

High mobility robotic and
telerobotic vehicle concept,
capable of moving and navigating on
land, water and in midair.

Summary

Figures

Description

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Robotic and telerobotic vehicle concept capable of moving and navigating on land, water and in the air.

The present invention refers to a robotic and telerobotic vehicle concept with capabilities of moving and navigating on land, water and in the air. The technical solutions implemented in this invention help solve problems regarding the degrees of mobility of robotic and telerobotic vehicles, with applications in several industries such as: robotics, toys, consumer electronics, medical care, navy, executive, automobile, security and military.

Figures

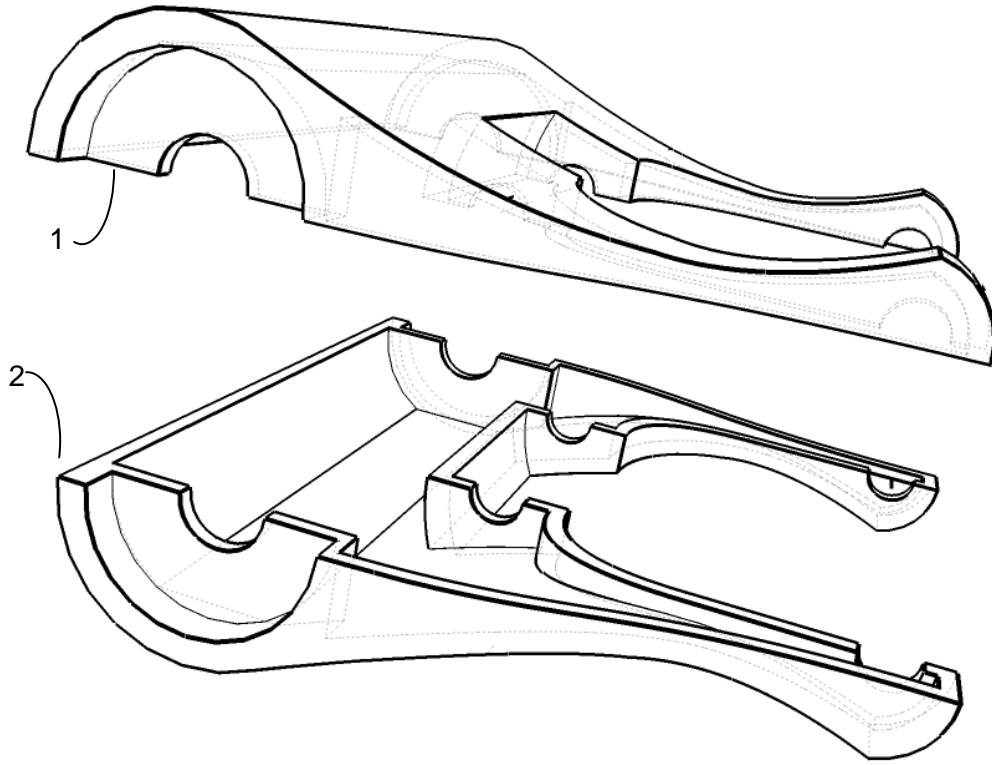


Figure 1

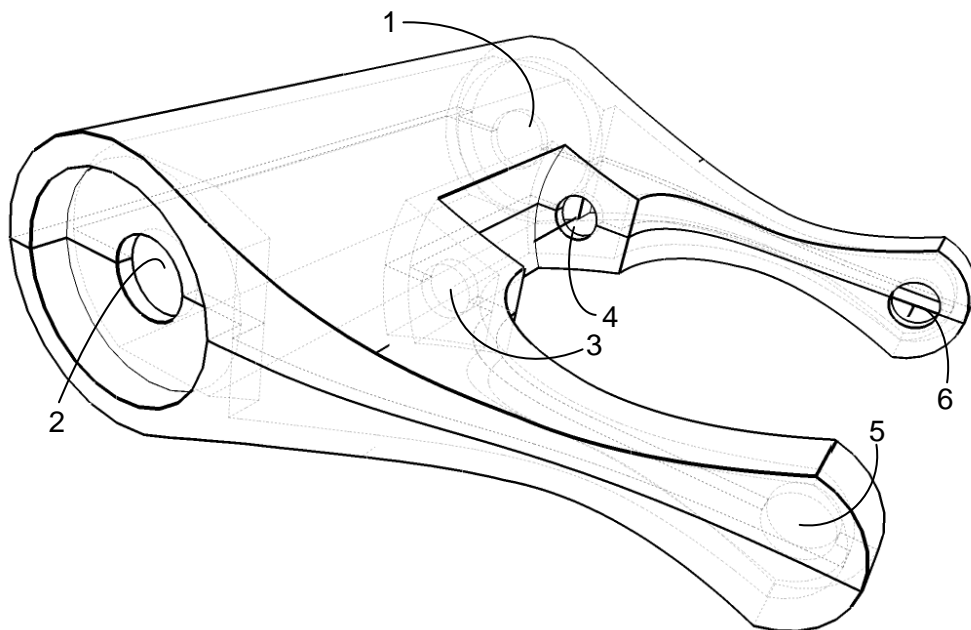


Figure 2

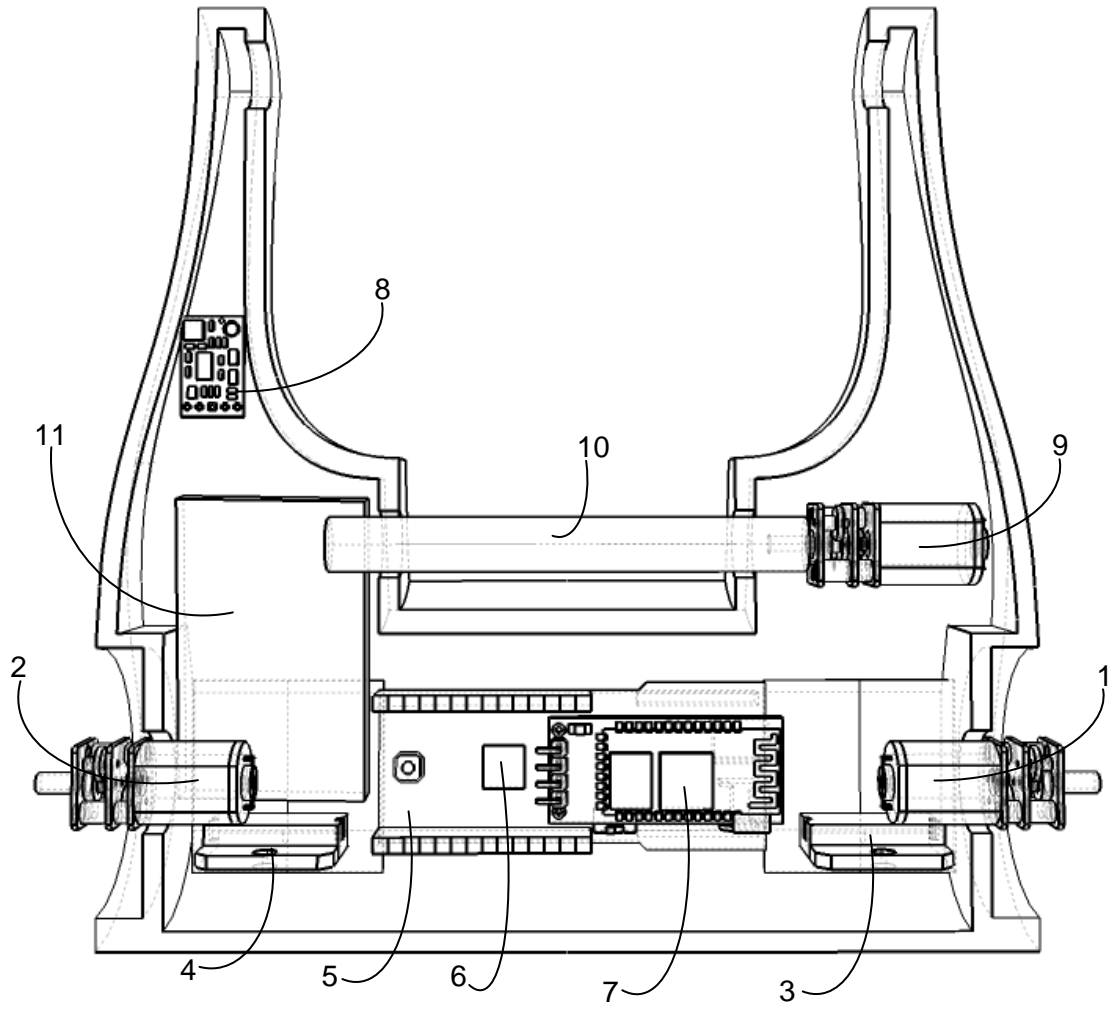


Figure 3

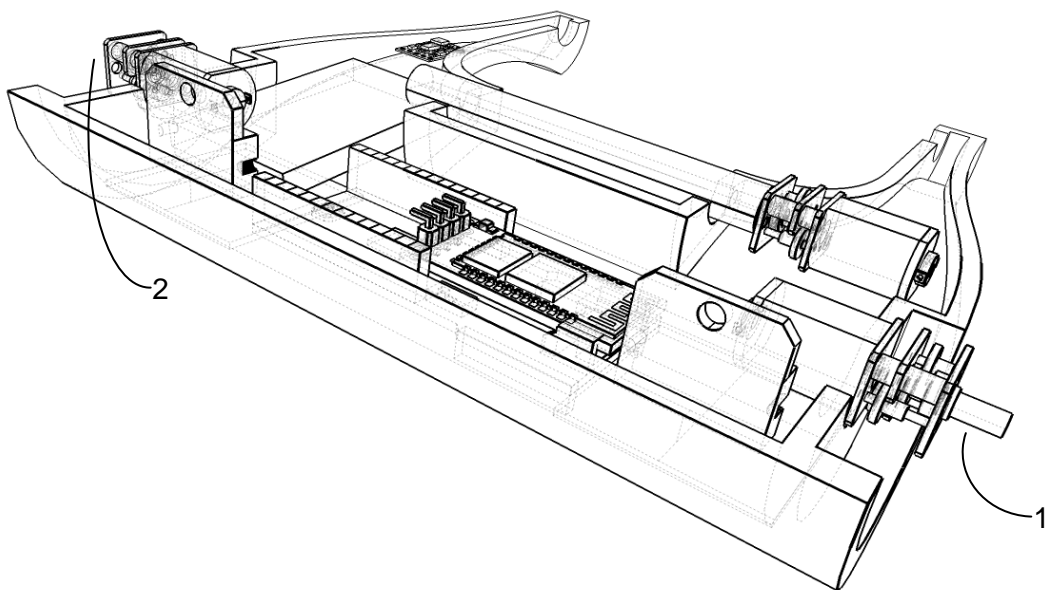


Figure 4

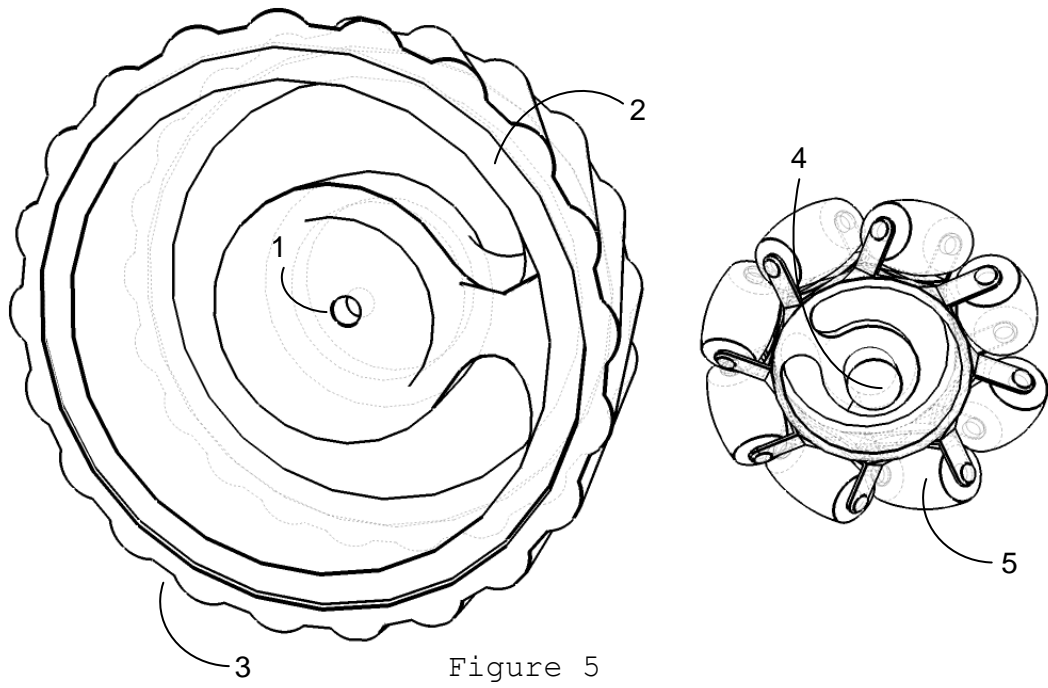


Figure 5

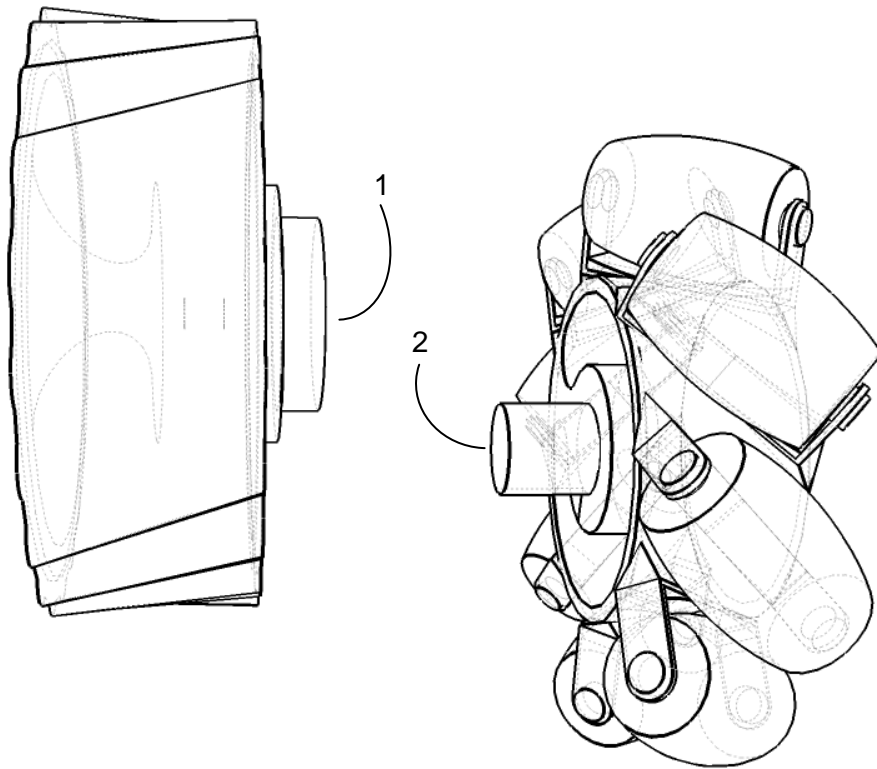


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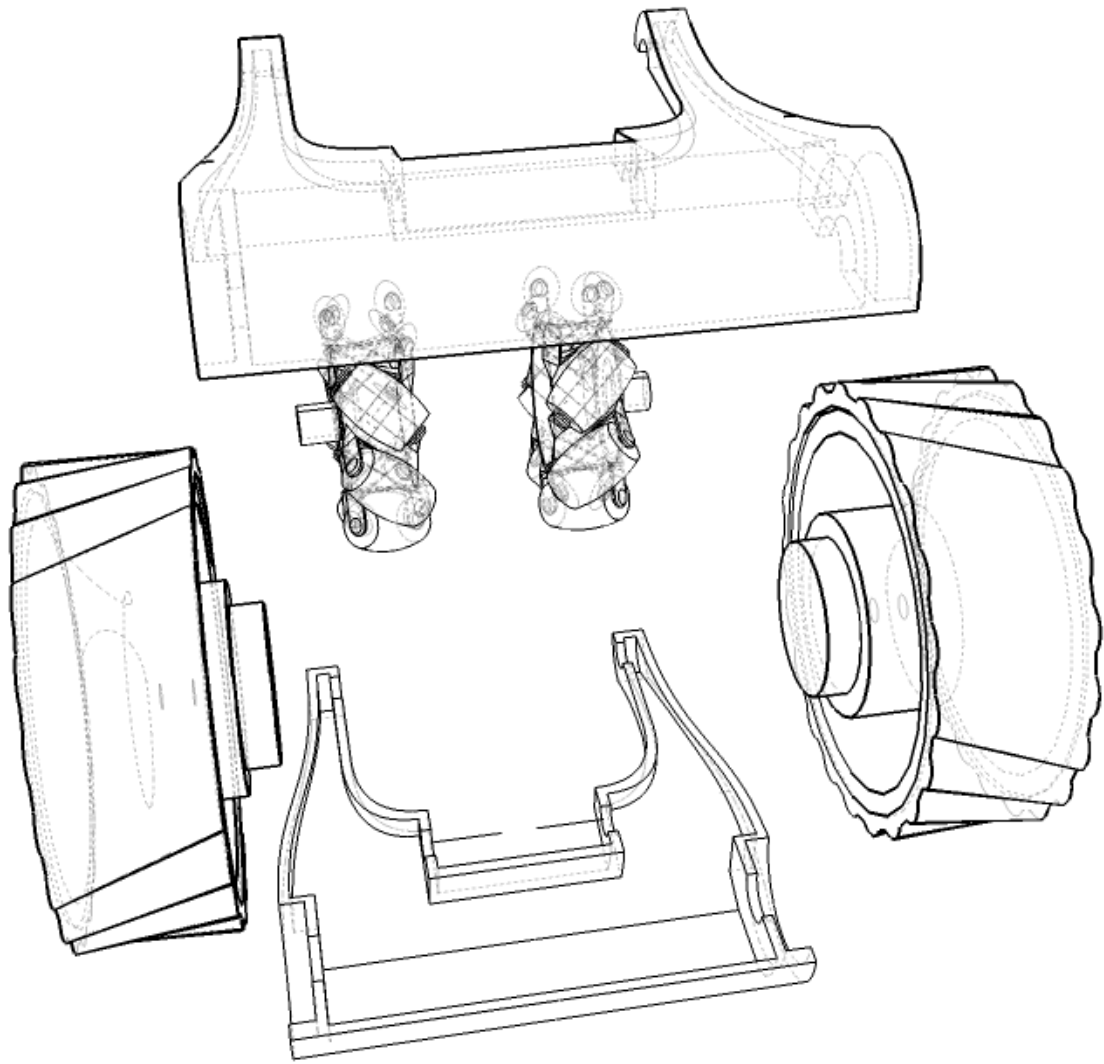


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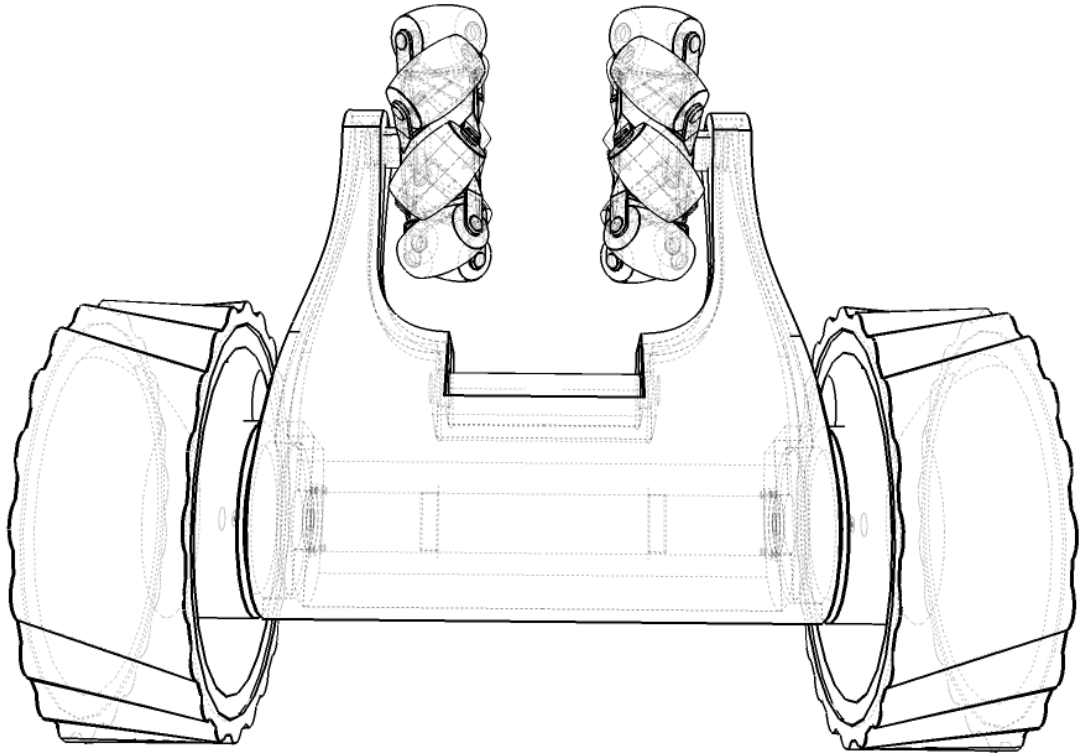


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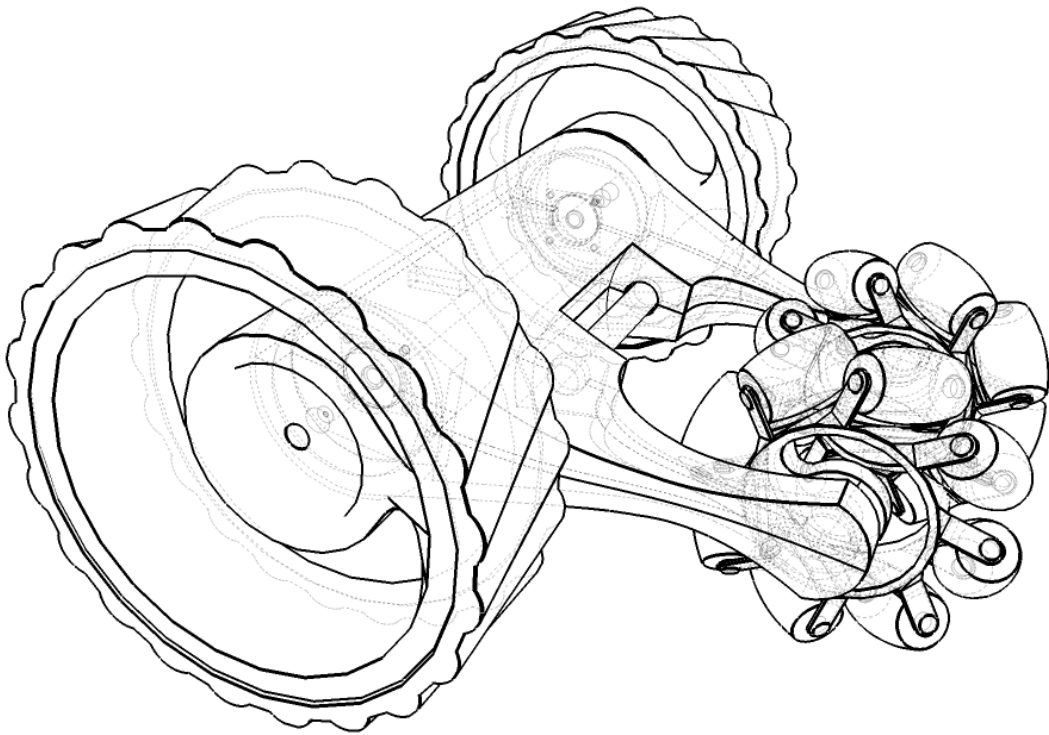


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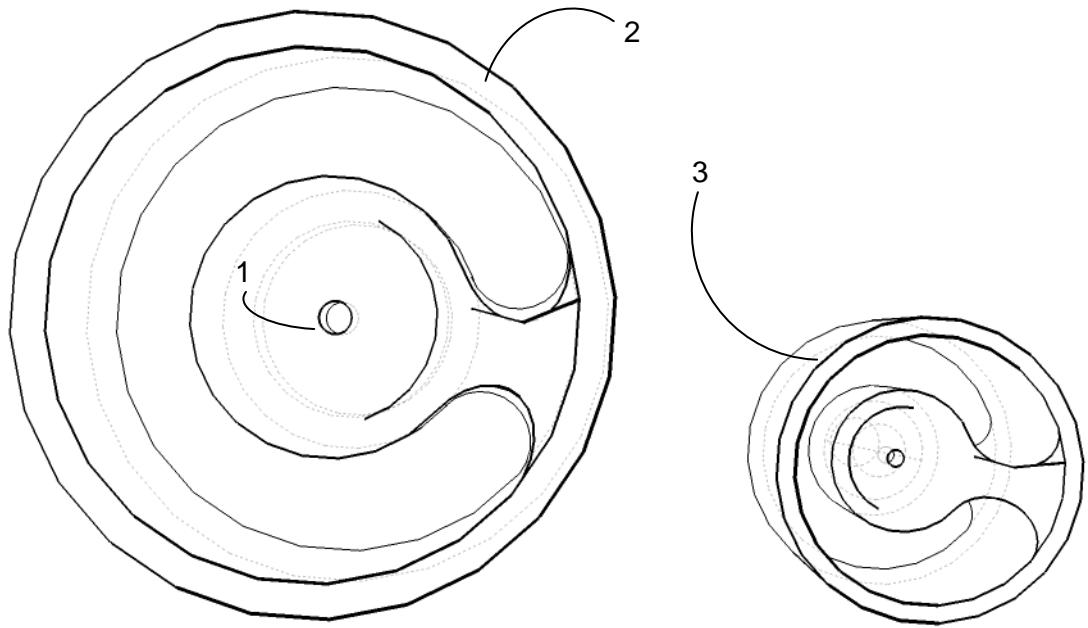


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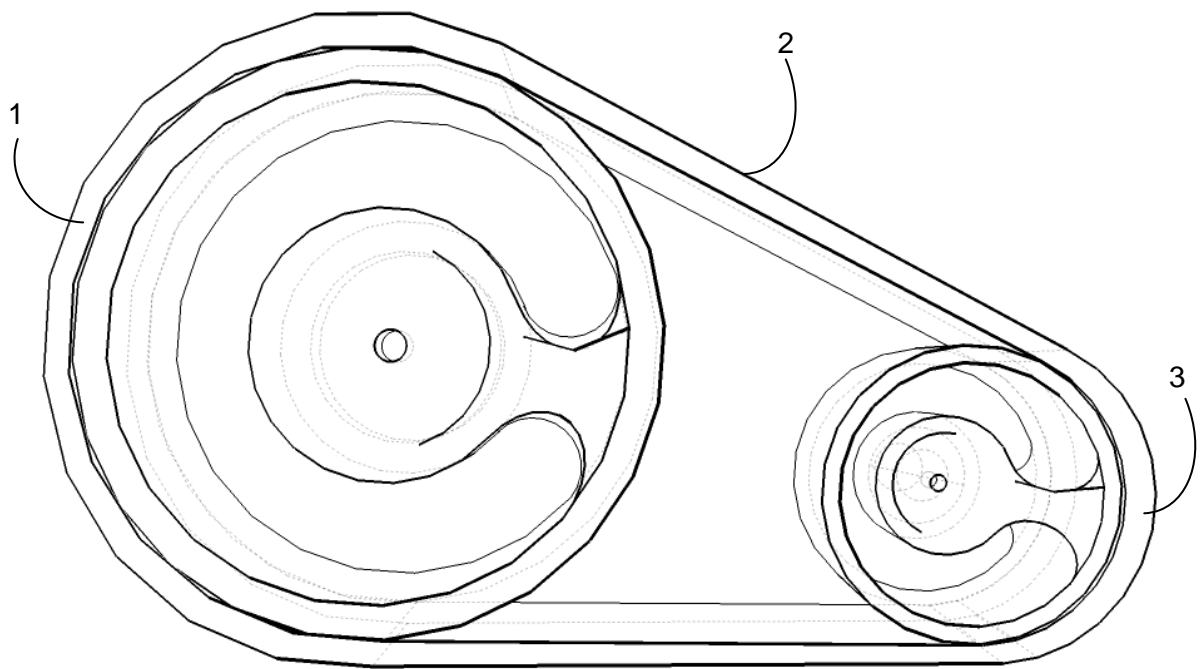


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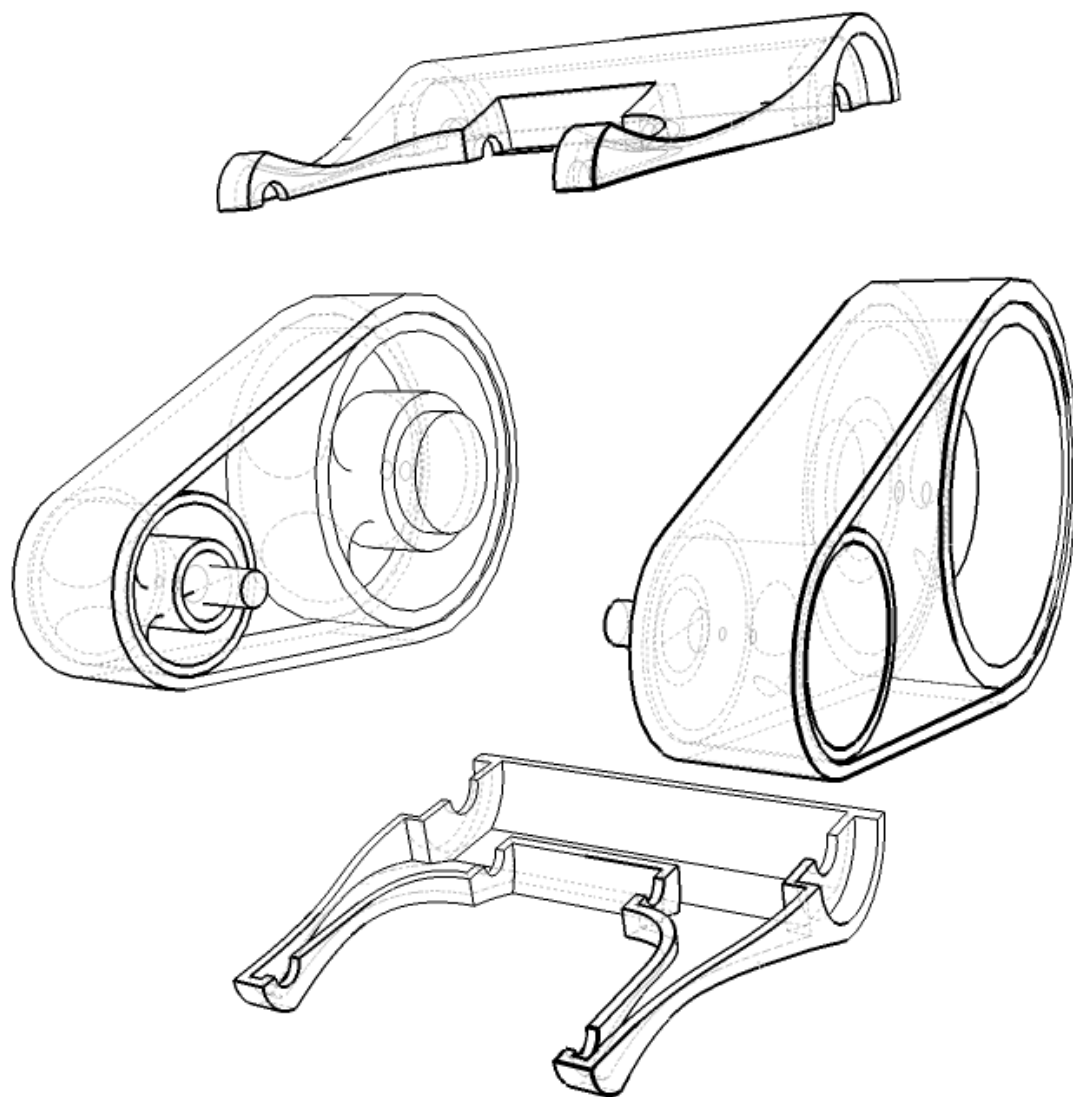


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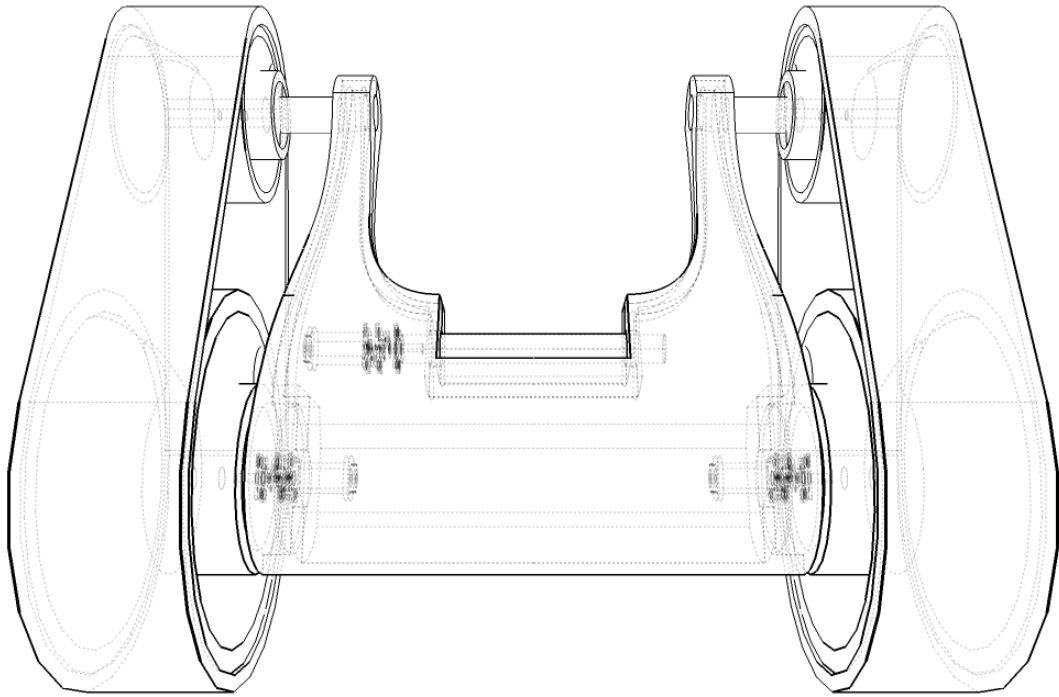


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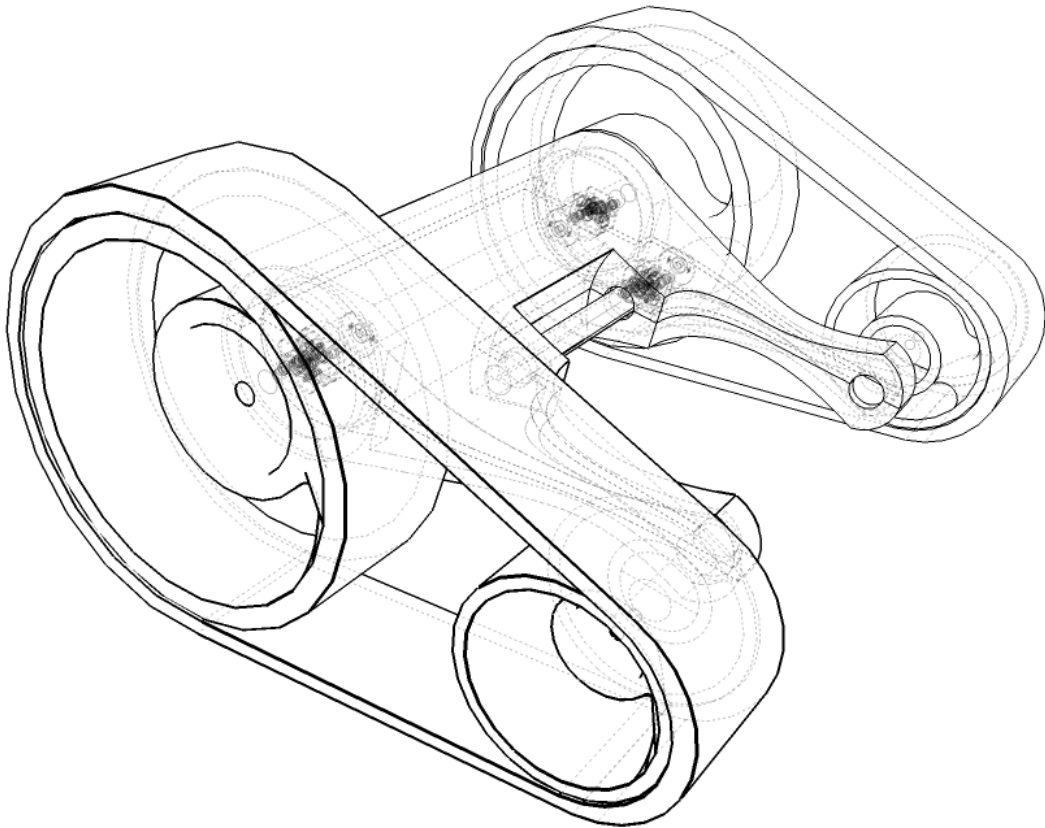


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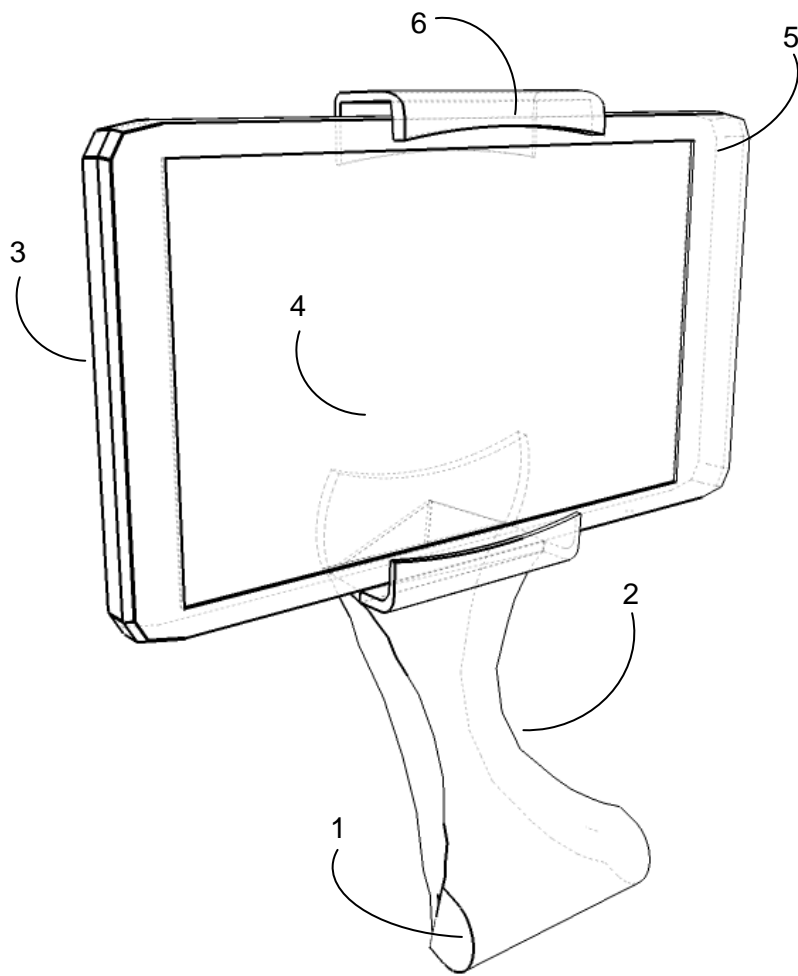


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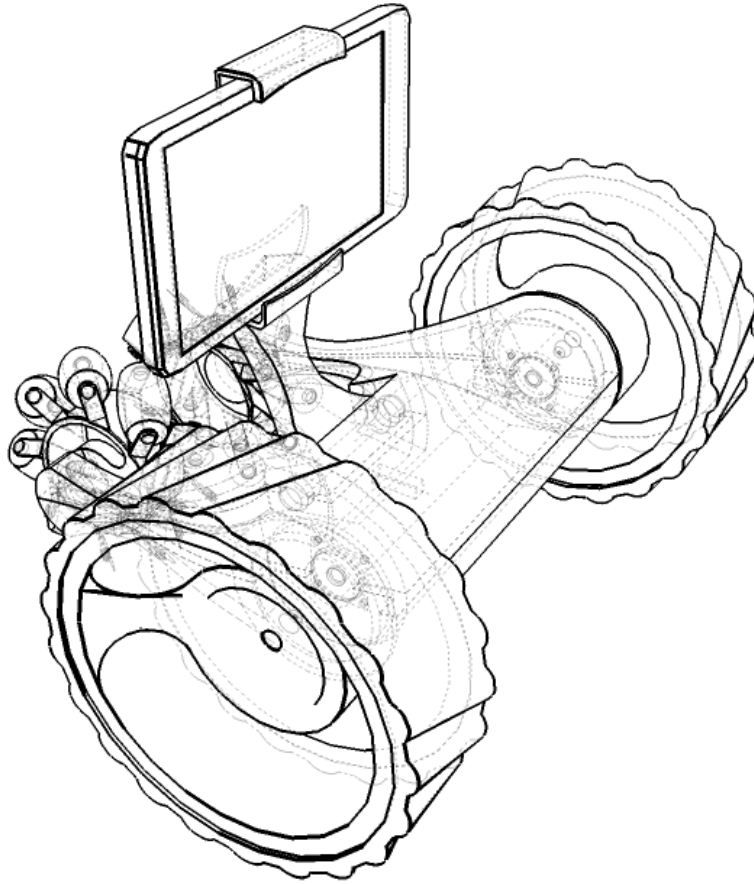


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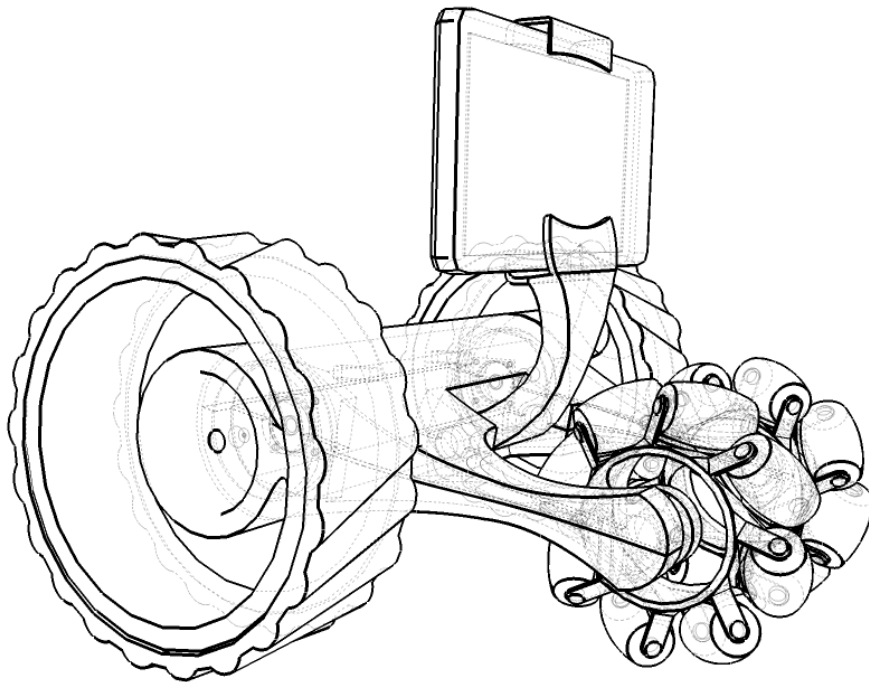


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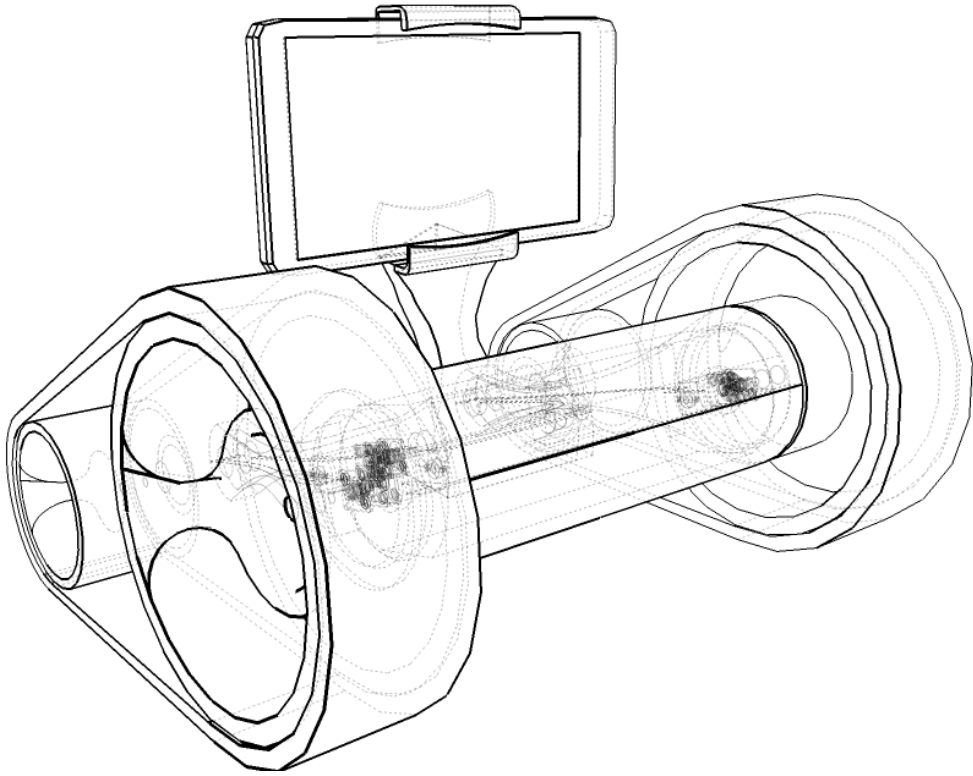


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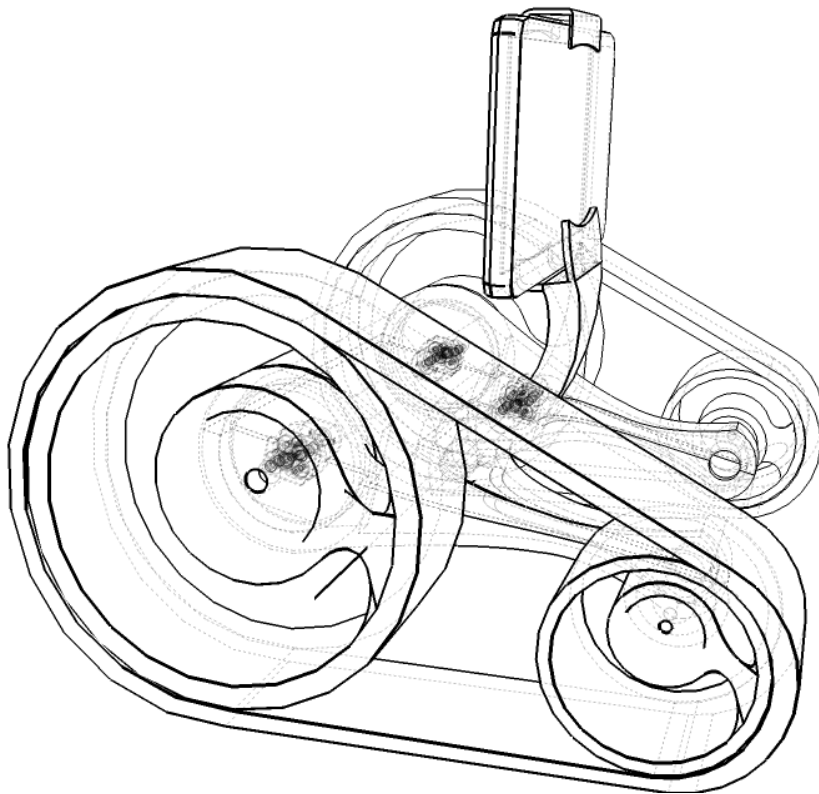


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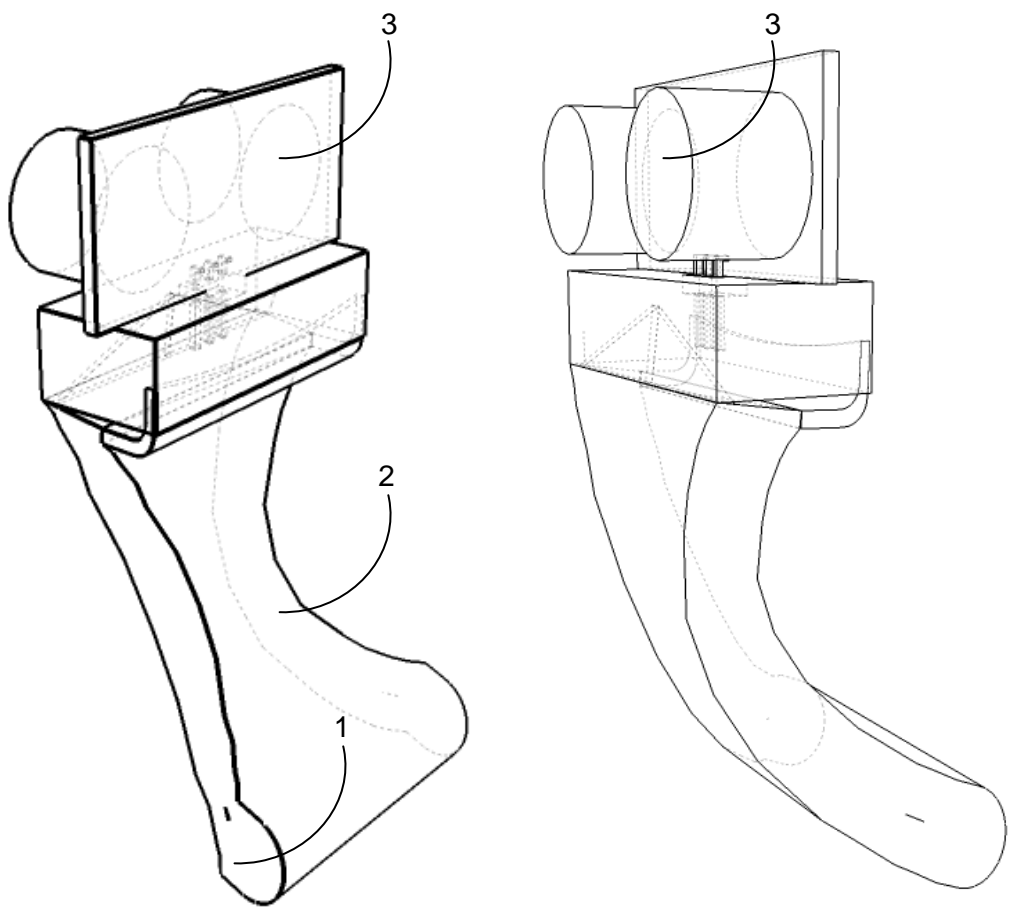


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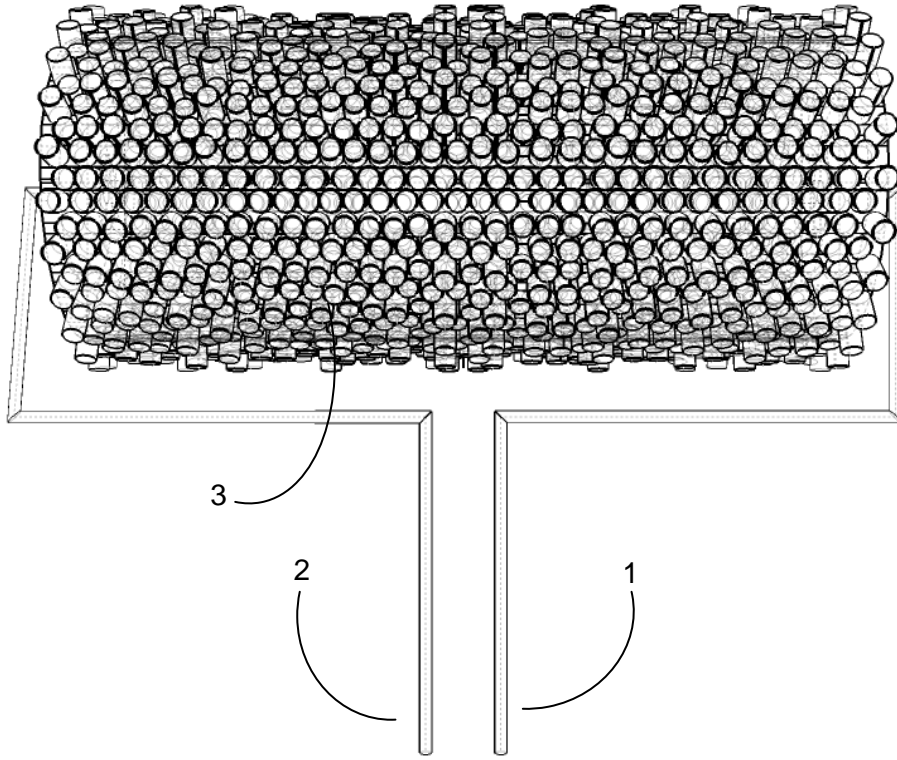


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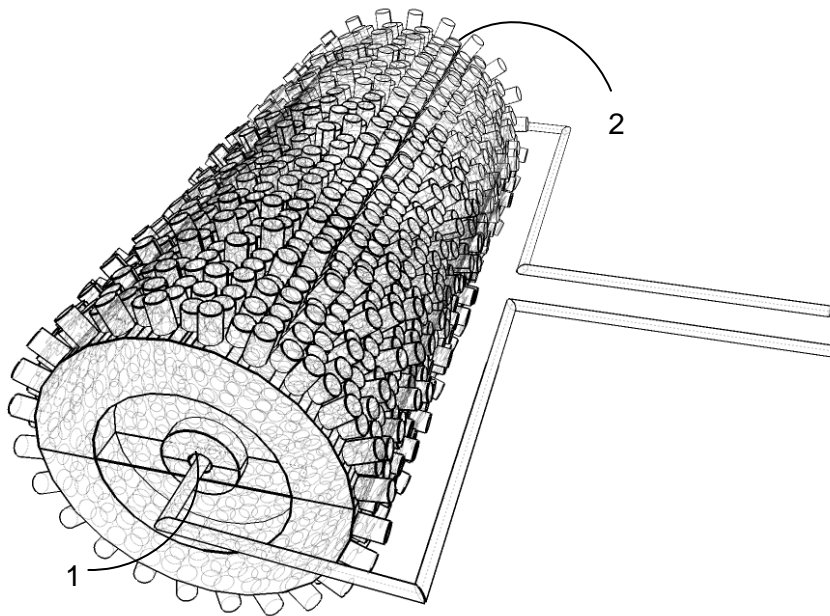


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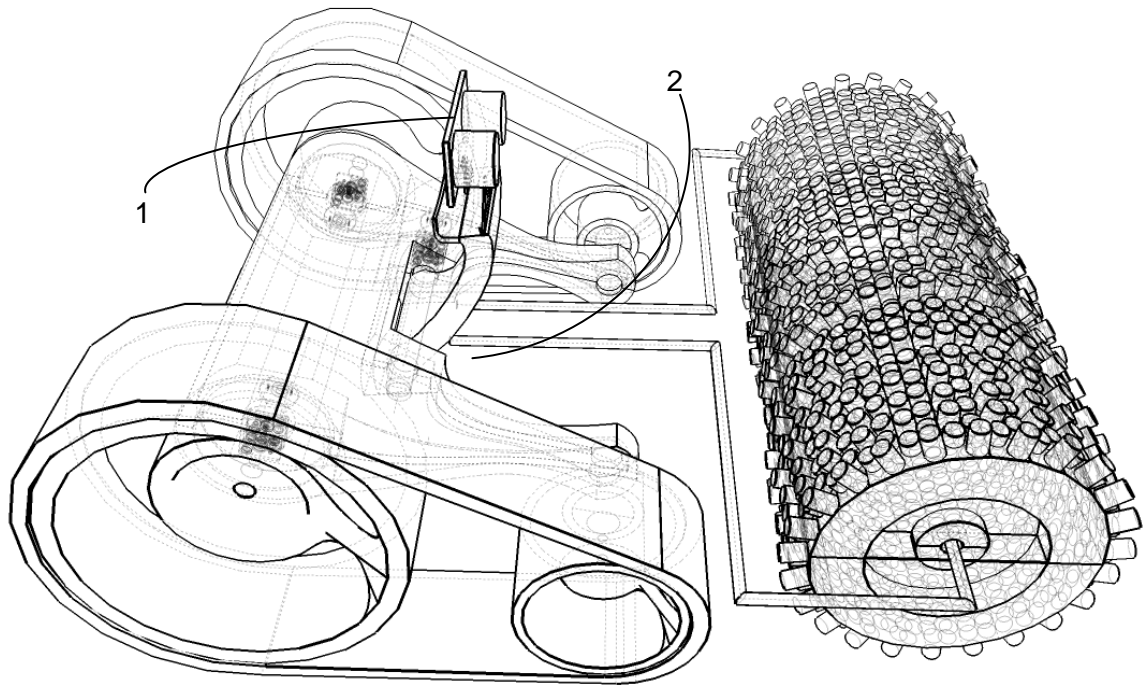


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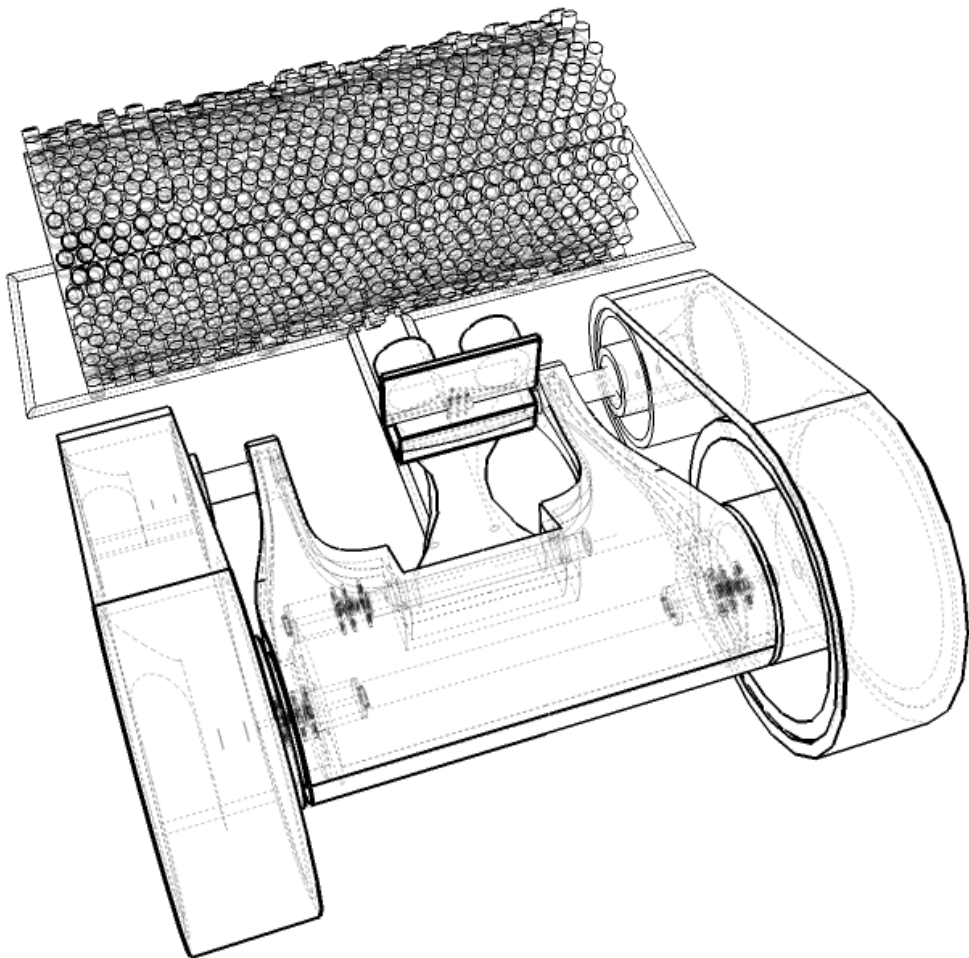


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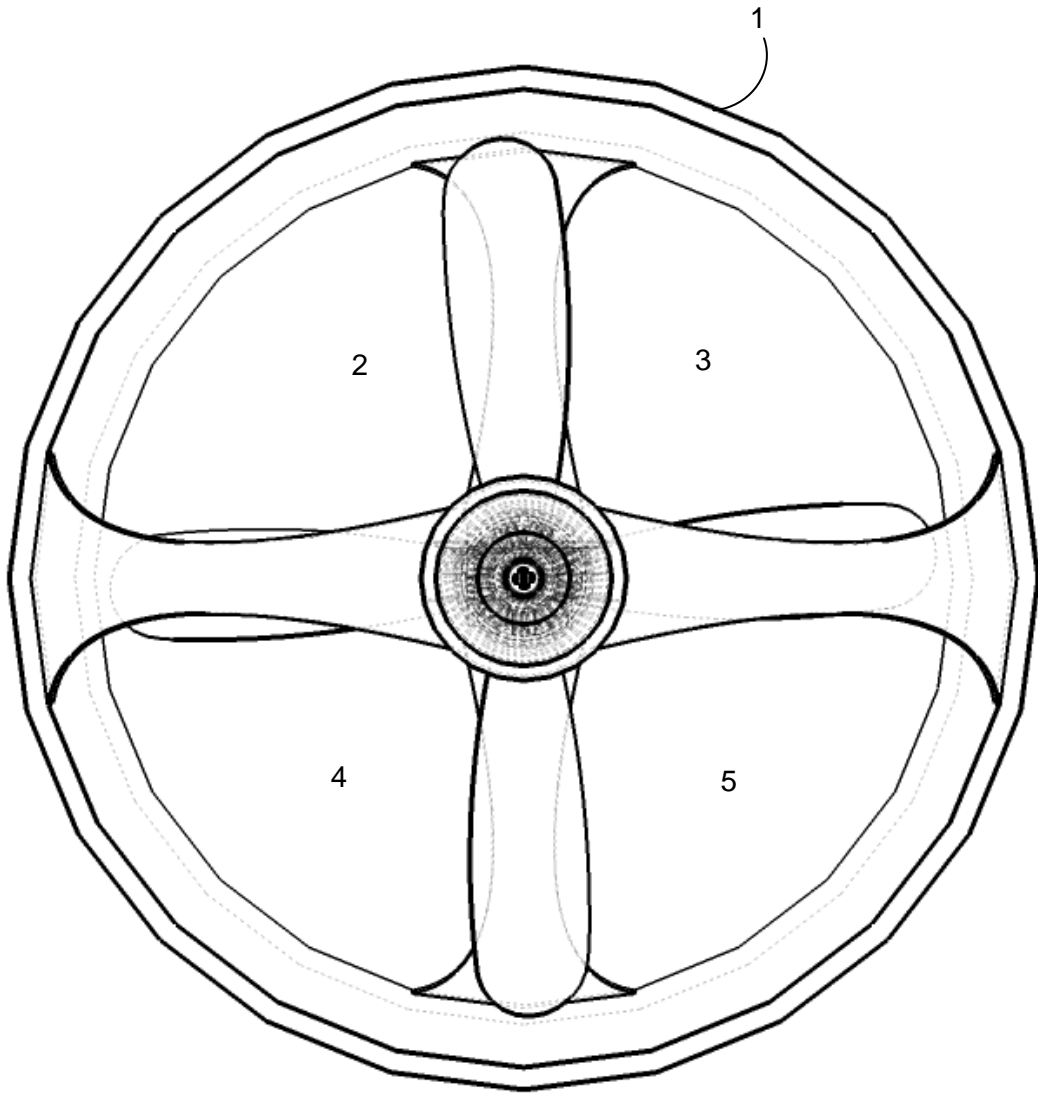


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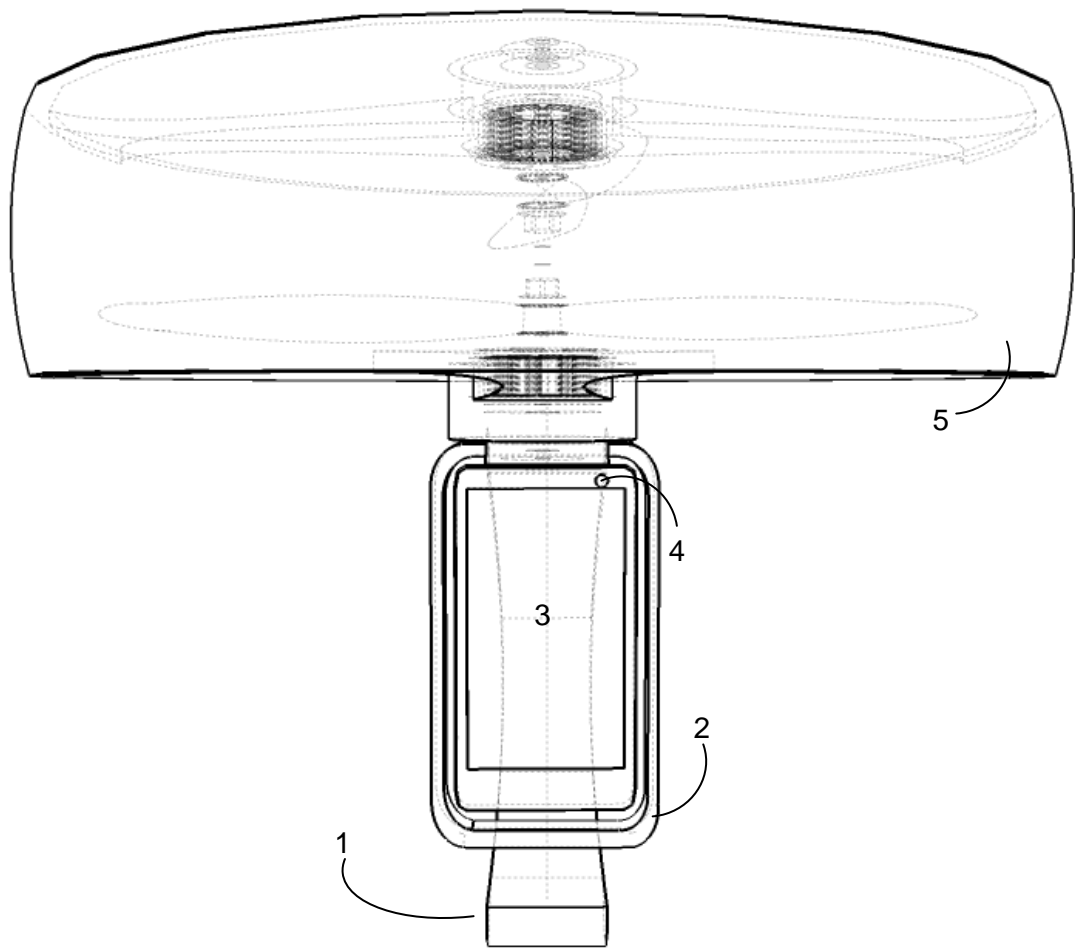


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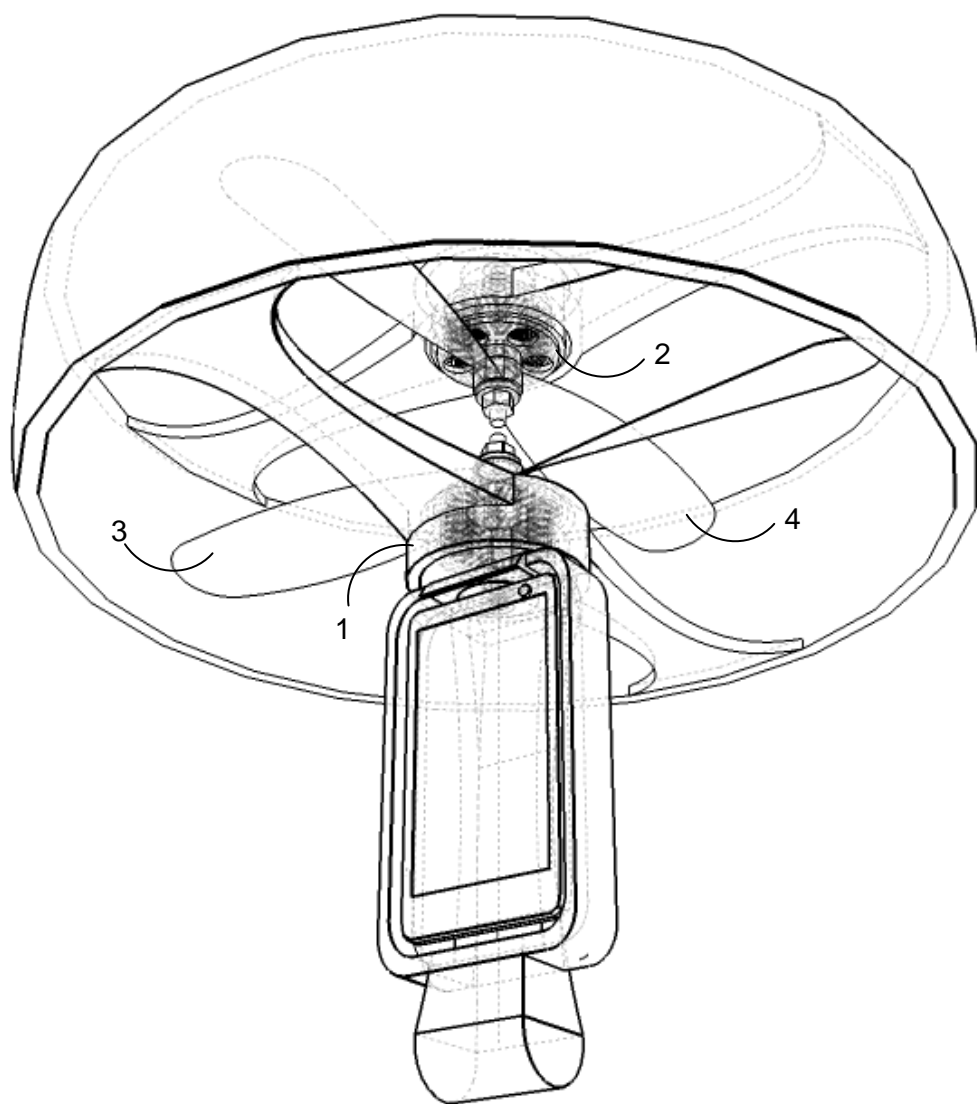


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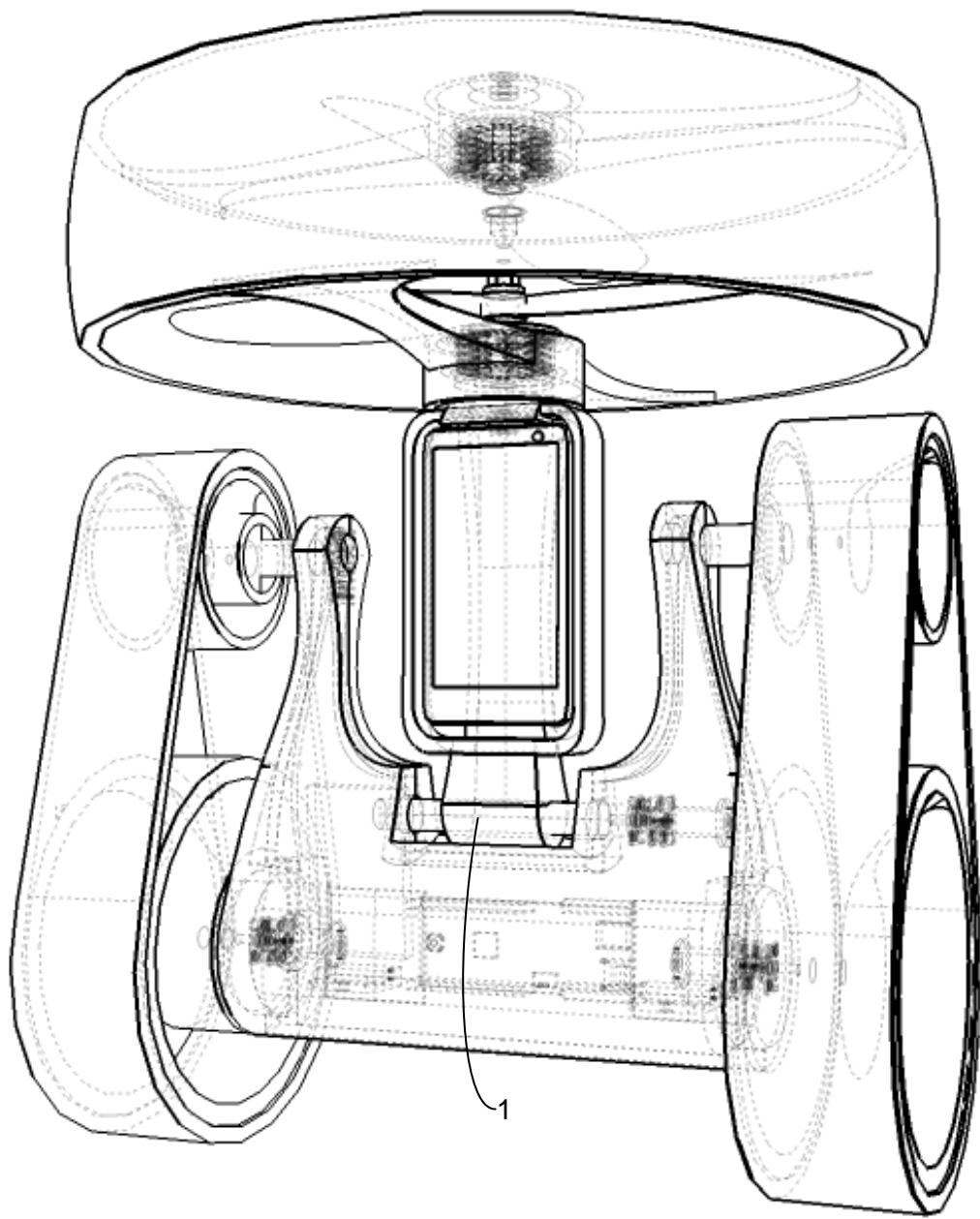


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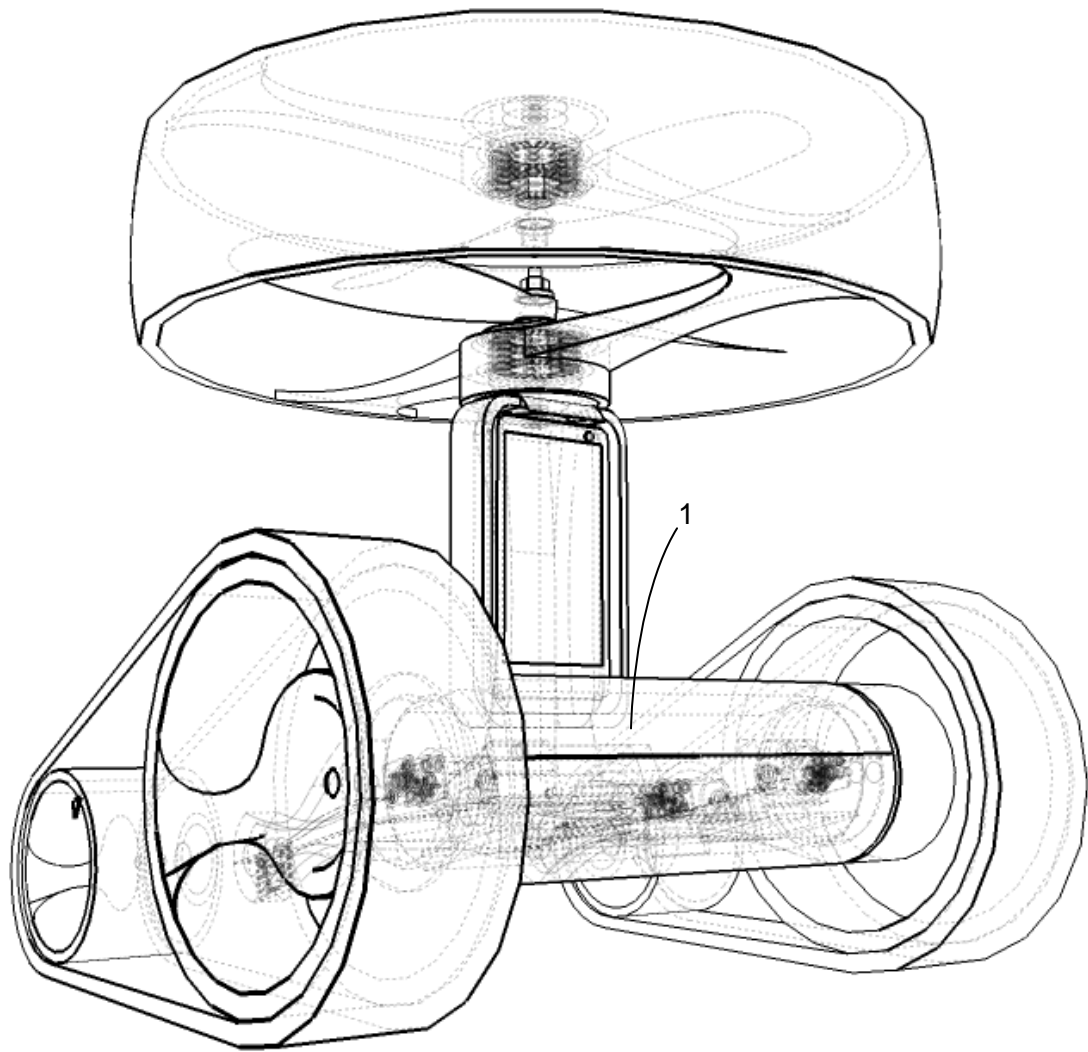


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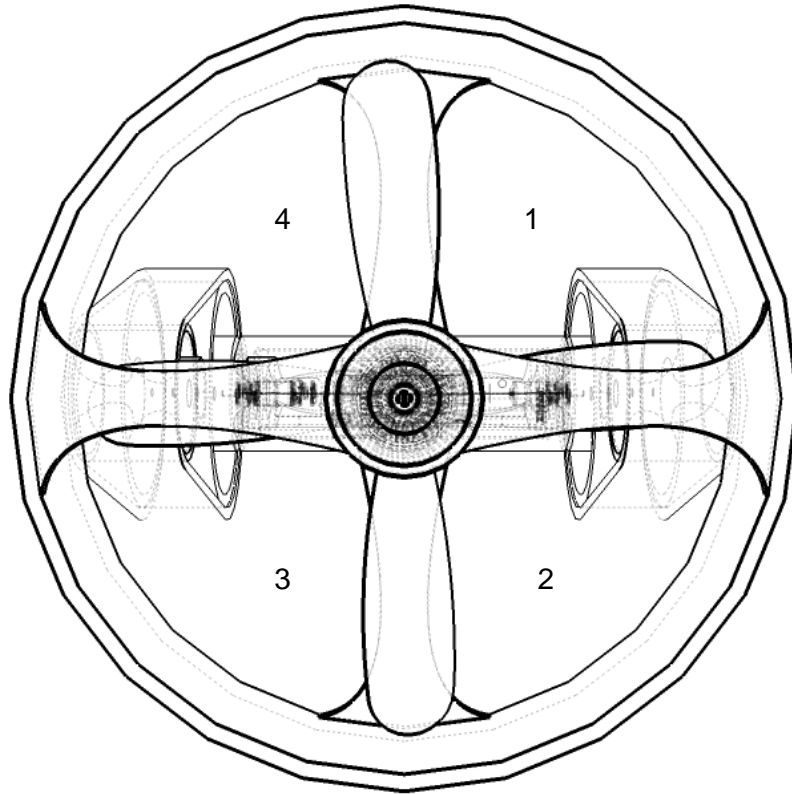


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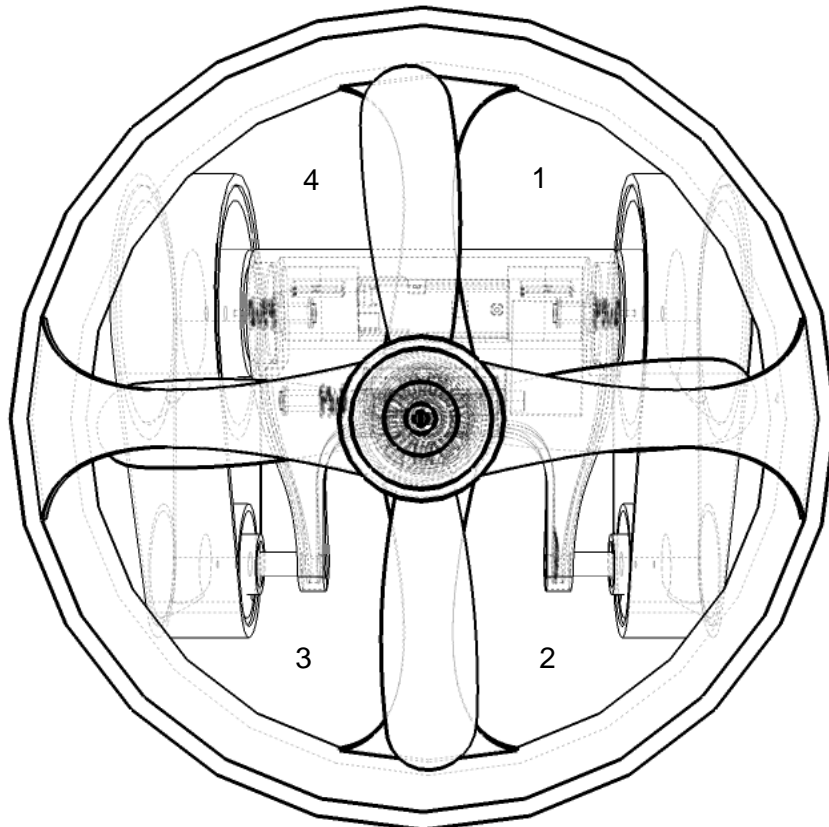


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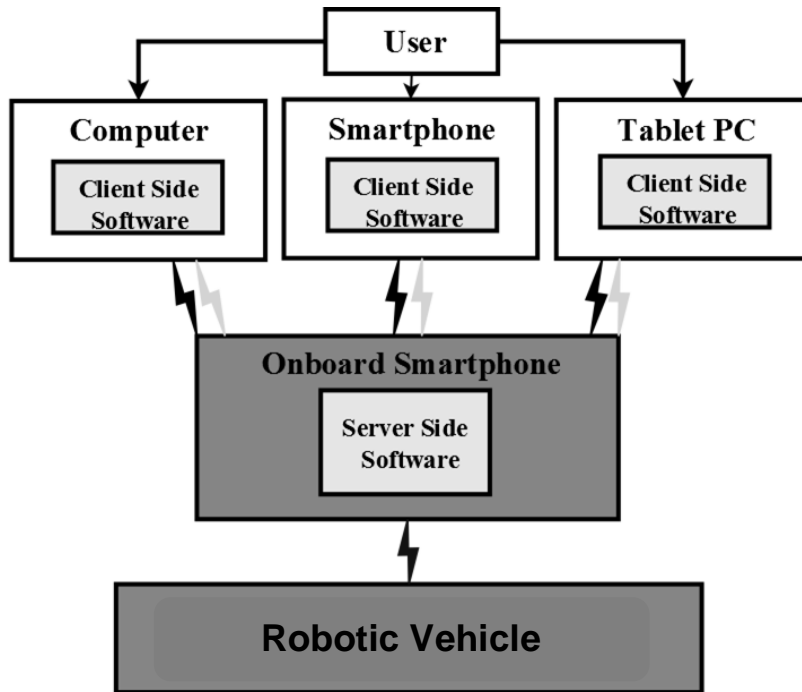


Figure 32

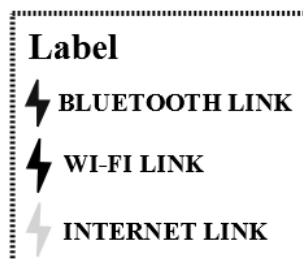
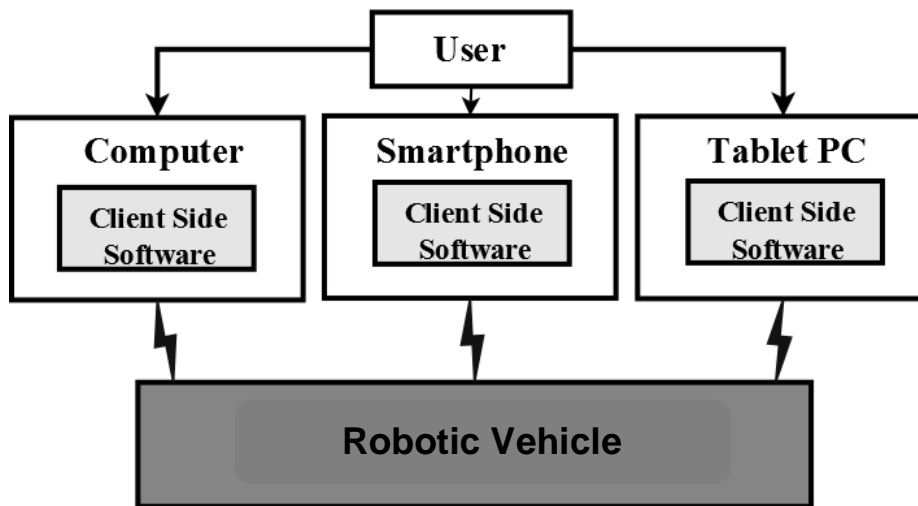


Figure 33

Description

Technical area of the invention

Robotic machines and vehicles have generated much interest in recent years due to their great promise for performing repetitive, dangerous, or information gathering tasks in hazardous or remote environments.

The diversity of environments in which these vehicles must operate (space, air, water, ground, and combinations of these) results in a wide variety of vehicle types.

Researchers in this field are taking several different approaches in the design, modeling, and control of these vehicles, for each of the four types of environment.

Among these challenges are communications, sensors, materials, locomotion, cooperative control, machine-level control, as well as computational horsepower and others.

The present invention consists of a high mobility robotic and telerobotic vehicle capable of moving and navigating on land, water and in the air. The vehicle is equipped with several attachable modules such as the flying module, the object avoiding module and the telerobotic module.

Functionality

Regarding Mobility:

1. The vehicle can move freely (remotely controlled by an operator or autonomously) on land using tank tracks or wheels.
2. The vehicle can move freely (remotely controlled by an operator or autonomously) on water using the air field hollow tank tracks or wheels to float. When the vehicle

is in the water, approximately 1/3 of the main chassis will be submerged and the remaining 2/3 will maintain itself above the water.

3. The vehicle can move freely (remotely controlled by an operator or autonomously) on the ground only balanced on its two front wheels. This feat is achieved by using the measurements of the inertial measurement unit (accelerometer, gyroscope and magnetometer readings) to maintain its balance.
4. When the vehicle in the position where it is balancing on its 2 front wheels, it can activate the propellers from the flying module to lift (remotely controlled by an operator or autonomously) into the air.
5. To turn the vehicle left or right in midair, it is necessary to create a difference in the speed of rotation of the two propellers. If the upper propeller is turning faster than the bottom propeller the vehicle will spin concentrically in one direction. If the upper propeller is turning slower than the bottom propeller the vehicle will spin concentrically in the other direction previously stated.
6. To move the vehicle frontwards or backwards in midair, it is necessary to change the aerodynamic characteristics of the wind trajectory, this is done by moving the motor attached to the chassis that supports the propeller system. By moving the motor forward the vehicle will lean forward and start moving forward in midair. By moving the motor backwards, the vehicle will lean backwards and start moving backwards in midair.

Regarding communications:

1. The vehicle can be remotely controlled by a remote operator using a Bluetooth capable device such as a Smartphone, PC or Tablet, via a Bluetooth communication channel (Figure 33).

2. The vehicle can be remotely controlled by a remote operator using a Wi-Fi capable device (Smartphone, Tablet or a Computer) via a Wi-Fi communication channel (Figure 32).
3. The vehicle can be remotely controlled by a remote operator using Wireless capable device via a wireless capable communication channel, such as AM, FM, etc.
4. The vehicle can be controlled by a remote operator using a device connected to the internet or a private network to communicate with the onboard Smartphone or Tablet PC.

Regarding autonomous navigation:

1. The vehicle has the capability to navigate autonomously, avoiding obstacles or following an object, by using the inertial measurement unit and image processing from the onboard computers (Smartphone or Tablet) camera sensor and other sensors (ultrasonic range finder).
2. Autonomous navigation in a preset path can also be attained by remotely or physically reprogramming the vehicles microcontroller to follow a specific route.

Regarding electronic circuit components:

1. The main electronic circuit board is composed by a microcontroller, motor controllers and a wireless communication module (Bluetooth, Wi-Fi, AM, FM, etc) (Figure 4).
2. The inertial measurement unit is composed by an accelerometer, gyroscope and a magnetometer, and is electrically connected to the main circuit board. The inertial measurement unit transmits its measured values to the microcontroller (Figure 4).

3. All electronic circuits are powered by an onboard battery (Figure 4).
4. All motors are powered by the battery and controlled/driven by the microcontroller/motor controller (Figure 4).

Regarding Tele-Presence:

1. The vehicle has an onboard computer such as a Smartphone or a Tablet that can communicate wirelessly and perform a Tele-Presence connection to a remote operator's device (Computer, Smartphone or Tablet).
2. The remote operator can perform full Tele-Presence capabilities, this is: a two way audio and video call, from the onboard device to the operators device.
3. The remote Tele-Presence operator can control the robotic vehicle in real time alongside the Tele-Presence service (telerobotics).
4. Only one remote operator can control the vehicle at a time, but different remote operators can tune in and watch the Tele-Presence stream using appropriate software.

Figure descriptions

Figures (1) to (14) describe the robotic vehicles main chassis and its enclosed electronic and mechanical components.

The chassis is composed by two symmetric plates that come together to form the enclosed structure of the vehicle. Inside this enclosure are the electronic and mechanical components of the vehicle.

Two types of wheels can be attached to the chassis, 2 front wheels and 2 back omni-directional wheels or a tank track.

Figure 1 description:

Figure 1 represents the outer and inner structure chassis plates.

- Location (1) represents the top chassis plate.
- Location (2) represents the bottom chassis plate.

Figure 2 description:

Figure 2 shows the two chassis plates joined together, creating six holes.

- Location (1) and (2) are for attaching the front wheels.
- Location (3) and (4) are for attaching a motor axis.
- Location (5) and (6) are holes to attach the rear wheels.

Figure 3 and 4 description:

Figure 3 and 4 show the chassis internal components.

- Location (1) and (3) represent the electric motors and its electronic controller/driver respectively, responsible for turning the right front wheel in motion.
- Location (2) and (4) represent the electric motor and its electronic controller/driver respectively, responsible for turning the left front wheel in motion.
- Location (5) represents the main electronic print circuit board.
- Location (6) represents the microcontroller attached to the Print Circuit Board.
- Location (7) represents the wireless communication module, either Bluetooth, Wi-Fi modules, AM, FM, etc.

- Location (11) represents the battery power supply that powers the microcontroller, the wireless communication module and all the motors.
- Location (9) represents an electric motor.
- Location (10) represents the motor axis extension.
- Location (8) represents the Inertial Measurement Unit composed by a 3-axis gyroscope, 3-axis accelerometer and 3-axis magnetometer, responsible for navigation and balance control.

Figure 5 description:

Figure 5 shows the side view of the front and rear wheels.

- Location (1) represents an air filled hollow tire.
- Location (2) represents the wheels rim.
- Location (3) represents the D shaped wheel center.

Figure 6 description:

Figure 6 shows another side view of the front and rear wheels.

- Location (1) represents the part of the wheel that attaches to the front of the chassis and into the front motor.
- Location (2) represents part of the wheel that attaches to the rear of the chassis.

Figures 7, 8 and 9 description:

Figures 7, 8 and 9 show different angles of the chassis with attached front and rear wheels.

Figure 10 description:

Figure 10 shows the side view of different front and rear wheels.

- Location (1) represents the front wheel rim.
- Location (2) represents the rear wheels rim.
- Location (3) represents the air filled hallow tank track.

Figure 11 descriptions:

Figure 11 shows another side view of the front and rear wheels with the air filled hallow tank track.

- Location (1) represents the part of the wheel that attaches to the air filled hallow tank track.
- Location (2) represents the air filled hallow tank track.
- Location (3) represents the part of the wheel that attaches to the air filled hallow tank track.

Figures 12, 13 and 14 description:

Figures 12, 13 and 14 show different angles of chassis with attached front and rear wheels and the air filled hallow tank track.

Figures (15) to (19) shows a removable attachment arm lodged to the vehicles main chassis. Tele-Robotics is achieved by using a Smartphone or a Tablet on the top of the removable attachment arm.

Figure 15 description:

- Location (1) represents the part of the removable attachment arm that connects to the motor axis extension on the vehicle.
- Location (2) represents the removable extension arm structure.
- Location (3) represents the Smartphone or Tablet located on the top of the removable extension arm.
- Location (4) represents the Smartphone or Tablet screen.
- Location (5) represents the camera sensor of the Smartphone or Tablet.
- Location (6) represents the part or the removable extension arm responsible for holding the Smartphone or Tablet firmly attached to the arm itself.

Figure 16 and 17 description:

- These two figures show the removable extension arm attached to the main chassis with wheels, with a Smartphone or Tablet mounted on top.

Figure 18 and 19 description:

- These two figures show the removable extension arm attached to the main chassis with a tank track, with a Smartphone or Tablet mounted on top.

Figures (20) to (24) shows a removable attachment arm lodged to the vehicles main chassis. On top of the removable attachment arm is an ultrasonic range finder, used to detect and avoid obstacles during the autonomous or manual cleaning session. The cleaning is made by using a mop tube with dust attracting fibers, attached to the vehicle.

Figure 20 description:

- Location (1) represents the part of the removable attachment arm that connects to the motor axis extension on the vehicle.
- Location (2) represents the removable extension arm structure.

- Location (3) represents the ultrasonic range finder responsible of detecting objects in it's path.

Figure 21 description:

- Location (1) represents the left part of the dust attracting fiber mop that attaches to the vehicle.
- Location (2) represents the right part of the dust attracting fiber mop that attaches to the vehicle.
- Location (3) represents the dust attracting fiber mop role, responsible for attracting and trapping dust particles in its fibers.

Figure 22 description:

- Location (1) represents the part of the dust attracting fiber mop role that attaches to the left support beam.
- Location (2) represents the part of the dust attracting fiber mop that attaches to the right support beam.

Figure 23 and 24 description:

These two figures show the vehicle ready for a cleaning session. The vehicle navigates in an area avoiding obstacles while attracting the dust particles in its path using its dust attracting fiber mop.

- Location (3) represents the ultrasonic range finder responsible of detecting objects in its path.
- Location (2) in figure 23 represents the part of the dust attracting fiber mop that attaches to the vehicles chassis.

Figure 25 to 31 describe the removable attachment arm responsible for allowing the vehicle to fly. These figures also describe the electronics and the aerodynamics of the flying system.

Figure 25 description:

- Location (1) represents the top view of the cylinder shaped "wind pipe" that lodges the two rotary propellers.

- Locations (2), (3), (4) and (5) represent the free spaces inside the wind tunnel that allow air to flow when the propellers are spinning.

Figure 26 description:

- Location (1) represents the part of the removable attachment flying system that connects to the motor axis extension on the vehicle.
- Location (2) represents the onboard Smartphone or Tablet housing.
- Location (3) represents the Smartphone or Tablet screen.
- Location (4) represents the Smartphone or Tablet camera sensor.
- Location (5) represents the side view of the cylinder shaped "wind pipe" that lodges the two rotary propellers.

Figure 27 description:

- Location (1) and (2) represent the electric motors that are attached to the rotor blades (3) and (4) respectively.
- Location (3) and (4) are two rotor blades responsible of lifting the robotic platform up and down into the air.

Figure 28 to 29 description:

These two pictures show when the vehicle is in position for flight navigation (figure 28) and when it is in position for land navigation (figure 29). The motor axis extension can rotate to toggle in between these two positions (analogically).

Figure 30 to 31 description:

Figure 30 and 31 show the top view of the robotic platform attached to the flight system, displaying the aerodynamic properties of the structures design.

- Locations (1), (2), (3) and (4) represent the spaces where the air will flow in order to move the aircraft forwards or backwards in the in air.

