

## **Introduction**

The Robotics Club, Pulchowk Campus has been organizing the **Robocup** since a long time. This competition has been able to merge the knowledge gained from academic side with the knowledge of real life resources and problems, giving the better insight to the practical aspects of engineering. The skills learned during the prototyping phases have proved to be indispensable in tackling with real life problems.

The success and excitement of the competition in past years has compelled us to come up with a newer theme **Robocup Nepal 2069: "Clean Bagmati, Green Kathmandu "**.

With the increasing population and rapid deforestation, the pollution has increased and the greenery has vanished. This pollution has had direct impact to the rivers in the country. Different organizations such as Save Bagmati Project, Nepal River Conservation Trust (NRCT), Art Of Living (AOL) Nepal, etc have been playing their active role to conserve and protect the river and enhance greenery through public awareness and projects such as Clean Bagmati, Green Kathmandu. In the pavement of nation building, the robots in **Robocup Nepal 2069** are intended to help on such noble deed of environmental conservation by cleaning the Bagmati region and doing plantation in Kathmandu region.

The contest sets its goal to uplift the technical and strategy level of the field of robotics and the associated researchers in the country. Also, it aims to raise public awareness for the environment conservation.

## **The Importance of Safety**

Safety is one of the most important elements in the sustainable development of the ROBOCUP NEPAL.

The safety of the robots themselves is the first and foremost issue for the safe holding of the contest. The participating teams, as the robot designers, are responsible for the safety of their robots.

The teams must work and co-operate closely with the organizers to ensure the utmost safety of the contest.

Safety must always be the top priority and it must be considered for all people involved in the contest as officials, participants or spectators in all circumstances.

Teams are required to pay sufficient attention to the safety of their robots on this basis before applying to take part in the contest.

### **Outline of the Contest**

The task of the contest is to classify the wastes near Bagmati region as degradable and non-degradable; further process the degradable waste into manure and plant a tree in Kathmandu region within a given time limit.

Each team comprises of two types of robots; Automatic and Manual. The manual robot is operated by Manual operator. It first classifies the degradable and non-degradable wastes from **Waste Zone** into two separate regions in **Separation Zone**.

The Automatic Robot then carries degradable waste into **Manure Production Zone** to prepare the manure. The Manual Robot then carries manure into **Tree plantation Zone**. It also prepares the trunk of the tree. The Automatic Robot then carries the tree cap and completes the tree.

Different points are allocated for various activities during the process. The team that plants the tree or scores more number of points is declared the winner.

Each match is contested by Red and Blue teams. A match lasts for three minutes. The game may end up earlier by successful "Clean Bagmati and Green Kathmandu".

1. ***Game Field: Structure and Specifications***(See Figures for more info)

- 1.1. The Game field measures 10000mm x 8000mm. It is surrounded by a wooden ***Boundary Fence*** 100mm high and 20mm wide.
- 1.2. White lines are drawn on the floor of the ***Game Area***. Each white line is 50mm wide.
- 1.3. The ***Game Area*** consists of ***Automatic Start Zone, Manual Start Zone, Forbidden Zone, Waste Zone, Separation Zones, Manure Production Zone, No Line Zone, Tree Plantation Zone, and Storage Zones.***
- 1.4. All the zones comprise of the game field surface and the vertically projected space above them.
- 1.5. There are two ***Storage Zones***. One ***Storage Zone*** consists of Tree Trunk of external diameter 200mm, internal hollow diameter of 100mm and height of 400mm. It will be placed onto the trunk stand of height 500mm. The other ***Storage Zone*** contains tree cap at stand similar to trunk stand. Tree cap is a cone of height 300mm, diameter 400mm with hollow of diameter 100mm and height of hollow is 120mm.
- 1.6. The ***Waste Zone*** is a trapezoid of parallel sides 1500mm and 1000mm, and breadth 600mm (including the fences) and contains 10 balls (5 Degradable and 5 Non-Degradable) in random position. The ***Waste Zones*** of two teams are separated by the fence of height 100mm.
- 1.7. The ***Forbidden Zone*** is the region of width 200mm, and length 6000mm and has the fences of height 50mm and width 20 mm..
- 1.8. The ***Separation Zone*** consists of Degradable and Non-Degradable separation zones. Each of these regions will have the dimension of 700mm x 500mm and fence boundary will be of height 100mm and width of 10mm. There is a slope at the entrance of base 200mm up to the height of 50mm and the Confirmation area of separation has the dimension of 700mm x 300mm.
- 1.9. The ***Manure Production Zone*** has the dimension of 320mm x 310mm x 120mm and a produced manure ball is in region of 200mm x 200mm x 30mm.
- 1.10 The ***Tree plantation Zone*** has cylindrical base of diameter 600mm and height 150 mm. It has a hole in its side of size 120mm x 150mm x 120mm. It has the cylindrical extension of dimension 88mm up to the height of 500mm.
- 1.11 The ramp has the height of 150mm and base of 700mm in ***uphill*** and in ***downhill***. The length of elevated plane is 800mm. The width of ramp is 1000mm.
- 1.12 Each of the two fences in ***No Line Zone*** will be the isosceles triangle of side 100mm x 100mm x 150mm and length 1100mm.
- 1.13 ***Automatic Start Zone*** is of 500mm x 700mm.
- 1.14 ***Manual Start Zone*** is of 1000mm x 1000mm.
- 1.15 The balls representing Wastes and Manure are 95mm in diameter each with a tolerance of 3 mm.
- 1.16 Each dimension of the game field has a tolerance of 1 percent.
- 1.17 All dimensions are in mm otherwise included.

## **2. Game Procedure**

### **2.1. Length of a match**

- 2.1.1. Each match lasts three minutes.
- 2.1.2. In the following cases, a match ends even before the passage of three minutes:
  - 2.1.2.1. When any of the two teams achieve the greenery in *Tree Plantation Zone* (Kathmandu region).
  - 2.1.2.2. In the event of disqualification.
  - 2.1.2.3. When the referees judge that the continuation of the match is impossible.

### **2.2. Setting of robots**

- 2.2.1. One minute is provided for setting of robots before the start of each match.
- 2.2.2. Three members of each team may engage in setting of robots.
- 2.2.3. Any team that fails to complete setting of robots in one minute shall be able to resume the setting work once the match has begun. In such case, only the corresponding operator is allowed to set the robot.

### **2.3. Deployment of the robots and team members at the start of the match**

- 2.3.1. The *Automatic and Manual Robots* shall be placed in their respective *Start Zones*.
- 2.3.2. Team member responsible for starting the *Automatic Robot* shall wait near the robot.
- 2.3.3. An *Automatic Robot Operator* is allowed to start robot being inside the *Game Area*.
- 2.3.4. The *Manual Robot Operator* shall wait within the *Game Area* with a controller in the hands.
- 2.3.5. **Starting an Automatic Robot**
  - 2.3.5.1. A team member shall start an *Automatic Robot* by single switch operation.
  - 2.3.5.2. After switching the robot on, the team member who performs the starting operation must immediately leave the *Game Field*.

## **3. Competition Tasks**

- 3.1. Once the match has begun, each team shall complete the following tasks:
  - 3.1.1. **The Manual Robot**
    - 3.1.1.1. Can sweep/pick up the waste balls (Degradable or Non-Degradable) from the *Waste Zone* (Bagmati Region) and place in corresponding region of Degradable(D)/Non-Degradable(ND) in *Separation Zone*. It has to separate at least two (one D and one ND) waste, to allow automatic robot to be started. The waste balls have to go inside the confirmation area in *Separation Zone* and should be stable, to be said as classified. The Manual Robot has to classify the waste ball that have come out of *Waste Zone* during initial separation before it could do further tasks.
    - 3.1.1.2. Can carry manure prepared from *Manure Production Zone* to the pit-hole at the bottom of *Tree Plantation Zone*.

- 3.1.1.3. Can carry the trunk of the tree from *Storage Zone* to *Tree Plantation Zone* only after the manure is carried to *Tree Plantation Zone*.
- 3.1.1.4. Can classify the further wastes in *Waste Zone* for bonus points in its free time.
  - 3.1.1.4.1 It can sweep/pick up the waste balls lying in his side.
  - 3.1.1.4.2 If waste balls are remained unclassified in *Game Field* outside the *Waste Zone*, it will be considered as the Violation.
  - 3.1.1.4.3 It can pick up/sweep the waste balls from opponent's side and bring onto his side for classification, with its base remaining in its side, through a narrow pathway between the opponent's game field. It *must have classified* all its wastes before it tries for waste ball of opponent team.
- 3.1.2. The Automatic Robots
  - 3.1.2.1. Can move only after Manual Robot places at least a waste ball in each separation region (1 D and 1 ND). It can pick/sweep up only a waste ball from the degradable section in *Separation Zone* and place it into the *Manure Production Zone* without touching the zone. If it tries for more than one ball, it will be considered as violation.
  - 3.1.2.2. Can carry the tree cap from corresponding *Storage Zone* and move towards the *Tree Plantation Zone* through any path as per its convenience.
  - 3.1.2.3. Can perform all the tasks of the Manual Robot except the initial Separation of waste balls as specified in rule 3.1.1.1
- 3.1.3. Each team must always observe that its *Manual Operator* doesn't enter the *Forbidden zone or Opponent team's area*.

#### **4. Retries of Robots**

- 4.1. In the case of faulty *Automatic Robot* movements, it is possible to start again (Retry) with the referees' permission.
- 4.2. An operator must move the Robot to its start zone while preparing for a Retry.
- 4.3. At the time of the Retry, Automatic operator shall switch the robot on to start it. After switching the robot on, the operator must immediately leave the Game Field.
- 4.4. The Robots can only be restarted in their respective *Start Zones*.
- 4.5. Retries can be made as many times as necessary.
- 4.6. Automatic robot must take retry after each violation.

#### **5. Deciding the Winner**

- 5.1. The team who first plants the tree at the *Tree Plantation Zone* in the Kathmandu region is said to achieve "*Greenery*", is awarded 200 points and is declared as Winner.
- 5.2. If neither team has completed the tasks stated in Rule 5.1. at the end 3 minutes, the winner shall be whoever has more points according to the following:

### 5.3. **Scoring:**

- 5.3.1. 10points for each correct waste ball separation by Manual Robot in each Degradable/ Non-Degradable region in *Separation Zone* for first time, and 5 points each for extra correct waste ball separation in appropriate region.
- 5.3.2. 30 points for Automatic Robot to bring a degradable waste ball in *Manure production Zone*.
- 5.3.3. 10 points for Manual Robot to bring manure ball from *Manure production Zone* into pit-hole at the bottom of *Tree Plantation Zone (Kathmandu region)*.
- 5.3.4. 25 points for Manual robot to bring tree trunk in the Tree Plantation area.
- 5.3.5. The winner is the team having the higher score.

## 6. **Conditions and Points to Watch out for in Designing and Manufacturing Robots**

- 6.1. Each team shall use One *Manual Robot*, and as many *Automatic Robots* as the team desires but they all must fit within dimensions of the *Automatic Robot*.
- 6.2. No communication between the robots is allowed.
- 6.3. The robots used in the contest must be handmade by students of the institution to which the team belongs.
- 6.4. **The Automatic Robot**
  - 6.4.1. The *Automatic Robot* shall move automatically once it has been started by a team member.
  - 6.4.2. The *Automatic Robot* shall be started by a single switch operation.
  - 6.4.3. Before the game starts, the dimensions of the *Automatic Robot* shall not exceed 700mm (long) x 500mm (wide) x 1200 mm (tall).
  - 6.4.4. After the game starts, there is no dimension limit in both robots unless it violates the rules.
- 6.5. **The Manual Robot**
  - 6.5.1. The *Manual Robot* can be operated by means of a cable connection or by remote control using infrared, visible rays or sound waves. Wireless radio control is not permitted. The operator is not permitted to ride on the manual robot.
  - 6.5.2. In the case of cable operation, the cable connecting the *Manual Robot* and the controller shall be at least 1,000 mm and not more than 3,000 mm long. The cable shall be connected to the robot at a height of not less than 700 mm above the floor surface of the Field.
  - 6.5.3. The dimensions of the *Manual Robot* shall not exceed 1000 mm (long) x 1000 mm (wide) x 1500 mm (tall) before the game starts.
- 6.6. **Power sources for the Robots**
  - 6.6.1. Each team must prepare the power sources for the robots.
  - 6.6.2. The voltage of the power source used by each robot shall not exceed DC24V.
  - 6.6.3. Any power source considered dangerous or inappropriate by the organizer may not be used.

## 7. **Detailed rules on safety**

- 7.1. The use of explosives, fire and dangerous chemicals is prohibited.
- 7.2. If a laser is used, it shall be of Class 2 or less. In designing and preparing the laser, full care must be taken to protect all persons at the venue from harm during all procedures. In particular, the beams must be so oriented that they cannot shine into the eyes of the spectators.

## **8. Examination of the robots**

- 8.1. Participating robots shall be examined prior to the test run on the day before the contest and again on the day of the contest before it begins. A team that fails an examination shall not be allowed to participate in the test run or contest.
- 8.2. Details of 'What will be examined and How' will be provided at a later date.

## **9. Violations**

- 9.1. If a violation occurs, 5 points will be deducted as a result of such violation.
- 9.2. A *Retry* shall be made by bringing the robot back to the corresponding *Start Zone*. The place and method of the *Retry* is laid down in "**4. Retries for Robots**". The following cases are violations:
  - 9.2.1. Any part of either robot or its operator crosses the *Boundary Fence* or the space above it.
  - 9.2.2. Any part of either robot or its operator enters or extends to the region of the opposing team except in rule 3.1.1.4.2.
  - 9.2.3. Automatic/Manual machine or any of its parts enters/touches in *Forbidden Zone*.
  - 9.2.4. Any part of Automatic machine touches the *Ramp, Manure Production Zone, No Line Fence* from *No Line Zone plane* or any ground plane.
  - 9.2.5. If any Robot displaces tree base from its position.
  - 9.2.6. The Manual Robot touches the Opponent's Manual robot while taking out the waste balls from the Opponent's *Waste Zone*.
  - 9.2.7. Other actions that break in the rules without producing disqualification.
  - 9.2.8. If Automatic Robot takes out more than one Waste ball from *Degradable Separation Zone*.
  - 9.2.9. If Automatic Robot and Manual Robot of any team touches each other.

## **10. Disqualification**

A team shall be disqualified if it commits any of the following during the match:

- 10.1. The team damages or tries to damage the Game Field, and/or facilities and equipment of opponent's robots.
- 10.2. The team's robot that has entered onto the region of the opposing team or into the space above it comes in contact with an opposing robot.
- 10.3. The team has made a false start twice in the same match.
- 10.4. The team performs any act that is not in the spirit of fair play.
- 10.5. The total weight of the robots participating in game crosses 50kg limit.

10.6. The team fails to obey instructions and/or warnings issued by the referees.

**11. On the Safety of the Robots**

11.1. All robots shall be so designed and manufactured as to pose no danger of any kind to any person in the venue.

11.2. All robots shall be so designed and manufactured as to cause no damage to any robot of an opposing team or the *Game Field*.

**12. Teams**

12.1. Each participating college in the contest can be represented by one team only.

12.2. A team consists of three students and one instructor who all belong to the same college. The three students of the team are entitled to participate in the match itself.

12.3. In addition, a three-member pit crew can adjust the robots in the pit room and help to carry the robots to the *Game Field*, but cannot participate in the match itself. The members of the pit crew must be students of the same college as the team.

12.4. Participation by post-graduate students (graduate school students) is not permitted.

**13. Others**

13.1. The legitimacy of any action not provided for in this rule book shall be subject to the discretion of the referees.

13.2. The dimensions, weights etc. of the Field and other facilities and equipment described in this rule book have a margin of error of +/- 5% unless otherwise stated. This rule does not apply to the participating robot.

13.3. All questions should be addressed to the official website of the ROBOCUP Nepal (<http://www.robotics.org/robocup2069>). A Q&A section will be provided on the site.

13.4. Notification of any addition and/or correction to this rule book shall be made on the official web site.

13.5. The referees may demand additional explanations on safety issues when the safety of a robot is deemed to be in question.

13.6. No contact by means of a radio communication device and/or loudspeaker is permitted between team members and/or team members and any third party during a match.

**Appendix**

**1. Colors and Materials**

S.N.	Items	Color	Material
1.1	Manual Start Zone	Red for Red Team Blue for Blue Team	Sticker

1.2	Automatic Start Zone	Red for Red Team Blue for Blue Team	Sticker
2	Waste Ball Zone	Grey	Sticker
3	White Lines	White	Sticker
4	Forbidden Zone	Sky Blue	Sticker
5	Separation Zone		
5.1	Degradable	Red	Sticker
5.2	Non Degradable	Blue	Sticker
6	Tree Plantation base	Transparent	Fiber glass + wood
7	Tree Plantation Stand	Black	HDP Pipe
8	Ball	Black for degradable White for non-degradable	Sponge
9	Tree Trunk	Brown	Thermo Cole
10	Tree Cap	Green	Thermo Cole
11	Tree Trunk Stand	Black	High Density Polythene
12	Tree Cap Stand	Whitish Grey	PVC Pipe
13	Ramp	Parrot Color	Sticker
14	Boundary Fence	Dark Brown	Wood

## 2.GameField Material and their approximate weight

S.N.	Item	Weight
1	Degradable and Non-DegradableBall (9.5 cm dia)	100 gm
2	Tree Trunk	750 gm
3	Manure Ball (9.5 cm dia)	100 gm
4	Tree Cap	250gm

### On the Distribution of Samples of Contest-Related Articles

The samples for the competition will be provided to each team after registration for participating in the competition. The samples will contain the following:

S.N.	Description	Quantity
1	Ball (9.5 cm dia)	2
2	Sample color for game field zones	1
3	Vinyl Sheet (10cm x 10cm)	1