

2023 THEME: WASTE MANAGEMENT

Waste management is a critical issue that affects the environment, public health, and the overall well-being of communities. Improper disposal and accumulation of waste pose significant challenges, particularly in developing countries like Nepal, Bhutan, India, Sri Lanka etc. The 2023 Yantra 9.0, organized by the Robotics Association of Nepal in Kathmandu, aims to address this pressing concern by focusing on waste management as its central theme.

In the spirit of the Robotics Association of Nepal's commitment to technological innovation and social responsibility, the Yantra 9.0 seeks to inspire the next generation of leaders, engineers, and environmental advocates. By raising awareness about waste management and encouraging creative problem-solving, this event aims to empower participants with the knowledge and skills needed to make a positive impact on Nepal's waste management practices and contribute to the global fight against environmental degradation. Let the Yantra 9.0 begin, as we navigate towards a cleaner and sustainable future for Nepal and our planet as a whole.

Introduction:

In the game "Swarmanoid," participants had the opportunity to gain insights into the environmental and health implications of handling roadside waste from open piles and open dumping. The game revolved around a duo of robots known as Swarm Robots, operating as a unified alliance, to efficiently manage and store waste. This interactive demonstration emphasized the importance of collaborative efforts in mitigating the negative consequences of manual solid waste management.

The game incorporated two different types of waste organic and inorganic, distinguished by different vision-based fiducial markers(Aruco) , which the central system(PC or Laptop) needed to identify using an overhead camera. Once identified, the robots autonomously sorted the waste into the appropriate locations. Both robots had to work in tandem, providing assistance to one another when arranging the waste.

The primary objective of the game is for the robots to solve the waste management problem swiftly through effective communication and cooperation. The team of robots that successfully accomplished this goal emerged as the winners of the game.

Objective:

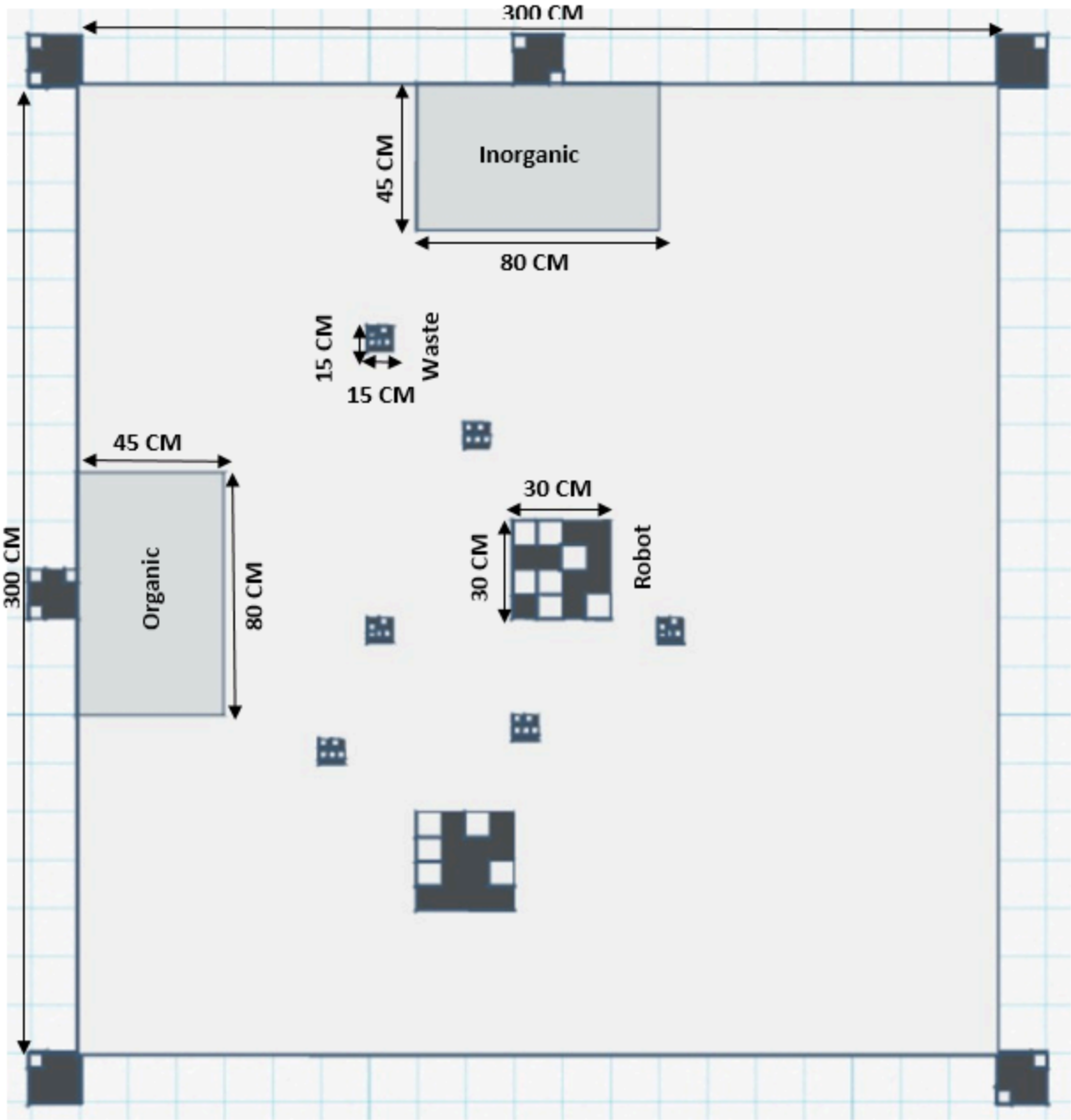
- i) Aligning with the RAN theme, aiming to establish the robotics industry by the year 2030.
- ii) Aligning with the YANTRA theme, which centers around the future of work.

Task:

There will be two robots in the arena both communicating with the central system(PC or Laptop). Both robots will have different vision-based fiducial markers(Aruco) using which the central system can find out real time position and orientation of the robot using an overhead camera. There will be two categories of waste organic and inorganic distinguished by Aruco markers. Two robots collaboratively have to drag or carry the waste (which will be a cube) and put them into their respective Organic and Inorganic area (there will be Aruco markers to be identified by the central system). Game arena will have four corners that need to be identified by using Aruco markers in the corners which is the boundary line of the arena that the central system needs to identify and robots cannot go beyond that line. The ultimate winner will be determined by completing the task in the shortest amount of time.

Game Arena

1. The size of the arena will be 300CMX300CM.
2. In four different corners there will be Aruco markers(15CMX15CM) to identify the boundary of the arena.
3. Designated area for organic and inorganic waste with Aruco marker(15CMX15CM) will be 80CMX45CM.
4. Wastes with Aruco markers(15CMX15CM) will be of 15CMX15CMX15CM(CUBE) 50-100 Gram.
5. The Size of the robot must not exceed 30CMX30CMX30CM.
6. The marker size on top of the robot should be of 15 CM X 15 CM.
7. There will be a total 10 waste (5 organic and 5 inorganic waste).
8. The type of Aruco marker that will be used in Arena is aruco.DICT_6X6_250. Different Ids will be used in Arena, Robot, Wastes.
9. Aruco markers for the Arena, Wastes and robot will be provided two weeks before competition.



Team Specifications

1. Maximum 4 members are allowed per team.
2. Any level of participants can participate in this competition.i.e students, teachers, professors all can participate.
3. All entrants for the Swarmanoid must declare their intention to enter the contest at least 2 days before the date of the Competition. The notice (registration form) must be submitted to the contact person(s) by email or through the online form.

Dimension and Fabrications:

1. Any microcontrollers and actuators can be used for designing a robot.
2. The robot should fit within a box of dimension 30 x 30 x 30 cm when the robotic arm is in a shrink state .
3. Each Team should have Two robots.
4. The robot should not weigh more than 5 KG.
5. Wired robots are not allowed.
6. Use of readymade toys is not allowed, but one can use the readymade circuits.
7. Robots should not be manually or remotely controlled. It should be completely automatic.
8. The robot could be of any design, could print with a 3D machine, could use any driver, motor and controller. But ready-made products cannot be used.
9. An overhead camera feed will be provided by the organizer covering all the arena. Any camera and sensors are not allowed on the robot.
10. Robots should only consist of a wheel drive process and control mechanism, Waste gripping, lifting or dragging mechanism, and wireless communication. Servo or stepper motor is recommended for wheel drive and Waste gripping. NodeMCU is recommended for wheel drive control and wireless communication.
11. There should be one centralized processing unit, PC or Laptop. The central system should be responsible for localization of the arena, robot, wastes and drop off location with the help of Aruco Marker and OpenCv.
12. After localization, any path planning algorithm can be used to generate a robot start and end path from the available occupancy grid of the frame available from camera feed. The generated path should be unique to each robot and not collide with another robot at any given time.
13. There should be a wireless communication channel of your choice in order to transfer the generated path from centralized system to the field robots.
14. The robot is only responsible for sending and receiving data from a centralized system, Wastes lifting, traveling given distance, and changing orientation when required.

Bot verification

1. The designed robot by participants will be verified by the organizer member one week or 2/3 days before competition.

2. So a team must come to the office of the Robotics Association of Nepal to verify the bot(flexible for those participants who are far from the valley).
3. If the bot is not verified by the organizer then the team cannot participate in the competition.
4. After verification the design of the bot cannot not change.

Game play rules

1. Initial time will be given to set up the overhead camera in the participant's central system.
2. The bot will be placed on the arena, after that, no participant can touch the bot without permission from the referee.
3. For each team, a maximum 10 minutes of time will be given to complete the game.
4. The two robots will be placed in opposite corners.
5. The robots can carry or drag waste to their designated area.
6. The operator may abort a run at any time.
7. If an operator touches the bot during a run, it is deemed aborted, and the bot must be removed from the arena.
8. If waste is collected by one robot only at the designated area then it will not count.
9. The illumination, temperature, and humidity of the room shall be those of an ambient environment. (30 to 120 degrees F, 0% to 95% humidity, non condensing).
 - i. **BEWARE:** Do not make any assumptions about the amount of sunlight, incandescent light, or fluorescent light that may be present at the contest site.
10. The run timer will start when the referee whistles.
11. A contestant may not feed information on the bot. Therefore, changing ROMs or downloading programs is NOT allowed once the arena is revealed. However, contestants are allowed to:
 - i. Change switch settings (e.g. to select algorithms)
 - ii. Replace batteries between runs
 - iii. Change speed settings
 - iv. Make minor repairs
12. The decision by the referee will be the final decision.
13. The organizing committee reserves the right to change the game rules at any time as per necessity.
14. If any member from participants tried to create conflict during competition then that team will be fired and punished according to the rules of Organization.

Marking strategy and Judging criteria

1. Marking:-

- a. 10 points are given for just pickup of waste by robot in case of dragging if bot is in the position to push or drag the waste and is touching the waste.
 - b. 10 points are given for the collection of waste in the proper target place.
2. The total points will be 200 and negative points will be given by judges according to the foul done by the robots.
3. Negative marking:-
 - a. If two robots collide with each other -5 points.
 - b. If robots place the Waste in the wrong target location -10 points.
 - c. If robots cross the boundary of the arena -10 points.
4. If waste is collected by one robot only at the designated area then it will not count.
5. Highest point receiver will be declared as the winner.
6. If two or more teams get the same points then those teams who complete the task in a short time among the participants, will be decided as the winner.