INTERNATIONAL DESIGN COMPETITION ROBOCON 2024

Theme for IDC ROBOCON 2024: The Coconut Kingdom

Background

Set against the lush landscapes of Kerala, a region synonymously known as the "land of coconuts," this year's Robocon challenges participants to intertwine technology with tradition. Kerala's economy heavily relies on coconuts, used in everything from culinary recipes to industrial products. Traditionally, coconut harvesting is a skilful yet perilous job requiring workers to scale tall trees. This contest aims to reimagine this task through the lens of robotics, enhancing safety and efficiency.

Coconut Harvesting Challenge

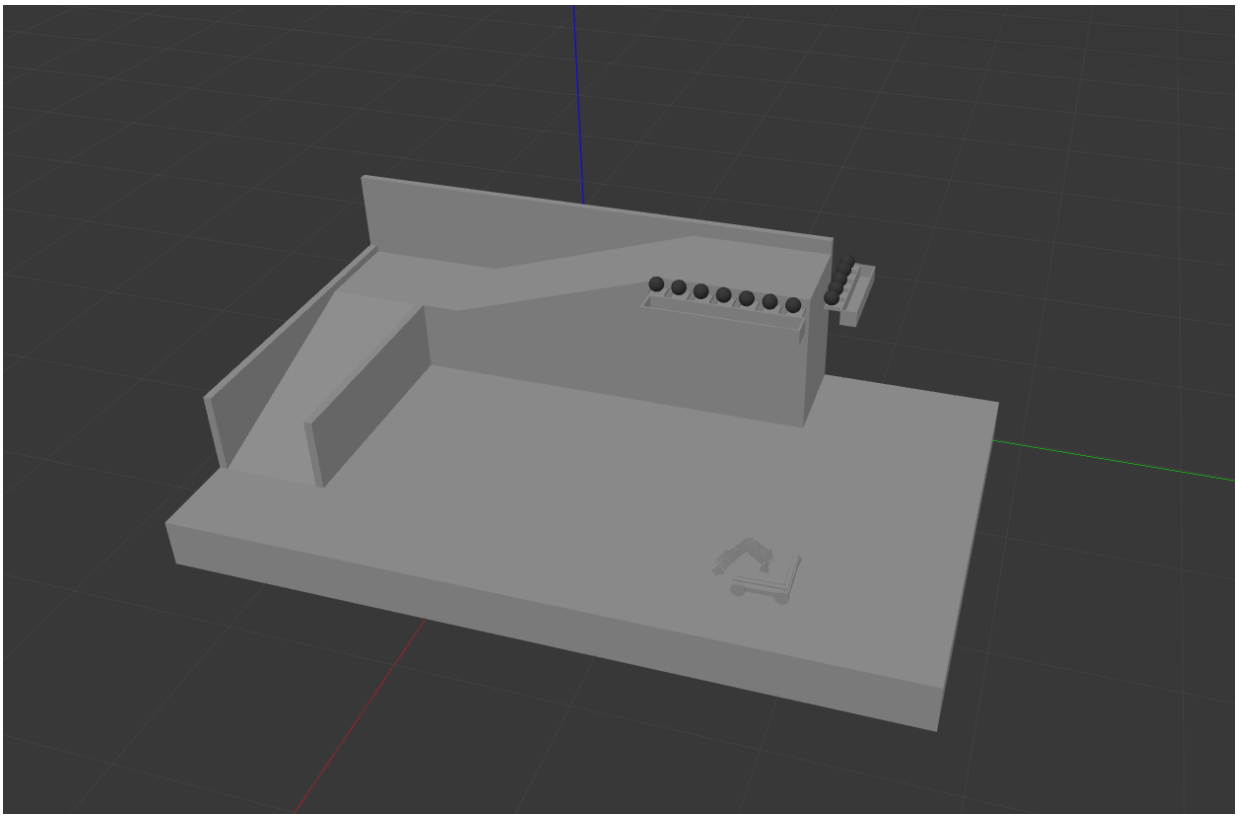
Coconut harvesting for this competition is transformed into an exciting robotic adventure. Participants will design mobile robots capable of navigating dual-levelled ramps to approach coconut trees strategically positioned within the arena. These robots must adeptly climb the ramps and, upon reaching the level of the treetops, extend or utilize integrated mechanisms to carefully pick the ripe coconuts. Once the coconuts are securely grasped, the robots are required to drop them safely onto the ground, simulating an efficient and safe harvesting process. This innovative approach not only tests the robots' climbing and manoeuvring capabilities but also their precision in handling delicate tasks like picking and placing agricultural produce.

Interactive Components

1. **Climbing and Harvesting:** Robots will ascend a two-tiered ramp system that mimics the natural height variations of coconut trees. Upon reaching the designated trees, these robots are tasked with imitation of picking the coconuts as part of harvesting.
2. **Coconut Collection**: Post-harvest, the ground-based robot enters the scene. Designed for agility and efficiency, robot role is to collect the fallen coconuts. It navigates the field, picks up the coconuts, and deposits them into a collection basket, showcasing its capability in handling and transport.

ONLINE MODE

Field description:



Section 1: Overview of Required Software

- ROS (Robot Operating System) for creating and controlling robot software.
- Gazebo for simulating robots in a virtual environment.
- CAD software (like SolidWorks 3D, Fusion 360) for designing the robot.

Section 2: Designing the Robot and Generating URDF

1. **Designing the Robot:**
    - Use CAD software like SolidWorks or Fusion 360 to design your robot.
    - Ensure that all parts are properly dimensioned and compatible for simulation.
2. **Generating URDF (Unified Robot Description Format):**
    - Export the CAD model to a format compatible with URDF generators (e.g., STL files from SolidWorks).
    - Use a tool like sw_urdf_exporter for SolidWorks or similar in other software to generate the URDF file.
    - Validate the URDF file to ensure there are no errors in the robot's structure or syntax.

Section 3: System Requirements and installation

System requirements :

- Ubuntu Linux (recommended version 20.04 LTS) as the host operating system.
- Sufficient disk space (at least 10GB free) and a stable internet connection.

Installation links :

- ROS installation : https://wiki.ros.org/noetic/Installation/Ubuntu
- Gazebo installation : https://classic.gazebosim.org/tutorials?tut=ros_installing&cat=connect_ros

Section 4: Simulating in Gazebo

1. Setting Up the Simulation Environment: Load the provided world description file into Gazebo to set up the simulation environment.
2. Launching the Simulation: Use ROS to launch the robot model in Gazebo: roslaunch *your_robot_package* gazebo.launch
3. Testing and Validation: Perform initial tests to ensure your robot interacts correctly with the virtual environment. Check for mobility and interaction with simulated objects.

Competition Rules and Guidelines

Robot Design: Participants must use the same robot design for the online mode as used in the onsite competition. Ensure to generate a URDF file for your robot.

Simulation: All robot simulations must be conducted using ROS on the Gazebo platform.

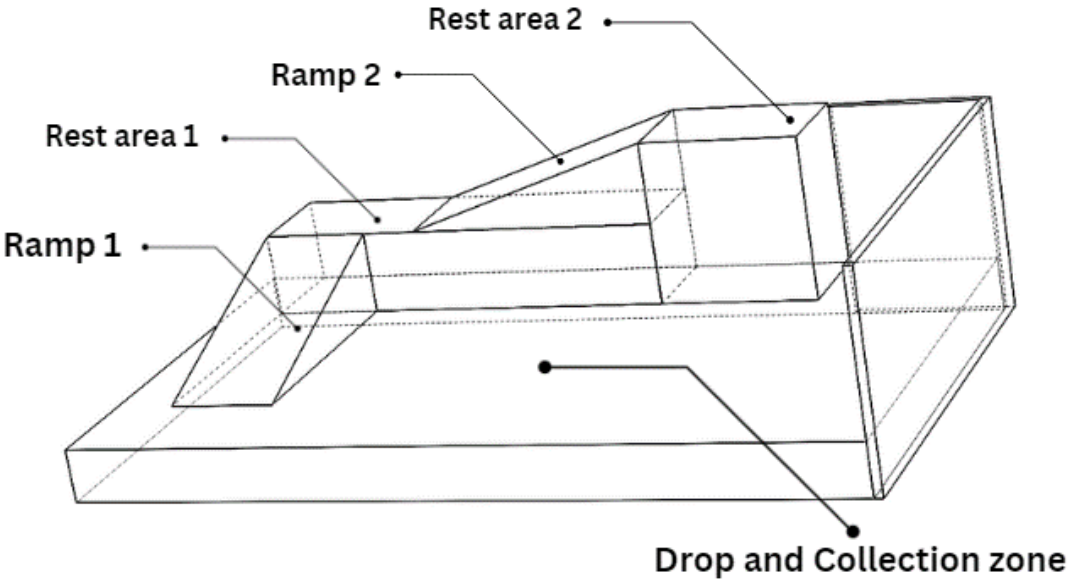
World Setup: A world description file will be provided to all participants. This file must be used to import your robot into the Gazebo environment.

Competition Task:

- **Navigate**: Successfully bring your robot into the Gazebo world and maneuver it to climb the ramp.
- **Objective**: Push the balls into the designated basket using your robot's grasper.

ONSITE MODE

Field description-



Ramp 1 – Designed with care, the 18-degree ramp offers a smooth climb for the mobile robots crafted by participants. This gently sloped ramp leads directly to a rest area, making it easy for robots to move safely and efficiently throughout the competition space. This thoughtful design ensures the robots can perform at their best while navigating seamlessly from one section to the next.

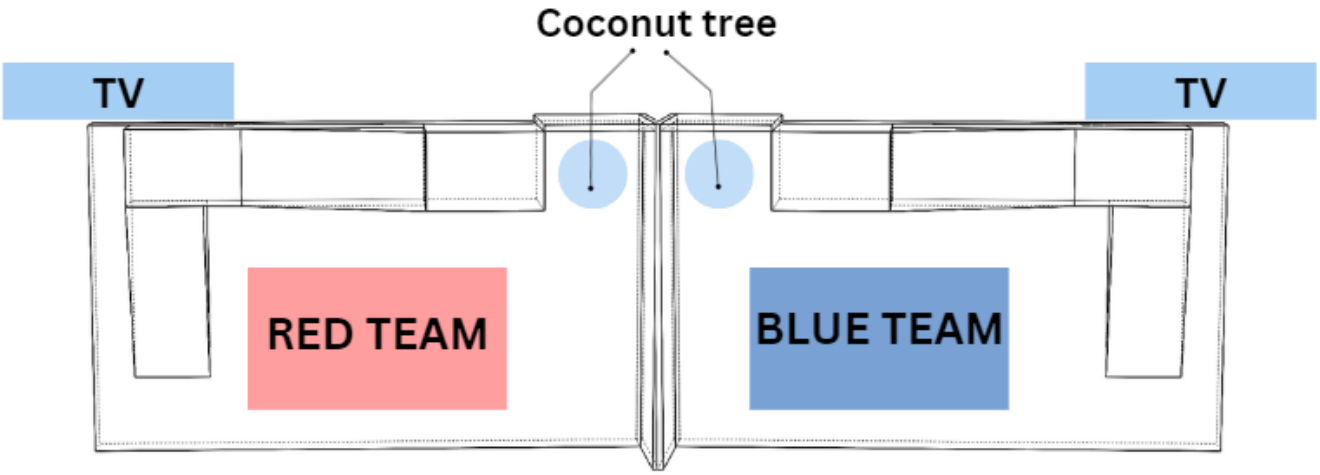
Rest area 1 - Once the mobile robot successfully ascends the required altitude via the ramp, it reaches Rest Area 1. This area is a flat surface that provides a seamless transition to Ramp 2, allowing the robot to continue its journey smoothly and efficiently.

Ramp 2 - After reaching Rest Area 1, the robot begins its climb on Ramp 2, gaining further altitude. This ramp leads directly to the destination, Rest Area 2, where the robot can complete its ascent.

Rest Area 2 –Rest Area 2 serves as the final zone that the mobile robots must reach. Once they arrive at this zone, their task is to pick up the coconuts and safely drop them into the designated Drop and Collection Zone below.

Drop and Collection zone - Once the first coconut is dropped into the zone, it triggers Collector robot to start moving. This robot is designed to collect the dropped coconuts and then deposit them into a designated basket.

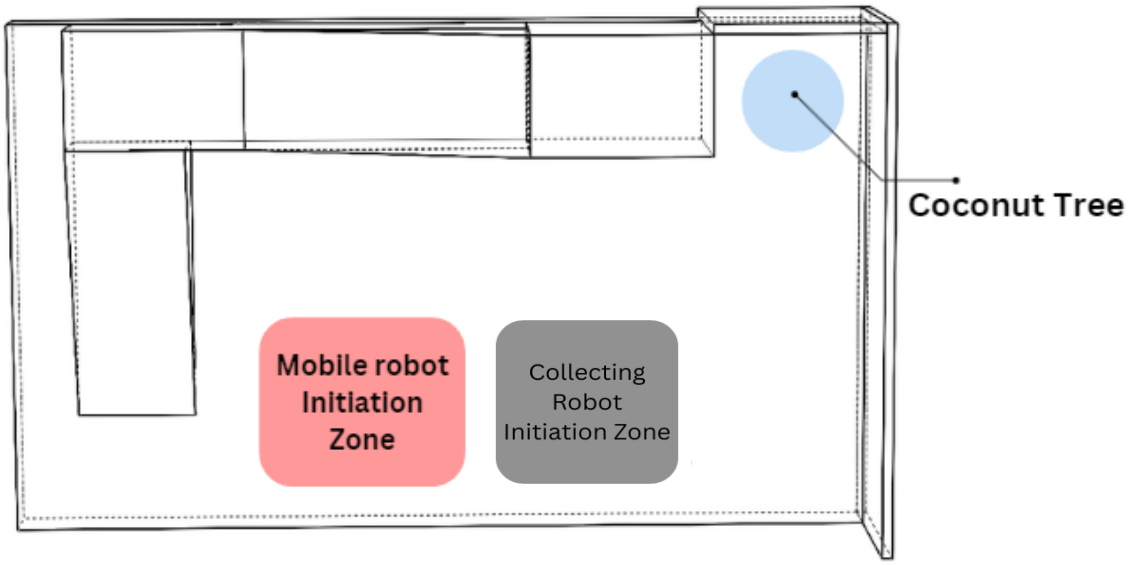
Complete Arena Design -



Rules and Regulations –

The competition arena is meticulously divided into two symmetric halves, with the left side designated for the Red Team and the right side for the Blue Team. Each side is outfitted with several strategically placed components that mirror those on the opposite side, ensuring fairness and balance in the competition. Here are the components detailed:

1. **Mobile Robot Initialization Zone**: This demarcated area serves as the starting point for each team's mobile robot, establishing the boundaries within which they can begin their operations.
2. **Tree-Mounted Coconut Basket**: Each side features a miniature coconut tree, complete with a basket attached high up. This basket initially holds the coconuts that the robots must strategically harvest.
3. **Harvesting:** The grasper that each team is needed to design is used to pick and drop the coconuts out of the basket.
4. **Ground Basket**: Positioned on the ground, this basket is the target receptacle where the teams aim to deposit the collected coconuts, accumulating points with each successful drop.



5. **Ramp and Raised Floor**: These elements simulate the challenge of climbing a coconut tree. The ramp leads to a raised platform, representing the physical elevation a robot must navigate to simulate the harvesting process effectively.

This layout not only tests the engineering prowess and strategic planning of each team but also provides a dynamic and visually engaging battlefield reflective of real-world challenges.

Design Regulations for Robocon 2024

The Robocon 2024 competition introduces a unique challenge, inviting teams to engineer a mobile robot equipped with a grasper, as well as configure an additional Collector robot attachment to efficiently manoeuvre coconuts into a collection basket. Below are the detailed specifications and rules governing the design and operation of the robots. The teams must build a Climber robot which has the capability to climb the ramp to collect the coconuts. Each team will be provided with a collection robot which they should use to push the coconuts into collection box.

Climber Robot Specifications

- **Construction Material**: The climber robot must be exclusively built from equipment provided by the competition organizers.
- **Size and Weight Constraints**: At the start of the match, the robot must fit within a cube measuring 30x30x30 cm and weigh no more than 3 kg, excluding the control unit.
- **Operational Freedom**: Robots are permitted to navigate on their respective sides of the arena, including ramps using the remote controller provided to each team.
- **Control**: Operation of the robot is restricted to RF (radio frequency) remote control.

- **Interaction Rules**: Robots may grasp and relocate any objects from their team's side to their basket but are prohibited from removing objects from the opponent's basket. Additionally, while robots may contact the tree, they must not damage or break it during coconut collection.
- **Manipulator Restrictions**: Any manipulator used must be constructed from the same set of provided materials as the robot, without the inclusion of any external tools.
- **Battery Safety**: Only batteries specified by the competition organizers are permitted. Teams must ensure that all battery connections are secure to prevent disconnections and short circuits during the competition.

Collecting Robot Specifications

Each team will be provided with a collecting robot kit. The teams are tasked to construct the collecting robot using the manual provided to them. Teams are not allowed to tamper with the collecting robot kit in any form. Teams are not allowed to add any additional attachment to the collecting robot. Further change in the rules will be communicated during the course of the competition.

These regulations are designed to challenge the ingenuity and technical skills of the participants, ensuring a level playing field and fostering an environment of fair competition. Teams are encouraged to focus on innovative design and strategic execution within the constraints provided.

Scoring and Winner Declaration Rules

The winner of the Robocon 2024 competition will be determined based on a comprehensive scoring system that integrates the performances of both the offline and online team components, along with additional criteria for tie-breaking scenarios:

Determination of Scores-

- **Combined Team Score**: The final score for each team will be the sum of the offline team's score and half of the online team's score (i.e., Offline Score + 0.5 * Online Score).
- **Completion Bonus**: If both teams successfully complete all designated tasks, the winner will be the team that finish the task early, demonstrating superior speed and efficiency.

Tie-Breaking Procedures:

- **Immediate Tie-Breaker**: In the event of a tie, a tie-breaker round will be initiated where both teams must quickly collect and deposit a coconut into the basket. The first team to successfully complete this task will be declared the winner.

Match Setup and Robot Configuration

- **Pre-Match Configuration**: Teams will be informed of their assigned side of the field (right or left) at least five minutes before their match begins, allowing time for any necessary adjustments due to field asymmetry.
- **Setup Time**: Teams will have access to their starting box to set up their machines prior to each round. The setup must be completed within a three-minute window to ensure a smooth and timely competition flow. The setup time will be 30 seconds where the teams are required to setup their robot in the arena and do the required preparations. After the 30 second count down, the teams are not allowed to enter the arena or touch the robot, if did will result in immediate disqualification declaring the opponent team as the winners.

Additional Competition Rules

- **Reconfiguration Allowance**: Between rounds, teams are permitted to reconfigure their machines. This flexibility is intended to optimize robot performance based on the side of the field assigned and specific match conditions.
- **Field Adaptability**: Robots must be designed to adapt to the slight variations between the right and left sides of the field, ensuring fair and balanced competition regardless of starting position.

These rules are crafted to promote a fair, efficient, and competitive environment, emphasizing both the technical prowess and strategic planning capabilities of the participating teams.

Fair Play and Safety Guidelines for Robocon 2024

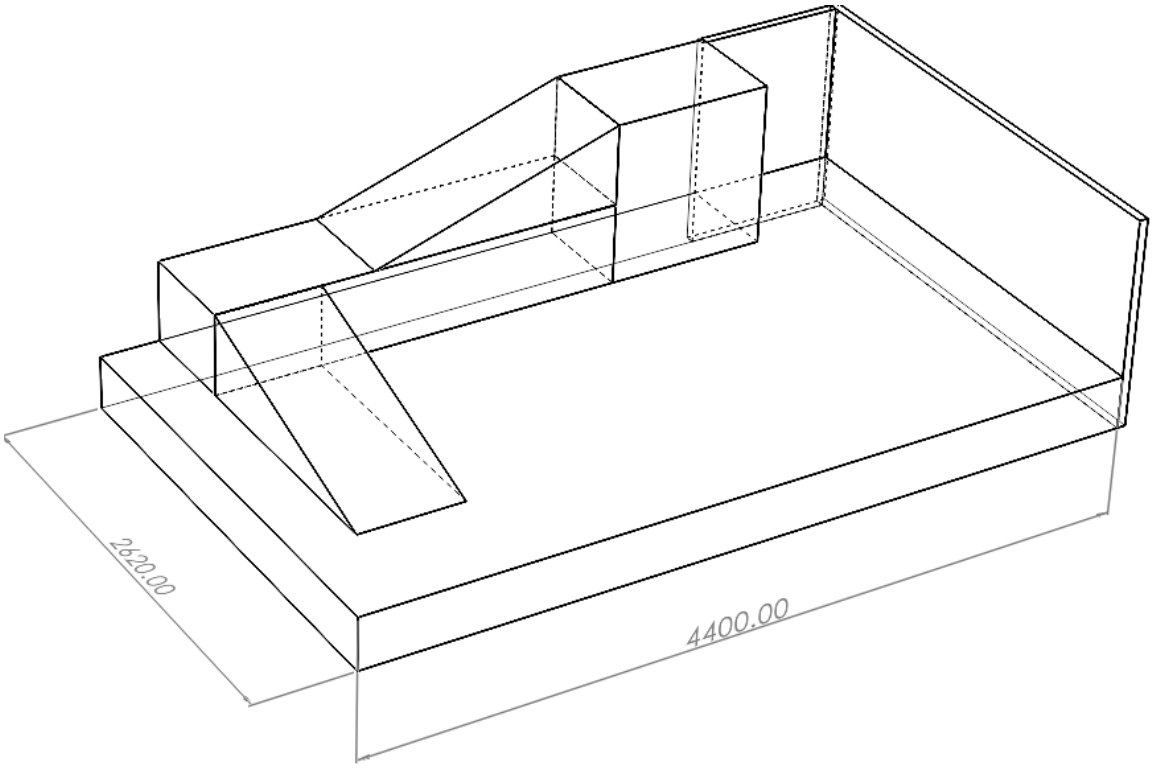
To ensure a fair, safe, and competitive environment during the Robocon 2024 competition, the following rules complement and expand upon the existing guidelines:

Fair Play:

1. **Irreversible Scoring**: Once points are scored, they cannot be nullified by defensive actions of the opposing team, although further scoring attempts can be defensively blocked.

2. **Non-Aggressive Conduct**: Any form of aggressive behaviour including damaging, overturning, pushing, or lifting an opponent's robot is strictly prohibited.
3. **Arena Integrity**: Participants must not damage the contest arena or any control equipment. Violations may lead to disqualification.
4. **Accidental Damage**: In instances of accidental damage as judged by the officials, teams may be allowed to repair their robots and a rematch may be scheduled.
5. **Human Interaction**: No direct physical interference with the robots or any arena elements by any human is permitted during matches.
6. **Retrieval of Items**: Components or objects that exit the arena boundaries must not be reintroduced manually during ongoing rounds.
7. **Prohibited Devices**: The use of nets or any devices designed to entangle or trap opponents is forbidden. Defensive strategies that do not involve such mechanisms are allowed.
8. **Judgment Post-Match**: After the allotted time expires, the referee will declare the winner based on the accumulated scores.
9. **Safety Compliance**: Machines deemed dangerous by the judges are not allowed, and all safety rulings by the judges are final and must be adhered to without delay.
10. **Surveillance and Monitoring**: All robots may be subject to random checks during and after matches to ensure compliance with all rules, including size, weight, and material restrictions.
11. **Pre-Match Checks**: Before each match, robots must pass a pre-match inspection by the judges to ensure they meet all competition specifications and safety standards.
12. **Sportsmanship**: Teams are expected to always conduct themselves in a sportsmanlike manner. Unsportsmanlike conduct, such as taunting, rude gestures, or inappropriate comments, will be penalized.
13. **Signal Integrity**: Teams must not attempt to interfere with the control signals of opposing teams, whether through electronic jamming or other means.

Arena Base Dimensions(mm)



List of materials

No	Materials	Quantity
1	60RPM 12V Low Noise Dc Motor With Metal Gears – Grade A	2
2	100RPM 12V Low Noise Dc Motor With Metal Gears – Grade A	1
3	Mega 2560 ATmega2560-16AU Board plus USB Cable compatible with Arduino	1
4	L293D Motor Driver/Servo Shield for Arduino	1
5	FlySky CT6B 2.4GHz 6CH Transmitter with FS-R6B Receiver	1
6	Female to Female DuPont Line 40 Pin 30cm	1
7	Center Shaft Gear Motor L Clamp (Bracket)-3pcs	1
8	SafeConnect DC Jack Female Connector 2.1mm x 5.5mm Pigtail	1
9	Male to Female Jumper Wires (20cm) 40pcs	1
10	Male to Male Jumper Wires (20cm) 40pcs	1
11	70 x 20 mm Robot Wheel and Tyre for 6mm shaft	2
12	Universal Swivel Castor Wheels	2
13	Servo 25KG RDS3225 270Deg Metal Gear Digital Servo Motor Arduino High Torque	2
14	Servo 20KG RDS3225 270Deg Metal Gear Digital Servo Motor Arduino High Torque	1
15	12V 2200mAh Rechargeable Lithium Battery Pack with Warranty (includes BMS & balance pin) for GPS, CCTV, Industrial and Commercial Application	1
16	B3 Lithium Battery Charger for 2S and 3S LiPo Batteries	1
17	DC to DC Buck Converter	1
18	Dot Matrix board	1