assistant and AI voice interaction technologies.

Main Functions of Robotic Vacuum Cleaner

Regular daily time consuming tasks are accomplished with minimal human interaction. Robotic vacuum cleaner helps in sweeping the floor and vacuuming, it can also help to mop the floors.

- **Sweeping and vacuuming**
- **Mopping**

Features of Robotic Vacuum Cleaner

Robotic vacuum cleaners include **rotating brushes** for sweeping, floor mopping, UV sterilization, a navigational system integrated with **security cameras,** and Intercom systems. (Refer Figure 2)

Anti-Drop Feature: Most Robotic vacuums include anti-drop and anti-bump features.

Anti-Winding Feature: When approaching obstacles, will automatically turn away.

Anti-Twining: Prevents the Robotic vacuum from getting twined by wires.

Virtual No-Go Lines: Set boundaries, to restrict the movements to desired cleaning areas.

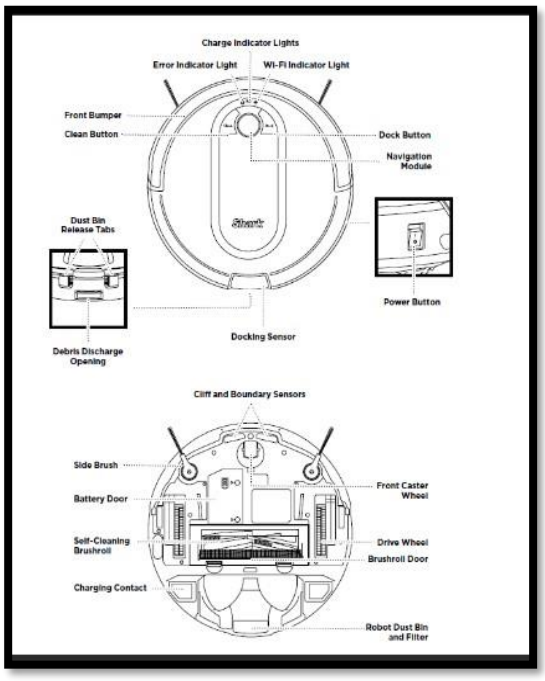

Figure 2: Features of Robotic Vacuum Cleaner

Quick recharge: This allows the unit to calculate the shortest way to recharge and charge as much as needed to finish the remaining task.

Connected app: This allows using an app over a Wi-Fi connection, from your Smartphone or Connected devices such as Alexa and Google Assist

HEPA Filters: HEPA air filters are industry standard now for vacuum cleaners. These remove dust and pollen from the air.

Memory of Robotic Vacuum Cleaner:

Using AI, Robotic vacuum poses a **fairly good memory** and has the ability to form a virtual map of the area (Refer Figure 2).

Bluetooth Capability: Allows using an **app on our phones** via Bluetooth to operate remotely.

Working Modes of Robotic Vacuum Cleaner

Robotic vacuum cleaner can work in the following cleaning modes,

- **Auto**: Cleans until the battery runs out.
- **Spot: Focuses on a particular dirty zone.**
- **Turbo**: Cleans and picks up the most dirt and dust.
- **Edge**: Cleans edges & corners.
- **Quiet**: Reduce its noise level.
- **Remote control**: Allows the user to control the vacuum cleaner. (Refer Figure 3)

Figure 3: APP Control

Working Principles of Robotic Vacuum Cleaner

In the last few years, Robotic vacuum cleaner technology has advanced significantly. Robotic Vacuum Cleaners are enabled with artificial intelligence (AI) and the internet of things (IoT). Robotic vacuum cleaners are designed with six mechanisms.

1. Wheels and Motors
2. Dustbin and Filters
3. The Vacuum
4. The brushes

5. Navigation Sensors
6. Battery Power

1. Wheels and Motors

Robot vacuums move on **two large wheels** on each side and with **a nose wheel** in the front. It operates with an **electric motor** that provides the suction for the vacuum. As many as **five motors** are there,

- **One driving each wheel (2 total).**
- **One driving the vacuum.**
- **One driving the spinning side brush.**
- **One driving the agitator assembly.**

2. Dustbin and Filters

The dustbins trap all dirt and debris. Typically, all dustbins use HEPA or HEPA-style filters to keep the air clean (Refer Figure 4).

Some Robotic vacuum dustbins are emptied **manually**; others will automatically eject the contents of their dust cup into a larger dust bin in a docking station.

Figure 4: Dustbin and Filters

3. The Vacuum

Robotic vacuum cleaners use standard vacuum functioning. Relative vacuum suction strength is described as efficiency, 3X the power, or turbo.

4. The Brushes

The suction created by the motor allows the vacuum to collect dirt using a **series of brushes**. There are three types of brushes:

- The **spinning side brush** sticks out to reach spots the underside cannot access.

It spins along walls to kick up dirt and direct it into the vacuum area. The brush on the opposite side directs any wayward dirt back under the unit to be sucked up.

- Double V Brush
- A **rotating brush bar** on the **agitator** on the underside of the vacuum consists of two counter-rotating brushes that grab dirt and other debris and deposit it directly in the dust bin.

5. Navigation Sensors

Figure 5: Ultrasonic Sensors and Impact Sensors

Robotic vacuums use a combination of **sensors and algorithms** to map out the area to be clean. These stop Robotic vacuum cleaners from falling from stairs or drop-off. Some Robotic vacuum Cleaners utilize **ultrasonic sensors** instead of light (Refer Figure 5).

Different types of sensors are used for better navigation,

- **Cliff/Drop sensors**: Located at the base of the robot vacuum to sense the edge of the surface to prevent it from falling down a drop.
- **Proximity/Wall sensors**: Look for a continuous line, which is a wall.
- **Impact sensors**: Impact sensors alert it when it has bumped into an obstacle and change path (Refer Figure 5).
- **Mapping**: Uses **navigation technologies** to map the area, like **gyro**,

cameras, and LiDAR **radar and laser** to get a detailed map of the area. Some models can store this **map**. **Mostly Infrared lasers** are used for mapping, some use **physical boundary stripes** that are placed on the floor to ensure the cleaning in a specific area.

- **Optical encoders:** These are sort of a yard measuring wheel (Rotary Encoders) and are used to **measure the number of rotations of the wheels** in order to measure the distance it covers.

6. Battery Power

Most Robotic vacuum cleaners use Lithium metal-hydride rechargeable batteries. Which lasts 100 minutes and clean 200 m^2 of floor space. The normal charge time for the battery is 5 to 6 hours (Refer Figure 6).

Figure 6: Battery Charging

Advantages of Robotic Vacuum Cleaner

- **Ease** of using it.
- **Cleaning is done with minimal human interaction.**
- It can easily creep under tables and chairs to clean.
- **Low noise**.
- Since Robotic vacuums are **smaller and weigh less,** they are **easy to carry and store.**

Disadvantages of Robotic Vacuum Cleaner

- Can be expensive.
- May not clean as well as the manual vacuum.
- Sometimes get stuck under the furniture or sometimes get **tangled** into some wires or stuff.
- Takes an extended amount of time to vacuum an area due to its smaller size.
- The battery runtime is as little as 30–40 minutes.

Summary

In modern multitasking life, Robotic vacuum cleaners are **an essential part of daily cleaning. It saves** time. **My recommendation** is that if you do not need deep cleaning, it is **worth trying**.

References and Acknowledgements

Wikipedia, and Google.

Plagiarism Check

(Refer Figure 7)

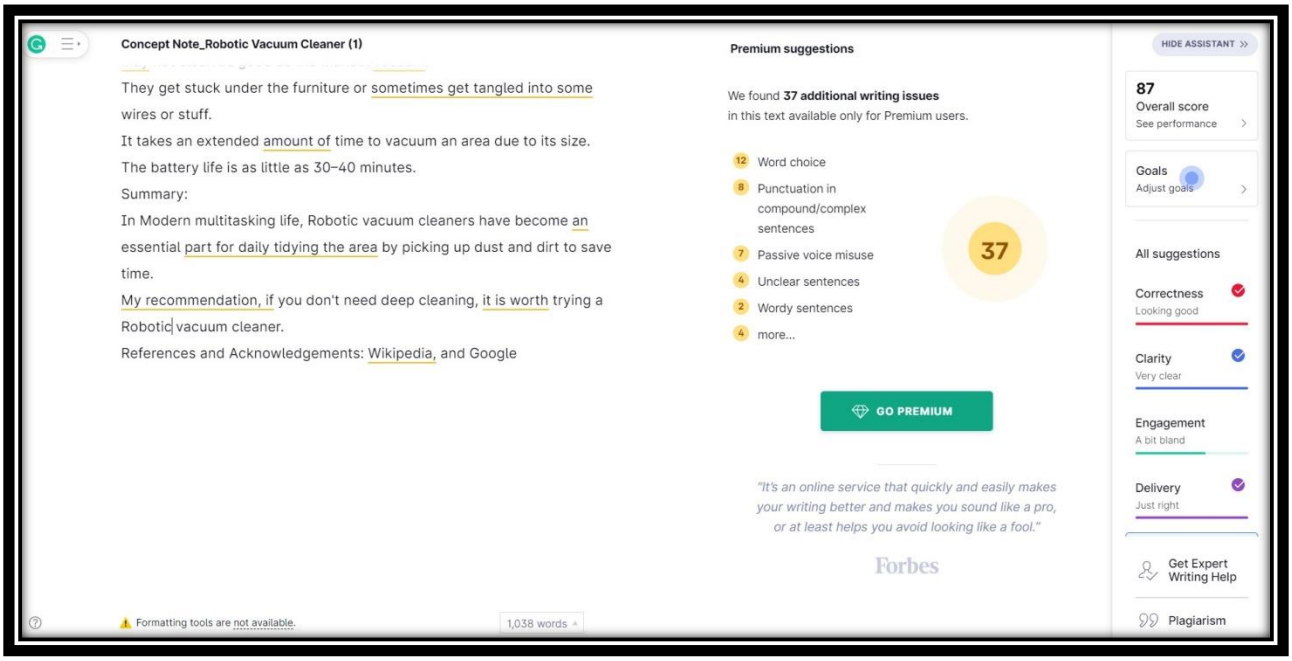

Figure 7: Grammarly Check