THE ROBOCON DIARY 2009

INDIAN INSTITUTE OF TECHNOLOGY DELHI

MAY 2009

PREFACE

It feels special to present a brand new version of ROBOCON diary 2009. The most emphatic focus of this diary is the latest stint of team IIT Delhi at National Robocon. Year 2009 has been unfortunate for Robotics club with an unexpected loss in Quarter final. This time's ROBO diary gives an insight about the growth of club members in past few years of Robot building. We have brought you the details of our manual, automatic robots for Robocon 2009. It is said that a picture conveys a thousand words. Hence treat your eyes on our picture gallery.

Robotics club have started making its presence felt all across the campus with a brave initiation from the sincere efforts of Prof. S. K. Saha with inauguration of ROBOMUSE on the Republic Day; Jan 26 of year 2009.

ACKNOWLEDGEMENT

The team members of ROBOCON 2009 sincerely acknowledge the financial and logistic support provided by Prof. Surendra Prasad, Director of IIT Delhi, and his complete administrative and moral support; without whose blessings we would not be able to participate year after year in ROBOCON. The support of Prof. A. Sharma, Dean of Students, and Prof. S. Mathur, BRCA President (later Prof. P.M.V Subbarao, since September 2008) and Associate Dean of Students, in helping us getting funds from IIT's account for purchasing the components required for fabricating the robots, and also in allowing us to work in the Robotics Room of SAC is highly acknowledged. The Robocon team members would also like to thank Prof. S.K. Saha, the team mentor and Faculty-in-Charge for his guidance. Assistant Registrars of the Accounts and Stores and Purchase Sections, Mr. R.K. Gupta and Mr. Nanak Chand, respectively, are also thanked for speedy actions on Robocon matters. The team and the institute would like to thank IFM, Bangalore for providing 12 photo sensors worth Rs. 50,000 for use
in Automatic robots. Thus there is an endless list of people from different departments and sections of this institute without whose supports and blessings the participation in DD-MIT-Robocon 2009 would not have been possible.

PERSONAL NOTE

This section is dedicated to all the people involved in and around the team IIT Delhi who work day and night for fulfillment of their dream of participating in ROBOCON. There are people who work in core teams, some work in marketing teams, some work in logistics, some work only to give suggestions but there is only one who is working endlessly to support our team i.e. Prof.S.K.Saha. Prof. Saha is a great motivator and most profound personality who impresses all of us and we all will be indebted with his love and affection. Thank you sir!!

This Diary also comes out with sincere efforts of all team members, but few people have really helped me in compiling this issue.

1. Rohit Taneja
2. Himanshu Gupta
3. Vyom Jain
4. Abhijeet Rathore
5. Prateek Agrawal
6. Danvir Singh Sethi

There are others too who have been real great help, but cannot mention each one's name.

Manish Chauhan
2nd year, M.Tech (Design of Mechanical Equipment)

CONTENTS

ROBOCON 2009

- Reached the quarterfinals out of 54 teams.
- Lost to IIT Mumbai in quarterfinals.

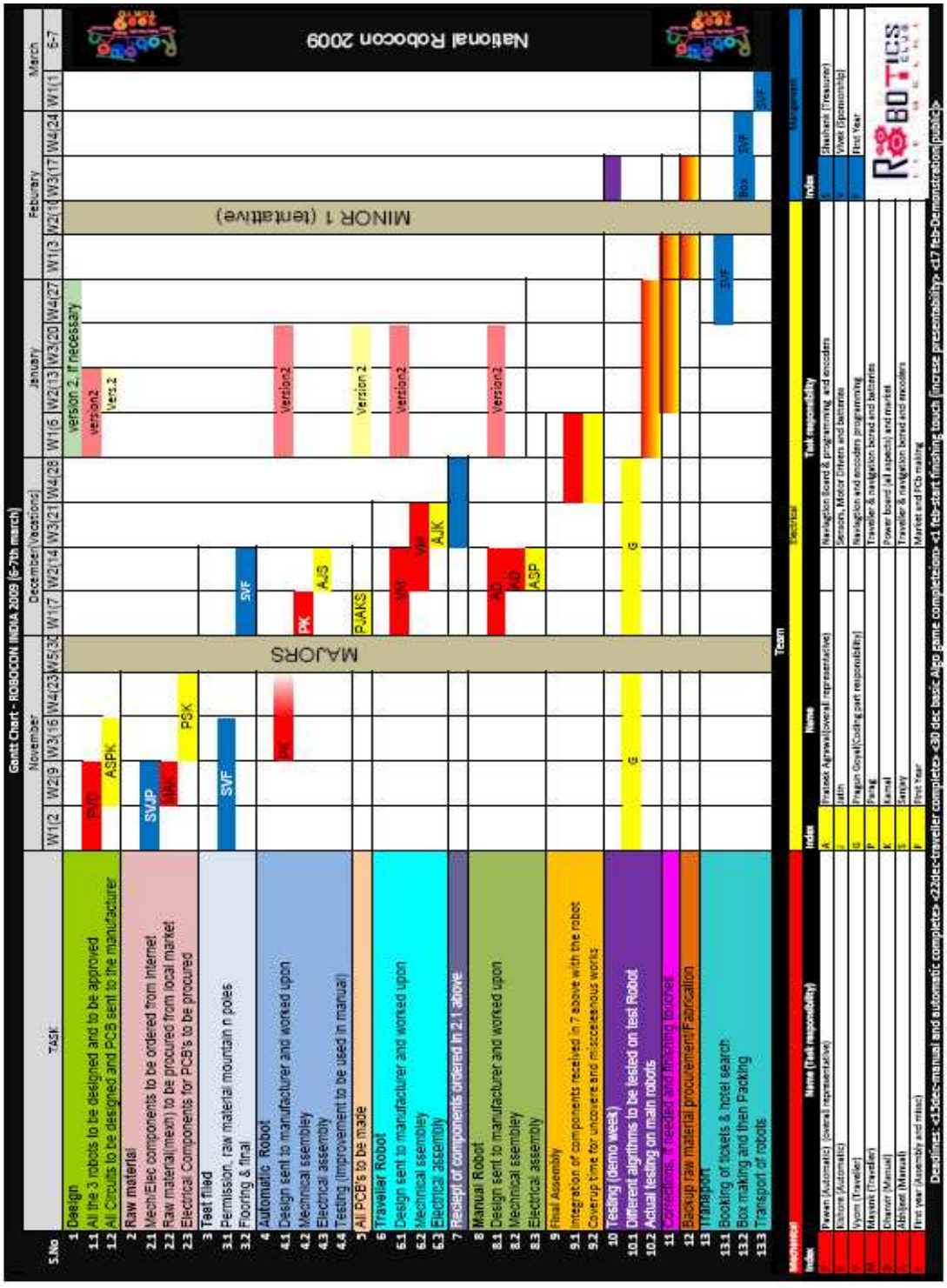
TEAM THIS YEAR

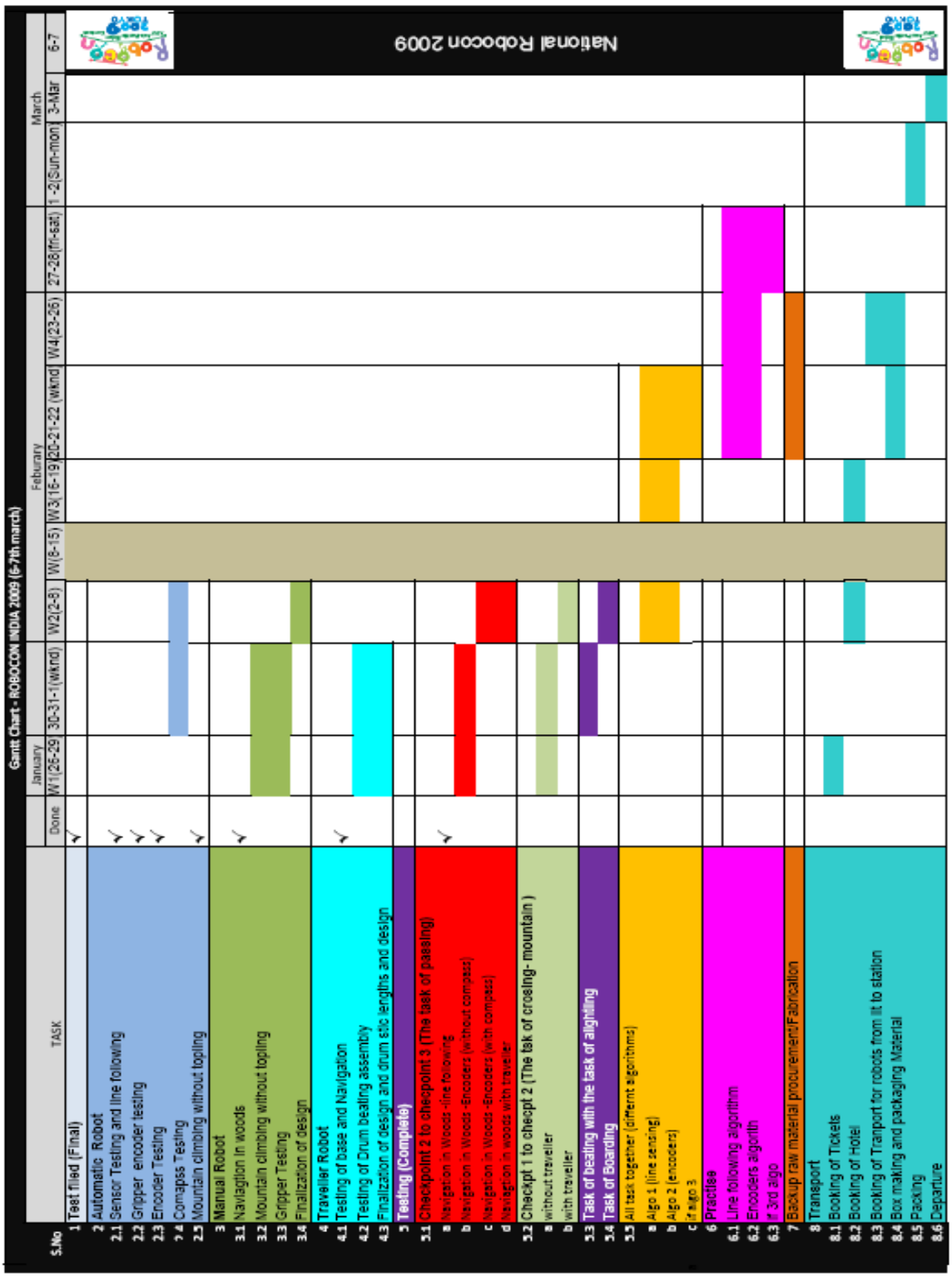
Prof. S.K. Saha	(Team mentor & Faculty-in-charge)
Jainesh Sinha	(Team Coordinator), Mechanical, 4th yr
Chinmay Agarwal	(Electrical Coordinator), Electrical, 4th yr
Ripudaman Singh	Electrical, 4th yr
Gaurav Mittal	Mechanical, 4th yr
Sanchit Arora	Computer Science, 4th yr
Prateek Agrawal	Electrical, 3rd yr
Shashank Singla	Electrical, 3rd yr
Jatin Pasrija	Electrical, 3rd yr
Kamal Gupta	Computer Science, 3rd yr
Vijay Kumar	Electrical, 3rd yr
Danvir Singh Sethi	Mechanical, 3rd yr
Sanjay Dhakar	Electrical, 3rd yr
Abhijeet Rathore	Mechanical, 3rd yr
Parag Jain	Electrical, 2nd yr
Pawan Kumar Sahay	Mechanical, 3rd yr
Vyom Jain	Mechanical, 3rd yr
Kishore Kumar	Mechanical, 3rd yr
Abhishek Surana	Electrical, 1st yr
Dhananjay Mishra	Electrical, 1st yr
Himanshu Gupta	Electrical, 1st yr
Manas Paldhe	Physics, 1st yr

Pawan Gupta	Electrical, 1st yr
Prashant Joshi	Electrical, 1st yr
Rohit Taneja	Electrical, 1st yr
Ankit Jain	Mechanical, 1st yr
Nitesh Kansal	Chemical, 1st yr
Rohit Goel	Chemical, 1st yr
Rohit Kushwaha	Mechanical, 1st yr
Ashwini	Mechanical, 1st yr
Kamlesh Swarnakar	Mechanical, 1st yr
Nihit Kumar	Mechanical, 1st yr
Shikar Aggarwal	Mechanical, 1st yr

Manish Chauhan	M.Tech, Design of Mechanical Equipment, 1st yr

1. THE TASK ITINERARY





Chapter 1 is contributed by Shashank Singla

2. THEME, RULES AND AIM '09

Travel Together for the *Victory Drums*

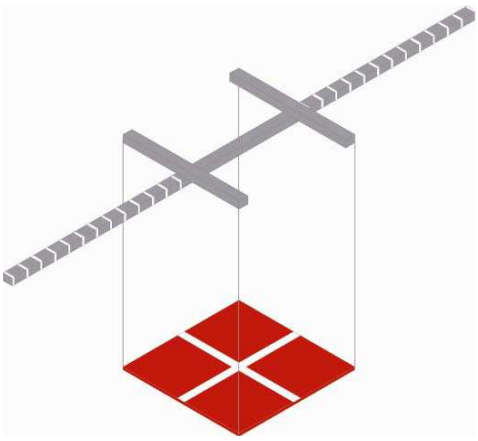
Contest Theme:

Towards the Cooperative Society of People and Robots

Cooperation between people and robots is the theme of the ABU Asia-Pacific Robot Contest 2009 Tokyo. In industry, the use of robots is already common practice. The development of new types of robot has now become necessary in such fields as care for the elderly and the physically disabled, and rescue work in times of emergency. New types of robots are required that are capable of being a part of our daily life and providing us with care. They must share such human qualities as kindness and cooperation above and beyond the speed, power and precision demanded of conventional robots. Robots designed from this new perspective are expected to meet rising demand in the years to come. The ABU ROBOCON 2009 Tokyo has been conceived of as a step towards the goal of close cooperation between manual (or directly human-controlled) and automatic robots. That is not an easy challenge but it is one of truly great worth.

Kago, the Core Item of the Contest Theme

The core item of 2009's contest is the Kago, the traditional Japanese palanquin or litter of the pre-modern era. People were often carried in Kago to distant places. The Kago was a basket suspended from a wooden pole, called here the Shoulder Pole, as shown in the photo. Two men, one in front and the other behind carried it. Travel in olden times was far from smooth. There were mountains, steep slopes, and sharply winding roads to traverse. The bearers who carried the Kago had to cooperate very closely to reduce the sway and complete the journey safely.,



The Importance of Safety

Safety is one of the most important elements in the sustainable development of the ABU ROBOCON. 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 cooperate closely with the organisers 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.

RULES

1. Outline of the Contest

Travel Together for the Victory Drums is a game based on an imaginary journey of olden days using the *Kago* palanquin. An *Automatic Carrier Robot* in the front and a *Manual Carrier Robot* in the rear shall cooperate to carry an automatic *Traveller Robot* in a *Kago* to the goal with the aim of completing the journey before the other team. Various tasks stand in the way, including a *Mountain Pass* and *Woods*. The *Kago* and *Traveller Robot* must not be dropped. The *Traveller Robot* must beat the three *Victory Drums* when it reaches the *Goal Zone*. The three traditional Japanese drums are arranged vertically on a platform. The team that beats all three drums first is the winner. Red and blue teams contest each match. A match lasts three minutes.

2. Field

- The *Field* consists of the *Game Area* and *Safety Area.*
- The *Game Area* measures 12,000 mm x 12,000 mm. It is surrounded by wooden fence

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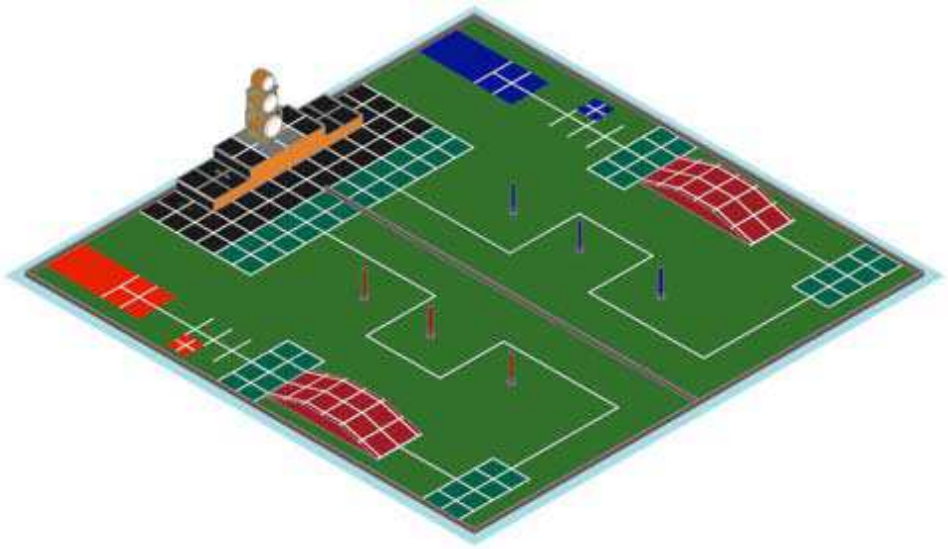

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30 mm wide.

- White lines are drawn on the floor of
- The *Game Area*, as shown in Figure 1. Each white line is 30 mm wide.
- The *Game Area* consists of a *Kago (=Palanquin) Zone* and a *Goal Zone*.

Kago Zone:

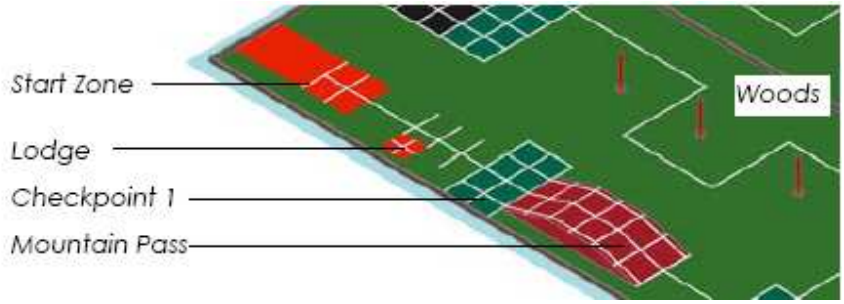
- The *Kago Zone* is divided into two exclusive sections, one for the red and the other for the blue team, separated by a wooden fence that is 100 mm tall and 30 mm wide.
- The *Kago Zone* contains a *Start Zone*, a *Lodge*, *Checkpoints*, a *Mountain Pass* and *Woods*.

(i) Start Zone;

- The *Start Zone* measures 1,000 mm x 2,500 mm.
- The floor surface is red for the red team and blue for the blue team.

(ii) Lodge:

- Each *Lodge* is 500 mm x 500 mm in area and 12 mm tall.



- The floor surface is red for the red team and blue for the blue team.

(iii) Checkpoints:

- There are three *Checkpoints* each within the *Kago Zone* for the red and blue teams.
- *Checkpoints 1* and *2* are 2,000 mm x 1,000 mm and *Checkpoint 3* is 3,000 mm x 1,000 mm large.

(iv) Mountain Pass:

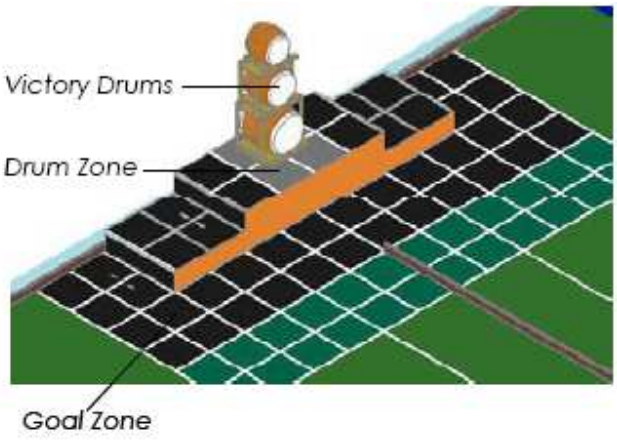
- *Mountain Pass* is 1,200 mm x 3,000 mm in area.
- Viewed from above, the slope climbs across a horizontal distance of 1,000 mm from each side. The flat top has an elevation of 300 mm.
- The flat section at the top of the pass has an area of 1,200 mm x 1,000 mm.

(v) Woods:

- The *Woods* consist of three poles.
- Each pole is cylindrical with a diameter of 76.3 mm and rise to a height of 1,600 mm from the floor. Each pole stands on a pedestal 176.3mm in diameter installed on the floor of the Field.
- The edges of the pedestals of poles 1 and 2 are 2,000 mm apart and edges of the pedestals of poles 2 and 3 are 1,600 mm apart.
- The poles and pedestals of the red team are painted red and those of the blue team are painted blue.

(vi) Goal Zone:

- The *Goal Zone* is 6,000 mm x 2,000 mm.
- Part of the *Goal Zone* is stepped.
- The stepped area is 1,000mm x 4,000mm large.
- There are two steps, each 250 mm high.
- The first steps each have an area of 1,000mm x 1,000mm. The top step is 1,000mm x 2,000mm.
- There is a *Drum Zone* in the middle of the top step. This measures 1,000mm x 1,000mm.
- The *Victory Drums* are placed in the *Drum Zone*. Three drums are arranged vertically with the largest one at the bottom and smallest on top. The *Victory Drums* consist of the three drums and the drum stand to hold them.



- The drums are hand-made in the traditional Japanese style with the body made of wood and faced with leather. The diameters of the circular faces of the drums that must be hit are approximately 420 mm for the large drum, 360 mm for

the middle drum, and 300 mm for the small drum.

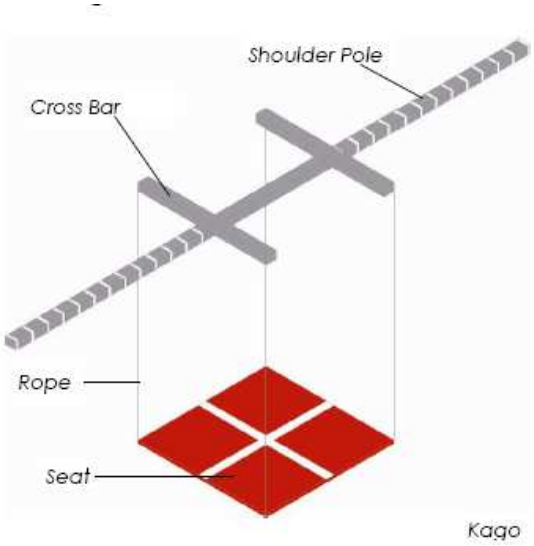
(vii) Safety Area:

- The *Safety Area* is 300mm wide, including the fence surrounding the *Game Area*.

3. Specifications for the *Kago*

- The *Kago* used in the contest shall be provided by the organisers.
- Each *Kago* consists of a *Shoulder Pole*, *Cross Bars* and a *Seat* on which the *Trave*ller Robot sits and *Ropes* that attach the *Seat* to the *Cross Bars*.
- The *Kago* weighs approximately 3 kg.
- ***Shoulder Pole***

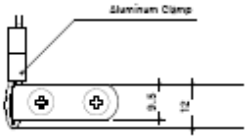
  - The *Shoulder Pole* is a rectangular wooden rod measuring 2,000mm (long) x 40mm (wide) x 30mm (thick).
  - The *Shoulder Pole* is marked with a 10 mm wide painted white lines to a distance of 730 mm from each end of the pole at intervals of 50mm.
  - *Cross Bars* are installed 750 mm from each end of the *Shoulder Pole*. Each *Cross Bar* is a rectangular wooden rod measuring 500 mm (long) x 40mm (wide) x 30mm (thick).



- ***Seat***

  - The *Seat* is made of plywood and measures 500 mm x 500 mm x 12 mm (thick).
  - The red team's *Seat* is painted red and the blue team's *Seat* is painted blue. Each is marked by a white cross in lines that are 30mm wide.

- **Connection of the *Shoulder Pole* and the *Seat***



The *Seat* is attached to the *Cross Bars* by four *Ropes*.

The *Ropes* are made of 1.5 mm thick stainless steel wire.

The bottom of the *Shoulder Pole* shall be 800 mm from the top of the *Seat*.

4. Game Procedure

(i) Length of a match

- Each match lasts three minutes.
- In the following cases, a match ends even before the passage of 3 minutes.
    - When the *Goal* is achieved.
    - In the event of disqualification.
    - When the referees judge that continuation of the match is impossible.

(ii) Setting of robots

- One minute is provided for setting of robots before the start of each match.
- Three members of each team may engage in setting of robots.
- 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.

(ii) Deployment of the robots and team members at the start of the match

- The *Automatic and Manual Carrier Robots* shall be placed in the *Start Zone* carrying the *Kago*. The *Automatic Carrier Robot* shall be in front of the *Kago* in the direction of travel and the *Manual Carrier Robot* behind it. The *Kago* shall not be touching the floor.
- The *Traveller Robot* shall be placed at the *Lodge*.
- Team members responsible for starting the *Automatic Carrier Robot* and the *Traveller Robot* shall wait near their respective robot. They are allowed to start inside the *Game Area*.

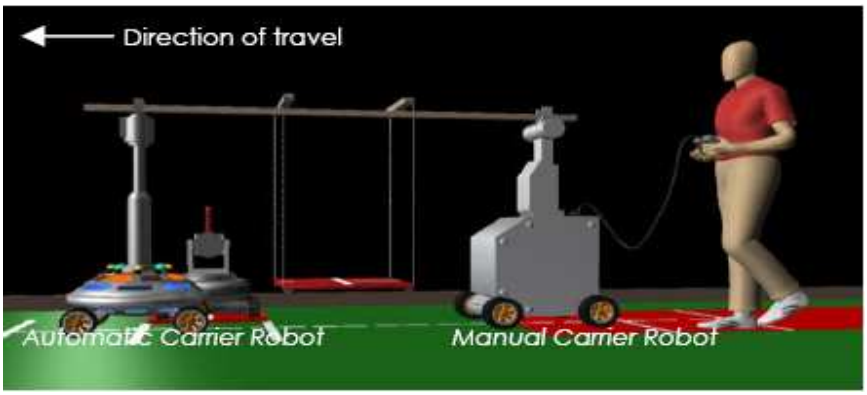
- The operator of the *Manual Carrier Robot* shall wait within the *Game Area* with a controller in the hands.

(iii) Starting an *Automatic Carrier Robot*

- A team member shall start an *Automatic Carrier Robot* by single switch operation.
- After switching the robot on, the team member who performs the starting operation shall immediately leave the *Field*.

5. Competition Tasks

- The task of the *Traveller Robot* boarding the *Kago* (The *Task of Boarding*).
- The task of crossing the *Mountain Pass* (The *Task of Crossing*).
- The task of passing through the *Woods* (The *Task of Passing*).
- The task of the *Traveller Robot* alighting from the *Kago* (The *Task of Alighting*)
- The task of the *Traveller Robot* beating each drum (The *Task of Beating*).
    - Each team must always observe the following during the match:
    - The *Automatic Carrier Robot* shall always be in front of the *Kago* in the direction of travel.
    - The *Manual Carrier Robot* shall not move the *Automatic Carrier Robot* directly with the *Shoulder Pole.*
    - The *Carrier Robots* may not touch any part of the *Kago* other than the *Shoulder Pole*
    - No part of the *Automatic or Manual Carrier Robots* may enters onto the



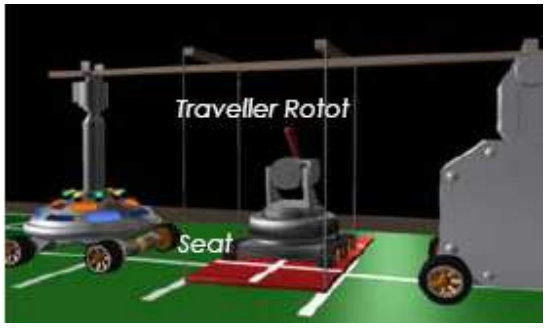
Goal Zone or into the space above it

- The *Kago* may not touch the floor of the *Field*. This rule shall not apply, when the *Traveller Robot* is boarding or alighting from the *Kago*, or when part of the *Automatic Carrier Robot* is touching or above a *Checkpoint*.
- Neither the *Kago* nor the *Traveller Robot* may touch either the poles or the pedestals.
- Neither the *Traveller Robot* nor the *Drumstick(s)* shall touch the floor surface of the *Field*. The floor surface of the *Lodge* is, however, excluded from this rule. This rule shall cease to apply from the time of the *task of alighting*.
- The *Traveller Robot* shall not touch any part of the *Kago* other than the *Seat*.
- The *Traveller Robot* shall not touch the *Automatic or Manual Carrier Robots.*

(i) *Task of Boarding*

- The *Traveller Robot* shall board the *Kago* when the *Kago* arrives at the Lodge.

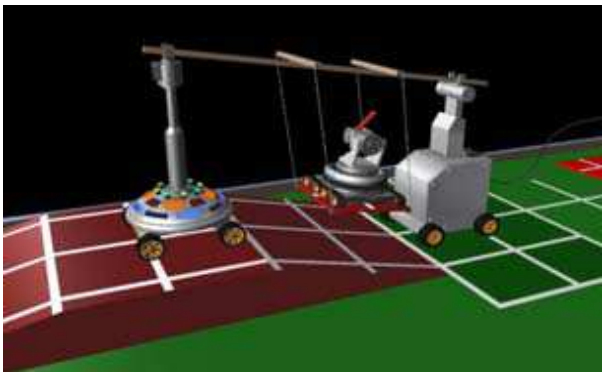
  The *Kago* may touch the floor of the *Kago Zone* for the purpose of boarding.
- Boarding the *Kago* means the *Traveller Robot* mounting onto the *Seat* and having no remaining contact with the floor of the *Lodge*.
- A team member shall start the *Traveller Robot* for boarding onto the *Kago* by a single switch operation.
- The *Task of Boarding* shall be completed once the *Traveller Robot* has boarded the *Kago* and any part of the *Automatic Carrier Robot* in front has entered onto the *Checkpoint 1* or into the space above it.



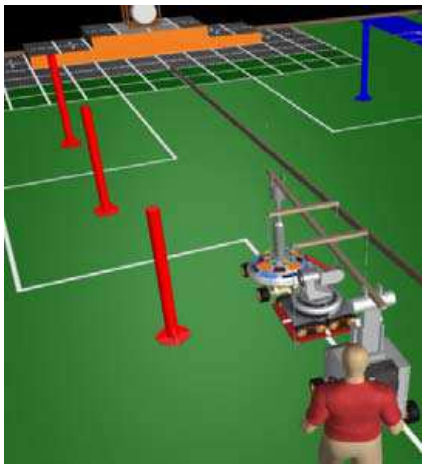
(ii) *Task of Crossing*

- The *Automatic and Manual Carrier Robots* shall cross the *Mountain Pass* while carrying the *Kago* with the *Traveller Robot* on the Seat. To cross the *Mountain Pass* means to ascend the slope from the *Checkpoint 1*, continue across the flat ground at the top of the *Mountain Pass* and descend the slope on the other side to the *Checkpoint 2*.

- The *Task of Crossing* shall be completed once the *Manual Carrier Robot* (excluding the controller) has left the area of and above the *Mountain Pass* and any part of the *Automatic Carrier Robot* has entered onto the *Checkpoint 2* or into the space above it.



(iii)<u>Task of Passing</u>



- The *Automatic and Manual Carrier Robots* shall pass through the *Woods* while carrying the *Kago* with the *Traveller Robot* on the *Seat*.
- The robots shall first pass between the poles 1 and 2 and then between the poles 2 and 3.
- At the start of the *Woods*, the robots may pass either side of the pole .
- The passage between poles 1 and 2 is complete once the entire body of the *Manual Carrier Robot* (excluding the controller) has crossed the virtual straight line connecting the centres of poles 1 and 2. The passage between poles 2 and 3 is complete once the entire body of the *Manual Carrier Robot* (excluding the controller) has crossed the virtual straight line connecting the centres of poles 2 and 3.
- The *Task of Passing* is complete once the passage between poles 2 and 3 has been completed and any part of the *Automatic Carrier Robot* has entered onto the *Checkpoint 3* or into the space above it.
- Neither the *Kago* nor the *Traveller Robot* may come in contact with either the poles or their pedestals.

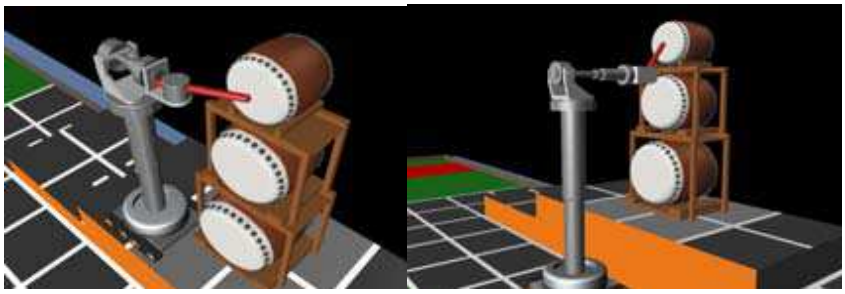
(iv)Task of Alighting

- The *Traveller Robot* may alight from the *Kago* anywhere in the respective *Kago Zone* and *Goal Zone*.

- The *Manual Carrier Robot* may touch the *Traveller Robot* when the *Traveller Robot* alights from the *Kago*.
- The *Task of Alighting* is complete once the *Traveller Robot* has left the *Seat* completely.
- Once the *Task of Alighting* is completed, a team member shall switch off the *Automatic Carrier Robot* with the referees' permission.

(v) How to achieve the *Goal*

- Only the *Traveller Robot* may enter the *Goal Zone*.
- Only the *Traveller Robot* of the red team may enter onto the steps or into the space above them on the red side, and only the *Traveller Robot* of the blue team may enter onto the steps or into the space above them on the blue side, of the *Drum Zone*.



- The *Traveller Robots* of both teams can enter onto the *Drum Zone* or into the space above it.
- The *Goal* is achieved once a team's *Traveller Robot* has beaten each of the three drums in the *Goal Zone* with the *Drumstick(s)*. The referees shall judge whether the drums have been beaten by listening to the sound.
- The *Traveller Robot* must remain in contact with the *Drumsticks* while the drums are being beaten.

- The *Traveller Robot* may beat the drums from any position on either the respective steps or the floor of the *Field*.
- Neither the *Traveller Robot* nor the *Drumsticks* may touch any part of the *Victory Drums* other than the faces to be beaten .
- No part of either the *Traveller Robot* or the *Drumsticks* may enter onto the *Drum Zone* or into the space above it for the purpose of obstructing the opposing team.

(v) At the Checkpoints

- The *Kago* may be placed on the *Field* once any part of the *Automatic Carrier Robot* has entered onto a *Checkpoint* or into the space above it. The *Manual Carrier Robot* may touch the *Traveller Robot* at this time.

6. *Retries* for Robots

- In the case of a violation, the referees shall instruct the team to start again (*Retry*).
- In the case of faulty robot movements, it is possible to start again (*Retry*) with the referees' permission.
- Team members are permitted to touch the robots while preparing for a *Retry*.
- The place of the *Retry* shall depend on how far the tasks have been completed
- In the case of failure to complete the *Task of Boarding*, the *Retry* shall be made from the *Start Zone*.
- When a *Retry* is made after completing the *Task of Boarding*, the *Automatic Carrier Robot* shall be placed at the *Checkpoint 1*.When a *Retry* is made after completing the *Task of Crossing*, the *Automatic Carrier Robot* shall be placed at the *Checkpoint2*.When a *Retry* is made after completing the *Task of Passing*, the *Automatic Carrier robot* shall be placed at the *Checkpoint 3*. To be placed at a *Checkpoint* means that at least a part of the *Automatic Carrier Robot* shall be inside or above the *Checkpoint*.
- To make a *Retry* at a *Checkpoint*, the *Automatic and Manual Carrier Robots* shall carry the *Kago* with the *Traveller Robot* on the *Seat*. The *Kago* shall not be touching the floor.
- A *Retry* after completing the *Task of Alighting* shall be made by placing the *Traveller Robot* anywhere within *Checkpoint 3*.

- Only a single switch operation is permitted for each robot.
- *Retries* can be made as many times as necessary.
- Strategies premised on the use of *Retries* are banned.

7. Deciding the Winner

- The team whose *Traveller Robot* has beaten the three drums first shall achieve the *Goal* and be the winner. This ends the match.
- If neither team has achieved the *Goal* at the end of the 3-minute match the winner shall be decided in the following order of priority:
- The team that has beaten the greater number of drums is the winner.
- If the number of drums beaten is the same, the team that has beaten the higher drum is the winner.
- If the teams are level in terms of drums beaten, the team that was first to beat a drum in the case in which both teams have beaten only one drum, or the team that was first to beat a second drum in the case in which both teams have beaten only two drums, is the winner.
- The team that has completed greater number of tasks is the winner.
- If the same number of tasks has been completed, the team whose *Traveller Robot* is closest to the drums is the winner.
- If the winner has not been settled by any of the above, the match shall be replayed or the winner shall be chosen by the judges.

8. Conditions and Points to Watch out for in Designing and Manufacturing Robots

- No communication between the robots is allowed.
- The robots used in the contest must be handmade by students of the university to which the team belongs.

(i) The *Automatic Carrier Robot*

- The *Automatic Carrier Robot* shall move automatically once it has been started by a team member.

- The *Automatic Carrier Robot* shall be started by a single switch operation.
- The dimensions of the *Automatic Carrier Robot* shall not exceed 1,000 mm (long) x 1,000 mm(wide) x 1,500 mm(tall).

(ii) The *Manual Carrier Robot*

- The *Manual Carrier 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.
- In the case of cable operation, the cable connecting the *Manual Carrier 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 1,000 mm above the floor surface of the Field.
- The dimensions of the *Manual Carrier Robot* shall not exceed 1,000 mm(long) x 1,000 mm(wide) x 1,500 mm(tall).

(iii) The *Traveller Robot*

- The *Traveller Robot* must be able to move about automatically once it has been started by one of the team members
- The size of the *Traveller Robot* shall be within the range delimited by a circle that is 2,000mm in diameter as viewed from above.
- The *Traveller Robot* shall not touch any part of the *Kago* other than the *Seat.*
- The *Traveller Robot* may not be attached to the *Seat*. The *Traveller Robot* must slide or fall if the *Seat* is inclined by 20 degrees in either the longitudinal or the transverse direction to the direction of travel.
- The *Traveller Robot* shall carry *Drumstick(s)* to beat the drums. It can carry no more than three *Drumsticks*.
- At least one *Drumstick* must remain in its entirety at least 300mm above the surface of the *Seat* while the *Traveller Robot* is riding in the *Kago*.
- Each *Drumstick* shall be cylindrical and at least 300 mm long x 20 mm in diameter.

(iv) Weight of the robots

- The combined weight of all of a team's robots and other devices to be used in the entire contest, including the power source, cables, controllers, *Drumsticks* and other

equipment, shall not exceed 50 kg. The weight of back-up batteries of the same type, weight and voltage as the primary batteries is, however, exempted from this rule.

(v) Power sources for the robots

- Each team must prepare the power sources for the robots.
- The voltage of the power source used by each robot shall not exceed DC24V.
- Any power source deemed dangerous or inappropriate by the organiser may not be used.

(vi) Detailed rules on safety

- 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.

(vii) Examination of the robots

- 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.

9. Violations

If a violation occurs, a Retry shall be made by bringing the robot back to the Start Zone or the Checkpoints. The following cases are violations:

- Any part of either robot or its operator or the *Kago* enters onto the *Safety Area* or into the space above it.
- Any part of either robot or its operator or the *Kago* enters onto the *Kago Zone* of the opposing team or into the space above it.
- When carrying the *Kago*, the *Manual Carrier Robot* is in front in the direction of travel.
- Either the *Automatic or the Manual Carrier Robot* touches any part of the *Kago* other than the *Shoulder Pole*.
- Either the *Automatic or the Manual Carrier Robot* touches the *Traveller Robot*, except in the cases described in 5.6.4 and 5.8.1.

- Any part of either the *Automatic or the Manual Carrier Robot* enters onto the *Goal Zone* or into the space above it.
- The *Kago* touches the floor of the *Field*, excluding the cases stated in before
- Either the *Kago* or *Traveller Robot* touches the poles or their pedestals in the *Woods*. *The Automatic and Manual Carrier Robots* are permitted to touch the poles or their pedestals.
- The *Traveller Robot* touches any part of the *Kago* other than the *Seat*.
- Either the *Traveller Robot* or the *Drumstick(s)* touches the *Automatic or the Manual Carrier Robot*, except in the cases described in 5.6.4 and 5.8.1.
- Either the *Traveller Robot* or the *Drumstick(s)* touches the floor of the *Field*. The *Lodge* is, however, excluded from this rule, and this rule ceases to apply from the time of the *Task of Alighting*.
- The *Traveller Robot* drops all of the *Drumsticks*.
- Any part of either the *Traveller Robot* or *Drumsticks* enters onto the opposing team's steps or into the space above it, not including the *Drum Zone*.
- Any part of either the *Traveller Robot* or *Drumsticks* enters onto the *Drum Zone* or into the space above it for the purpose of causing obstruction.
- Either the *Traveller Robot* or *Drumstick(s)* touches any part of the *Victory Drums* other than the faces to be beaten.
- Other actions that infringe on the rules without producing disqualification.

10. Disqualification

- A team shall be disqualified if it commits any of the following during the match:
- The team's *Manual Carrier Robot* moves the *Automatic Carrier Robot* directly using the *Shoulder Pole*.
- The team damages or tries to damage the *Field* and/or facilities and equipment or opponent's robots.
- Either the team's robot or operator or *Kago* crosses the outer boundary of the *Safety Area* either on the ground or in the air.

- The team's robot that has entered onto the *Kago Zone* of the opposing team or into the space above it comes in contact with an opposing robot.
- The team has made a false start twice in the same match.
- The team performs any act that is not in the spirit of fair play.
- The team fails to obey instructions and/or warnings issued by the referees.

11. On the Safety of the Robots

- All robots shall be so designed and manufactured as to pose no danger of any kind to any person in the venue.
- All robots shall be so designed and manufactured as to cause no damage to any robot of an opposing team or the *Field*.

12. Teams

- Each participating country or region in the contest can be represented by one team only. Japan, as host country, may be represented by two teams.
- A team consists of three students and one instructor who all belong to the same university. The three students of the team are entitled to participate in the match itself.
- In addition, a three-member pit crew can adjust the robots in the pit room and help to carry the robots to the Field, but cannot participate in the match itself. The members of the pit crew must be students of the same university as the team.
- Participation by post-graduate students (graduate school students) is not permitted.

Chapter 2 is contributed by Himanshu Gupta

3. AUTOMATIC ROBOT

Autonomous Carrier Robot (Fig 10.2)

Constructional Features**:**

- It was with rear wheel differential drive.
- Trans-wheels (fig 3.1) were used for the first time.
- The Gripper
  - To hold the Kago, a Gripper was installed at the top of robot on a frame that could be moved up and down with the help of a pulley.
  - It was free to rotate in the horizontal plane about the vertical axis passing through the center of the gripper.
  - It also enjoyed limited rotation in the vertical plane about a horizontal axis that was perpendicular to the direction of motion. Actually, this axis was the shaft of the encoder used to measure the inclination of the Kago w.r.t. the base of the bot.

Sensors:

Encoders: Two kind of encoders were used

- To measure the distance we used: incremental encoders
- To measure the inclination of the Kago we used: absolute encoder.

Motors:

Micro controller: PIC18F4550

Working:

- The robot could be moved on the line followers or on encoders
- The vertical motion of the Gripper was controlled by the output of the absolute encoder was used.
- Saber tooth Motor drivers were used to drive the motors.

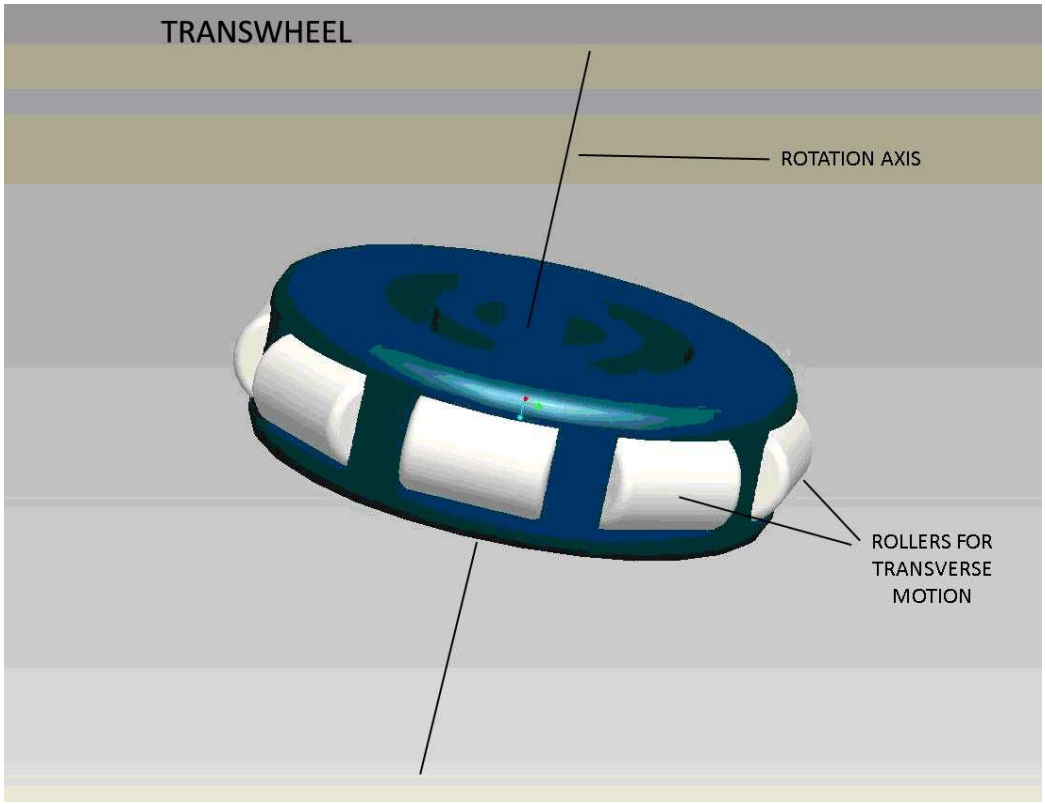


FIG 3.1 Transwheel

Chapter 3 is contributed by Himanshu Gupta

4. TRAVELLER ROBOT

This was another automatic robot, which had to finish the task i.e. by beating the drums, and was very crucial and required pity high speed to complete to save time in the last moments of the game.

Factors crucial in the designing

In September 2008, after the statement came at the end of August, the designing of this bot started along with other bots and the initial ideas came from the intra-club Idea Competition from all the 3 teams. The main idea was to enable the bot to hit the highest drum (at an height of 1.7 m) when the initial height has to be less than 800mm so that it does not touches the shoulder pole. All the 3 teams came with the same design of multi level jack mechanism for lifting similar to the snake mechanism that we have seen in the snake-toys. The idea came as all of us had witnessed the successful jack mechanism last year (which although did not come into use).

Also another suggestion was that to make the bot eccentric so that it has an height of more than 800 mm but which is offset from the center so that it does not touch the shoulder pole. As the teams for all the bots were decided for the mechanical part, Vyom and Mayank were chosen for the designing of traveller bot.

Design 1 (Fig 5.1)

The multi level jack mechanism was rejected as the level of complexity was pretty high and thus it was decided to go with the familiar **sliding mechanism** used last year and keeping the height to nearly 100 mm and keeping it eccentric.

Trans-wheels were enable the bot to move in both longitudinal and transverse directions without turning. This was done because of the rule that Traveller bot

had to slide or fall when tilted in by 20 degrees in either the longitudinal or the transverse direction. This was a very ambiguous statement as if the comma is placed in different places the meaning of the statement completely changes.

Due to majority opinion in the club it was decided to go with the meaning that bot should fall when it is tilted in longitudinal direction and also when it is tilted in the transverse direction. Although some seniors commented that if this is the rule then half of the teams will not be able to do it as it is a very complex thing to achieve. Also **3 different motors were used** for beating 1 drum each as using 1 motor led to events like 1 drum being beaten and other unbeaten, and if not this, high complexity.

Finally, a CAD model was made considering in mind the height factor and other things. The design was shown to SAHA sir, seniors and the I yearites and "fortunately" the **design was highly criticized** by Saha Sir and the seniors. The biggest point raised was the weight of the bot (which was estimated to be around 10 kilos (lolz) and was unacceptable as it had to be lifted and that would have resulted in very high torque motors in the other bots for lifting of the kago. We were brought down to the beginning of designing and the whole design had to be changed. Seniors suggested that a weight of more than 5 kilos can not be accepted as they will not be able to control the fall of traveler bot. Also the height should not be greater than 500mm as the bot will fall off. But it was approved from Jainesh and Gaurav that a height more than 800mm can be allowed if the Centre of mass of the robot is low. So the idea of the bot being eccentric was still an option.

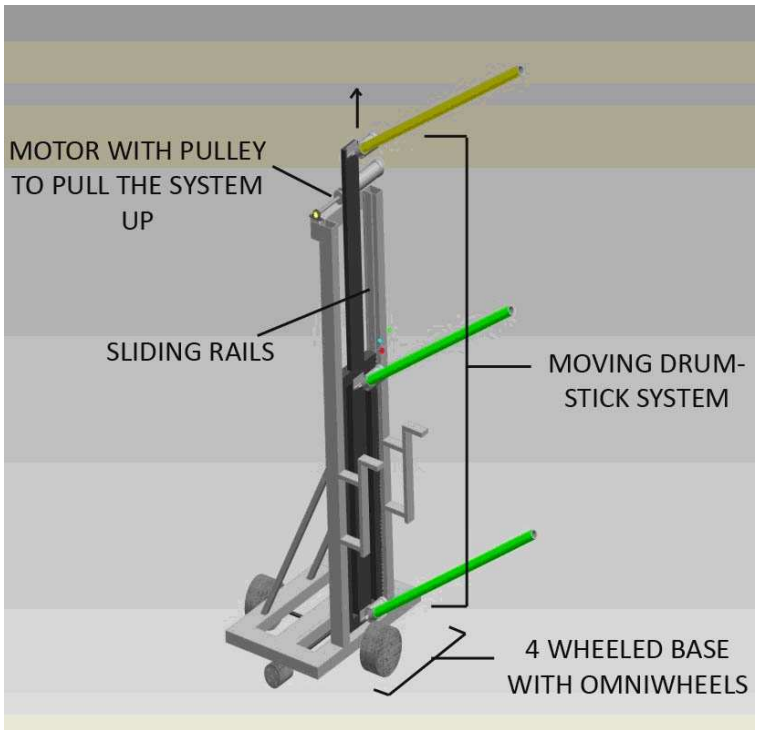


FIG 4.1 PRO-E DESIGN 1 OF TRAVELLER ROBOT

As the designing progressed many designs for lifting were suggested and almost all of them were rejected due to some reason or other. Some of the ideas suggested were as follows.

1. Fishing rod mechanism to simply increase the length of the drumsticks by the centrifugal force like a fishing rod. The idea was rejected as the there was a fishing rod present in the club and when it was tested with a motor, it required high torque and angular velocity to lift itself, which was not possible.
2. Using a motor to double the height by using a folding mechanism. But that mechanism was also rejected as the motor required will have to have a very high torque and also the weight of the robot would increase.
3. Using the sliding mechanism to increase the height. This also was rejected as the height of reaching the highest drum could not be achieved.
4. Hong Kong Sliding mechanism…this idea got its name from the sliding mechanism used by the Hong Kong team in the international ROBOCON. Everyone was very much impressed by the proper use of the engineering

mind used. The design was quite similar to the questions of tension problems that you may have seen in the JEE problems. Even this design was rejected as the weight would have increased if we would have used two sliding mechanisms as the sliders available to us were pity heavy.

Side by Side there was the problem of navigating the bot after it alights as if the line sensing mechanism would be used, it would have led to two problems, i.e.

- The starting angle of the bot after alighting could not be set properly that would have resulted in the bot not sensing the lines.
- The weight would have increased if this was used.

So the problem was how the robot can be sent to the drums accurately with high degree of reliability without using line sensing. Hence the bot had to be hard coded. No idea was clicking for doing this. But one day Chinmay came with the idea of what if such a base is made such that the robot hits at any angle with wall of the stage on which the drums were placed, aligns parallel to the wall and then moving it like this till the drums.

This idea was further structurised by the idea that the profile of the surface of the base should be made curved at the ends so that as it hits the wall the bot aligns itself with the wall. The base's profile had to be made symmetric so that it can align from both the sides. But another thing that could be done was to rotate the drum at one point and fixing it in the final position) beating mechanism as the side of the bot changes from Red to Blue or vice-versa. Its stoppage was done by use of a limiting rod that falls on the ground and detects the fence between the areas of the two teams. This was a very good idea.

Second Idea (Fig 5.2)

The base's profile was made like that of an plane(as observed by Chinni after designing), and the drum beating mechanism and the motor used to move the drumsticks could be rotated at one point.

The bot was made eccentric as was thought of earlier. Only 1 motor was used to beat all the 3 drumsticks by the use of pulley rope mechanism. The problem of all the drums hitting together was solved by the method of leaving the drumsticks at the highest position and the leaving them after providing sufficient velocities and relying on freefall by gravity.

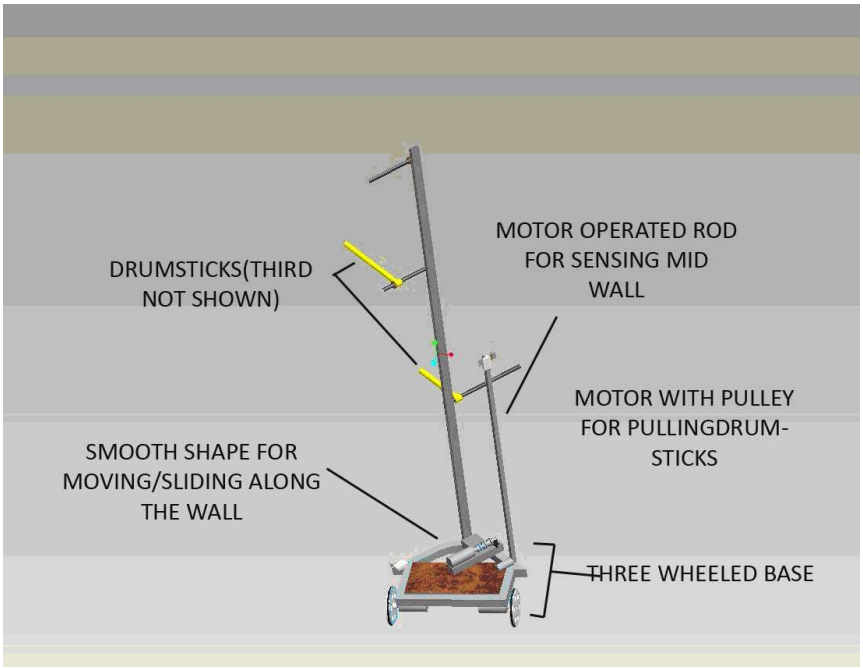


FIG 4.2 PRO-E MODEL OF DESIGN 2 OF TRAVELLER ROBOT

Third Idea (Fig 5.3)

Second idea was looking good but the height of the robot was the main concern because since traveler has to be carried in Kago, the instability due to height was unacceptable. Hence another idea emerged that the drumstick should be folded initially, so that the initial height of bot is minimum. Then at the time of beating a spring system will allow the drumsticks to unfold and beat all the drums at the same time.

Drumsticks were split into two halves and joined with initially elongated springs. The front part was held with an L shaped block, from unfolding. At the time of beating, one motor drives the L, and it frees the drumsticks to unfold. Now when drumsticks were open and on the ground the same L comes after one complete rotation on its axis, and takes all the three drumsticks on it to beat the drums.

Another specialty in the final design was the use of **brakes** for holding traveler on the Kago, when large swaying was there during traveling. Brakes were made up of simple aluminium sheets bend along the shape of wheel and rubber grip was applied to it. These brakes were applied by a high torque motor.

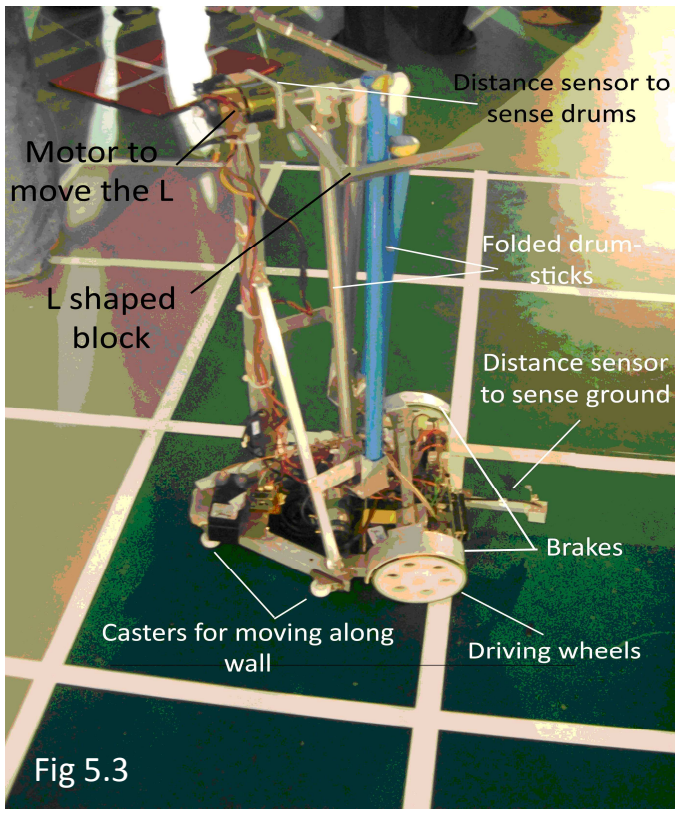


Fig 5.3

Chapter 4 is contributed by Vyom Jain

5. MANUAL ROBOT

Manual Robot

The design of the manual robot was very essential to the success and failure of the team this year. The coordination to be achieved between the manual and the autonomous carrier robot was a tricky thing. Like in previous years robots, the manual robot this year could not score points individually by itself and be instrumental in helping the teams win the competition solely on its basis. It had to be able to work in coordination with the other robots and thus couldn't be designed independently. Our initial designs and the final designs that we took to the competition were totally different. Here is the description of each of the designs and the problems faced with each of them.

Design 1 (Fig 5.1)

Initially, just after the problem statement for Robocon 2009 was released, our initial thought was that both the Autonomous Carrier and the Manual Robots were similar in their functionality and should be similar in design too. Thus we designed both the robots on similar grounds with the exception that the grippers in both the robots were different. The manual robot gripper required one more degree of freedom as compared to the Autonomous Carrier Robot. This was because, the Carrier Robot was supposed to hold on to the Kago rigidly but the Manual Robot had to give it some allowance for movement in the translator direction. Thus the gripper of the manual robot had rollers too to allow the Kago to have a translation movement too.

Some basic constraints identified in the design of the robots were:

- The width of the robots had to be less than 500mm so that they would not crash into the traveler robot placed in the lodge
- The minimum height had to be less than 800mm so that the Kago could be placed on the ground

- The stroke length had to be at least 300mm in each robot so that the robots could lift the Kago above the mountain with some clearance

We had presented two alternate and equally possible lifting mechanisms in the design of the robot

- Jack Mechanism (Fig 1) – This was similar to the car jack system. We had also tried and tested this mechanism in the "Jack", one of the robots used in Robocon 2008. According to the initial design of the traveler robot, it was realized that the Kago and the Traveller robots both were going to become pretty heavy, and other systems could fail. The mechanism was preferred because it could be used to lift very heavy weight without much problem. Due to the higher load, we rejected the common and simple pulley- slider mechanism. It was fast acting but there were some problems too:
    - The system was very bulky and complex.
    - It was too fast and gave a jerk.
    - Controlling the exact height of the mechanism was difficult.

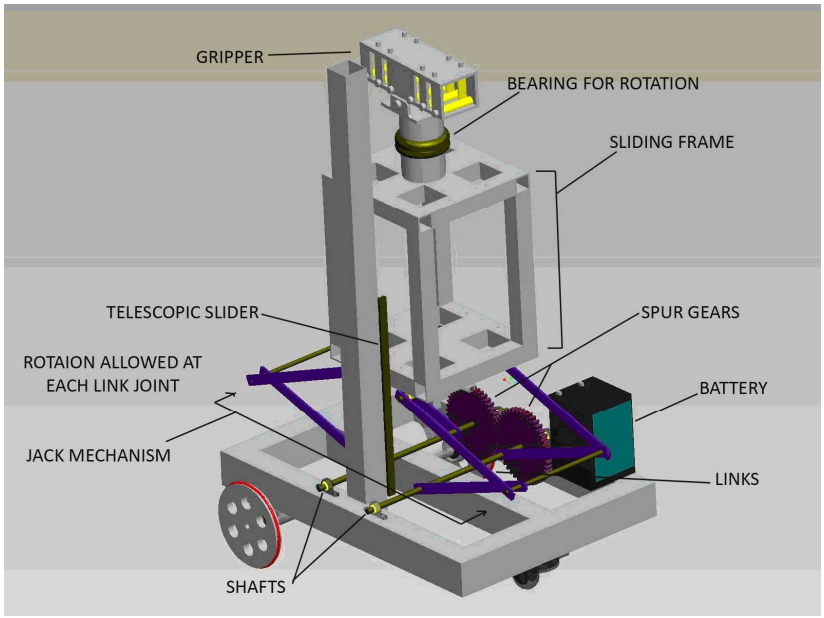


FIG 5.1 PRO-E MODEL WITH JACK MECHANISM

- Pneumatic Mechanism (Fig 5.2) – The second mechanism, which we considered suitable, was the pneumatic lifting system. This system had various advantages like
    - Fast acting
    - Easy control
    - Can lift heavy weight easily

  But it had various imminent problems associated with it too
    - Bulky (around 10 kg each)
    - Required stroke length was difficult to find and fit on the small base of the robots
    - Expensive

Thus the pneumatic system was finally rejected as with it, the total weight of the robots could easily cross 50kg, which was not allowed.

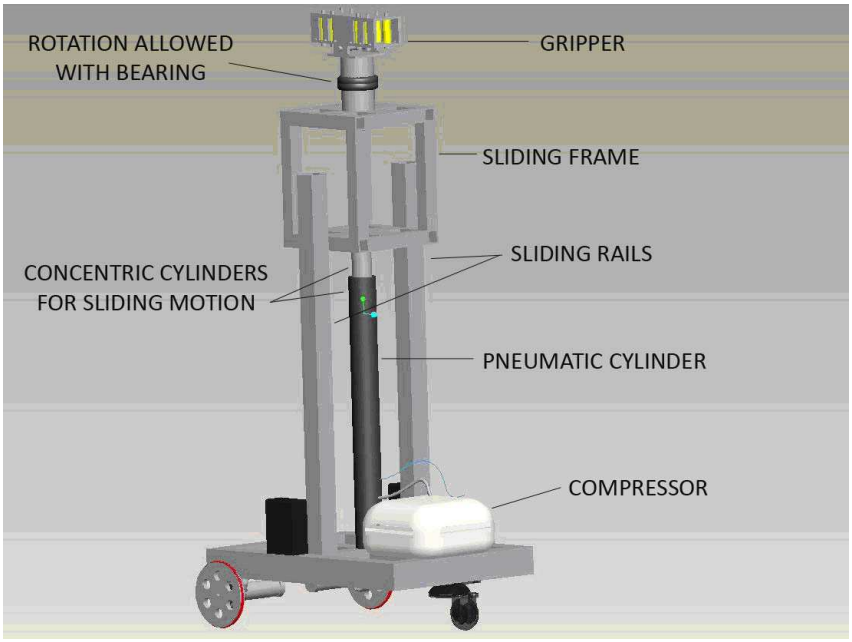


FIG 5.2 PRO-E MODEL WITH PNEAUMATIC SYSTEM

The **gripper** (Fig 5.3) of the robots was designed such that it had three degrees of freedom – 2 rotatory and one translatory. It was to have a thrust and roller bearings underneath it so that the Kago placed in the gripper could rotate with respect to the direction of motion. A pin joint was provided so that the Kago could be tilted with respect to the base of the robot when climbing up and down the mountain pass. Rollers were also provided to allow for translatory motion of the Kago as the speed of the Manual and Carrier Robot could vary and thus one bot had to hold on to it rigidly and the other robot could just support it. Instead of rollers, telescopic sliders could also be used for the same purpose with the added benefit that the Kago would be limited within its stroke and not fall if the manual robot lagged too much behind.

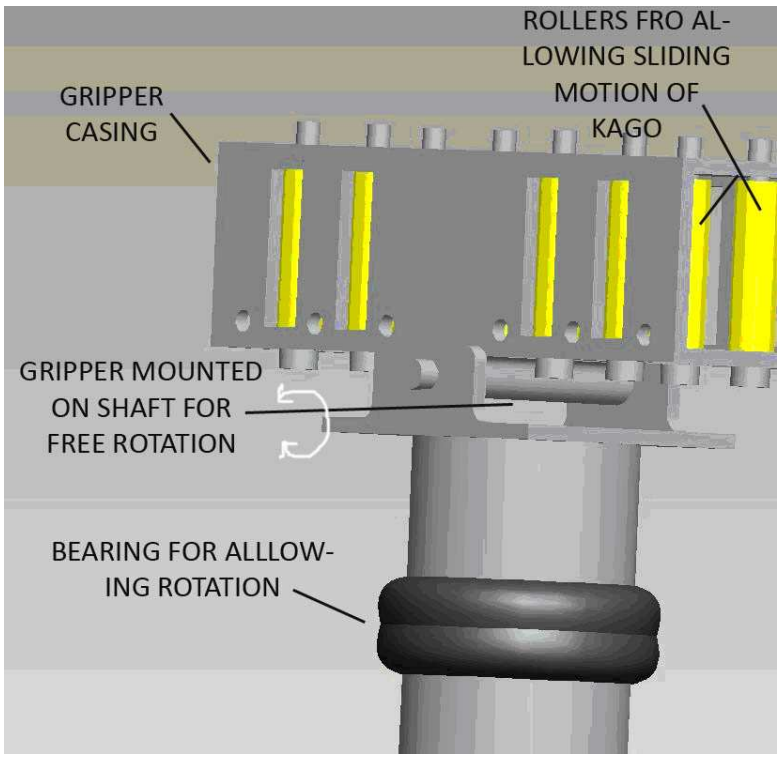


FIG 5.3 PRO-E MODEL OF GRIPPER

Design 2 (Fig 5.4)

After these designs were presented to Prof. Saha and we were asked to re-evaluate these designs, we realized that the system was becoming too

complicated. Thus in order to simplify things, the second design was made, in which the whole system was driven by the Carrier robot in front. The Manual robot was to be pulled by the Autonomous Bot through the Kago. Thus both the robots were to rigidly hold on to the Kago and the Manual Robot was to only have the capability to change the direction of its motion i.e. move in the left-right direction and the ability to lift the Kago up and down. Its major Components were:

- Trans Wheels - As the robot was to be pulled, it had to be free in the forward direction and not resist motion in the longitudinal direction. But in the transverse direction, the wheels should be able to rotate. Thus the conventional wheels couldn't be used as they provided huge friction in the direction perpendicular to their direction of rotation. Thus a single motor powered trans-wheel was decided to be used for the purpose.

- Gripper – The gripper now had to rigidly hold onto the Kago and only allow for the rotatory motion in the vertical plane. Thus a shaft and IGUS spherical bearings were decided to be used. The gripper did not require rotation in the horizontal plane as the Kago was to be aligned with its direction of motion, and not the Autonomous Carrier Robots motion

- Lifting Mechanism – The lifting mechanism was finally designed as the Pulley Slider system as in the new design, the weight of the robots was greatly reduced and the pulley slider system could now be able to lift the Kago. But a powerful motor was required and a Power Window motor was decided on due to its self locking (due to worm gear) and large torque(around 1.5Nm). The lifting mechanism was also designed such that the top portion was free without any obstacle i.e. the topmost part of the lifting mechanism was not constrained by the motor or the skeleton and thus the Kago could easily be placed over it.

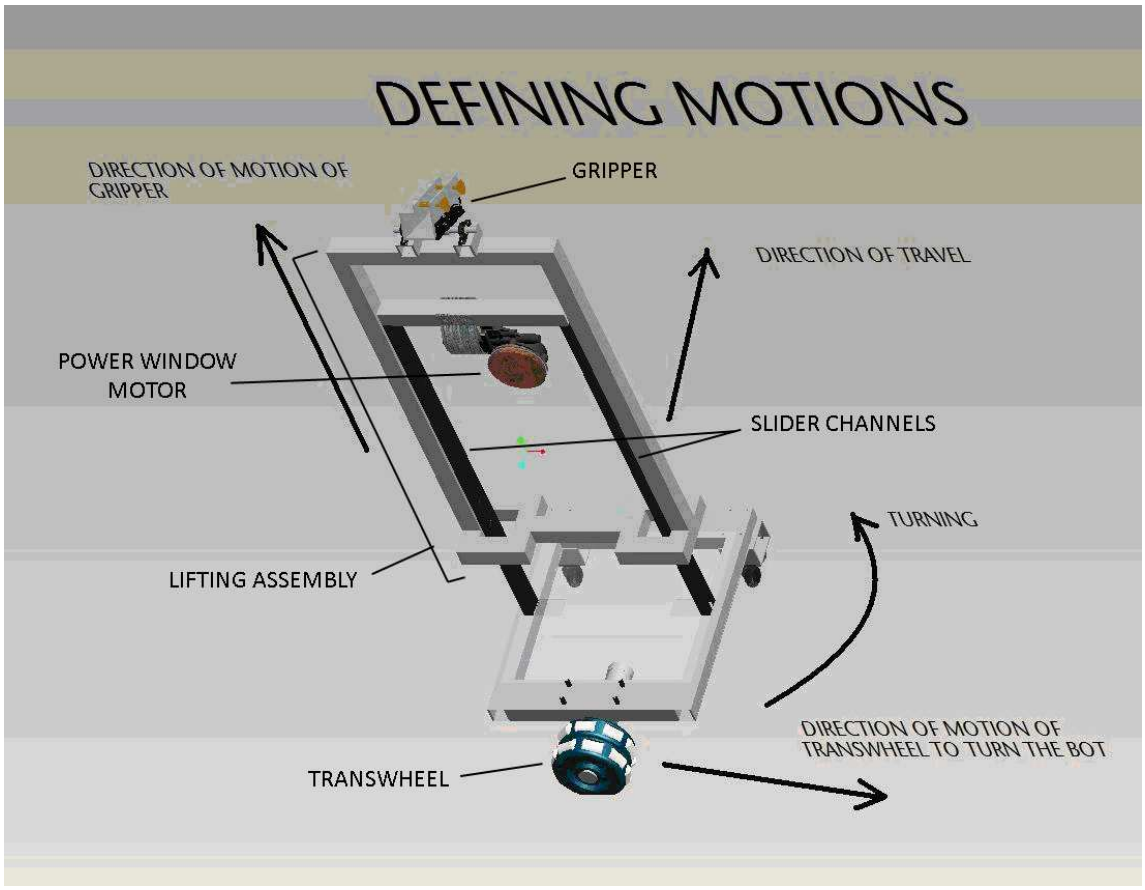


FIG 5.4 PRO-E MODEL OF DESIGN 2

Problems encountered:

Design 2 was finally realized for fabrication. In December 2008, the fabrication of the Carrier and Manual robots was started. Due to various problems on our side too, the manufacturer was unable to complete the fabrication on time and the robots were finally ready by mid January 2009 after a delay of nearly 20 days.

After the first iteration of the fabrication, the major concern was whether the Carrier Robot would be able to pull the Manual Robot and the Kago over the mountain pass. We had initially thought of using the Power Window motors with gear reduction (to increase the speed) as driving motor in the Carrier Robot. But we were unsuccessful in getting the Gears fabricated and we thought that the available Maxon 28:1 motor could do the trick as it had the required torque. But

on testing, it was realized that the Maxon motor would not be able to pull the whole system up the slope. Thus radical changes in the design were sought.

Also, FAQ's were being released at that time and a FAQ declared that a manual robot that is unable to drive on its own would be disqualified. Thus we needed to change our design.

Design 3 (Fig. 10.1)

After being unsuccessful in getting the Carrier robot pull along the Manual robot over the mountain pass, even without the Traveller being placed on the Kago, changes in the design of the manual robot were sought. These were:

- Attaching driving motor in the Manual Robot too such that it could assist the Carrier robot in climbing over the mountain pass
- The gripper then needed to have an additional degree of motion in the translation direction so that variations in the speed of the Autonomous and Manual robot could be taken care of. First we tried using a single telescopic slider placed horizontally for this purpose. But due to its weakness in that direction, the different layers of the slider broke apart when the robots nearly toppled. Thus two sliders were then attached parallel to each other with the gripper in between.
- Only one driving motor could be attached as the motor with the trans wheel should still be able to give direction to the robot and thus only one point of contact besides the trans wheel could be accepted as the robot would turn about that point of contact. In order to make the robot stable, two Motor driven Trans-Wheels in the transverse direction and one motor driven Trans-Wheel in the longitudinal direction were attached.

Another problem that still existed was that the base of the robot was too small and unable to prevent it from toppling when climbing up or down the slope. Various improvements were tried like by adding castors on the sides of the robot that improved its stability but the robot was still sometimes susceptible to

toppling due to errors in handling the robot while climbing down the slope of the mountain pass.

Thus the **main features of the final design (**fig 10.1**)** were:

- Three motors with Trans-Wheels were used on the base of the robot. Two were attached for transverse motion and one for longitudinal motion.
- Pulley mechanism was used for lifting the gripper Power Window motor and accelerator wire were used for the lifting..
- The motor and pulley were attached hanging from the top horizontal channel. The top of the lifted part was above the skeleton of the robot so that the gripper and Kago could be easily accessible.
- The Gripper allowed translatory motion and a rotatory motion in the vertical plane.
- The gripper consisted only of two halves hinged together. The Kago was first placed on one half of the gripper and then the other half was closed and tightened by hand as Wing Nuts were used for easy and quick tightening and loosening of the gripper(as it was to be achieved in under a minute allotted for this purpose)
- Two castors were provided for support that were initially not in contact with the ground but came into contact when the robot tilted in a direction.

Chapter 5 is contributed by Himanshu Gupta

6. WHAT DID WE USE?

AUTONOMOUS CARRIER ROBOT-

FRAME

- Basic frame was made up of aluminium channels, welded together.
- Gripper was made up of aluminium plate. (5mm)
- Thrust bearings were used for rotational degree of freedom of gripper.
- Wheels were made up of aluminium (solid).
- Transwheel was used in front side (Kornylak corp.)
- At the end we also used telescopic channels under gripper for additional translational degree of freedom of gripper.
- Lifting by clutch wire.

DRIVING MOTORS ARE AS FOLLOWS

- 2 X Maxon (28:1) ~ 30 watts
- Lifting- power window motor – 80 watts – worm wheel operated

SENSORS

- Absolute encoder (IFM) for angle measurement of gripper with respect to a reference base.
- Relative encoders for distance calculations (accounting for slip)
- Optical sensors –(IFM)

MANUAL ROBOT FRAME**:**

- Frame was made up of aluminium channels, exactly same as that of automatic one.(2”x1” ; 1”x1”)
- 3 Transwheel were used – two for turning (installed sideways), one for driving (front)

- Additional castors on sides for extra stability
- Gripper was same as of autonomous robot, except that the telescopic channel was installed in initial design itself.
- Lifting by clutch wire.

MOTORS:

- Driving – transmotech – (66:1)
- Turning – 2 X Maxon (14:1)
- Lifting- power window motor – 80 watts – worm wheel operated

TRAVELLER ROBOT:

FRAME

- Frame was split into two parts- one base and one adjustable drumstick holder
- Base – triangle shaped- (1 X 1, 2 X 1) aluminium channels, welded
- Drumstick holder- (1X 1) aluminium channels
- Wheels – aluminium (solid), front caster
- Casters were attached to sides for traveling while slipping on walls
- Drumsticks – aluminium pipes (21 mm) – folded drumsticks
- Brakes – aluminium sheet + rubber grip

MOTORS:

- Driving – 2 X Maxon (28:1)
    - Drumstick striking – some local motor- Torque- 1.2 N-m
    - Braking – Maxon – (159:1)

SENSORS:

- Distance sensors
- Magnetic compass- for directional alignment according to earth's magnetic field ☺

BATTERIES USED : Amptek – 12 V ,

Chapter 6 is contributed by Abhijeet Rathore

7. THE ARRIVAL AT PUNE

After the tiring yet enjoyable train journey, it was time for some relaxation as soon as we reached our destination. After unloading the robots and all other material brought along, most of us decided to have some rest before beginning the practices. Some of us departed for the room which had been reserved for our team in the hostel of the Commonwealth Games Village to return to the game field the next day while the other members went directly to the game field. The practice area was called the pit area. Within its boundaries each team had its own work-area in the form of a tent, we kept our belongings there along with the material brought along besides the bots. Most of us were feeling very sleepy so we retired for a sleep while one or two of us began unpacking. Most of the teams had not arrived by that time and so much of the place was vacant giving us the benefit of resting peacefully and conveniently.

The actual work began in the morning with the arrival of some more teams; everyone seemed to be busy all around unpacking and laying out all the material and equipments. I too got busy in that, everything was readily laid out, the electrical equipment in one corner alongside the power switches and the mechanical equipment in another. We began to arrange the circuit boards on the bots taking careful note of the wirings, another good suggestion this time was writing out the role of each pin and every connection in the circuitry to avoid any sort of confusion at the last moment.

The arrival of different teams also gave way to curiosity so many of us began to look out for their designs as well, quite a few of which were good and made us realise that maybe we were in for a surprise. With the aim of achieving success, we got down to our work of giving the final assembly to our bots so that we could start our practice. That evening, we began our practice. The starting was not that good as the bots were bound to have some difficulties in adjusting to the new type of vinyl covering on the game area. Though we noticed that the vinyl sheet used here was rougher; hence would aid us by preventing the slipping of bots.

The bots were having difficulty in climbing the mountain pass and all of us were quite busy in trying to do some minor changes in them while some of us were back there in our tent arranging the material and charging up the spare batteries to be used up for practice. The next day the rest of the members also arrived at the pit area after resting at the lodge and work began even more swiftly.

(6th march 2009)

The Prelims

The matches were to begin the next day so we were trying hard to sort out the problem of mountain pass. The other teams with whom are matches were to take place in the preliminary stage were not strong contenders as we had observed so we were quite confident about reaching the super-league smoothly.

All the teams including us were given 5 minutes as the stipulated time for grading our sensors according to the colours of the vinyl sheet employed on the main game field. Soon the tournament started and we were overwhelmed to see the huge crowd (not realising that more was expected during the later matches). Not only that there was Doordarshan-Television too besides the sponsors. The first match was with Govt. College of Engg. which we won easily as the other team was not even able to reach the top of the mountain pass. Again we got down to simplify our task of making the bots climb the mountain pass and we were successful to some extent.

The Super-league

Since the super-league had fewer teams so naturally the pressure mounted upon us to outperform the better performing teams at that stage like IIT Bombay and IIT Madras. IIT Madras was performing quite well with their bots giving minimum glitches and reaching almost the end of the designated travelling path without the traveller bot. Even IIT Bombay was doing well but was having some problems in loading up the traveller robot on to the Kago. They had minimum problems in covering the mountain pass which we noticed that this was due to the highly stable design that they had employed. Their four-wheel drive was doing its work well and good but they were somewhat slow in turning, an obvious disadvantage of this concept. We had to make rapid changes if we were to show our prowess in the arena. The problem of mountain pass was almost over via some minor changes in the wheels of the bots. Still there were some problems. This time probably in the code as the bots were not moving on the designated white line and were straying from their path very often. The task at hand was to make them cross the mountain pass smoothly with minimum deviation and then make them cross the woods efficiently i.e. to deal with their turning.

We had little time, so doing some major change was not an option. Hence we resorted to smaller changes and continuous testing of the bots on the practice area. The code modifications were done primarily by the seniors. We were having

some problems with the grips attached to the wheels of the bots as they were frequently coming out. For the automatic bot, we switched for the cricket bats' grips but the traveller bot was still giving a problem.

During our practice, we frequently noticed that our manual bot appeared to push the automatic one during the traversal of the mountain pass. Even most of the other teams also pointed this out to the same effect; I feel we did a big mistake by doing an important change in the design of the manual bot overnight. Even though we did a commendable job by completing out the design in one night itself and the design itself was looking excellent but little did we know that it would be a headache for us. We came to realise this after we resumed our practice, the autobot wouldn't just move forward, it got stuck due to some reason and hence the whole assembly was unable to climb up the mountain pass. This was later solved by reverting to the older design. Thus we learnt a very important lesson of not paying heed to any stray comment.

7th march 2009, the first match in the super-league was with IIIT Hyderabad at 10:30 a.m. They did not arrive in the arena for the 1st round in which we just completed boarding, so we were quite relaxed for the next round when they appeared, in which we went over to the mountain pass and later on the woods.
Our next match was at 2p.m. and we were trying our best to remove all possible glitches in the bots' motion. Parallely, matches were continuing among IIT Bombay, Madras, MIT Pune etc. There was an interesting match in between IIT Mumbai and VIT. We won our next against MIT COE. It was an easy win. It was quite weird that no one could beat the drums so far. An amazing match took place between VIT and NIT, Nirma .Nirma registered a clear by beating the drums in round one. VIT won the next round as NIT made a violation and had to restart. But in the third round NIT made a come back and bet the drums again but from the sides. This was a violation and so VIT was declared winner. But professor of NIT was not satisfied and argued for a re-match. The result of the re-match was that NIT won by beating the drums. This was the first time when the drums were beaten and that too thrice.
Our next match was with VJIT. The other team could not move an inch and we just reached the first Checkpoint. Hence due to their pathetic position we won. We were now amongst the winners of Super league.

A magnetic compass was attached parallel to the base along the shaft of the traveller robot to help in its alignment with the drums and beat them easily. Though we did not get a chance to display our traveller robot it had the best mechanism among our bots and probably among all the traveller bots present there.

8th March 2009, first quarter-final against IIT Mumbai at 10:30am turned out to be our last match unfortunately. Though we worked till wee hours last night and tried to correct our mistakes but still the main problem of mountain pass still was not completely solved. As the match begun we started out normally but disaster struck in between due to break down of the Gripper mechanism of the Automatic robot.

Semifinals and Finals

- IIT Madras vs. MIT,Pune. IIT Madras won. A very important reason for their confidence boost up was our cheering.
- IIT Mumbai vs. VIT. In this match too we cheered for IIT,forgetting that they had defeated us. The crowd too was ecstatic to see the harmony of IITians.

- Finals: IIT Madras vs. VIT
  Round 1: disaster struck on VIT as their robot broke down and IIT Madras could just complete the task of Boarding.
  Round 2: again IIT Madras just completed the task of boarding when the time finished. But they made a violation and meanwhile VIT also completed the task of boarding. VIT was the winner of this round.
  Round 3: referees decided that if a tie occurs in this match the winner will be decided on the basis of no. of violations. But such a situation did not arise. IIT Madras answered all the questions on them being the deserving team to represent India by beating the drums.
  Meanwhile NIT,Nirma made a poster “The Most Pathetic Final Ever”. It was very arrogant on their part and it was criticised by everyone.

Presentation of Awards
Best debut : Baba Ramdev Kamala Nehru College, Nagpur.
Runner up : VIT, Pune
Winner : IIT Madras

Chapter 7 is contributed by Rohit Goel

8. ROBOCON TO ROBOMUSE

Robomuse is a line following industrial robot capable of handling few kilos of load. It was manufactured as a part of Robocon-2008 by IIT-Delhi Robotics team. After participation in the event at MIT, Pune the robot was lying waste in the robotics room in Student's Activity Centre. The only time it was cared for was during the OpenHouse of IIT Delhi when the team decided to put it up on demonstration in the Exhibition Hall for few hours. Though it failed in its task to pick up and place back a small basketball in a basket after traversing a square path yet whatever random motion it underwent while keeping on track on the white line attracted great crowd. Next day the robot hit few articles in the local newspapers too.

It was late in the evening when our mentor, Prof. S.K. Saha seeing the favourable response from the public proposed the idea to put the robot on permanent display in SAC. It was a cool idea to have been conceived and a bold step in the history of IIT if it could have materialized.

A proposal for the Robomuse project was first made . There were issues like what all a robot should do when a user presses a button. Then there were issues regarding the power source for charging the batteries without human intervention.

The idea was as follows- We would have the robot modified a bit with the gripper replaced with T-shaped rod having 2 electrical contacts brought out from the battery terminals. The robot would move over a wooden surface with a white line in the middle and white crosses at the ends of the track to mark the beginning and the end of the track. At the start there would be a charging station consisting of 2 spring loaded metallic projections, making contact with the 2 electrical contacts on the T-rod of the robot when the rod docks onto the station. This docking would initiate charging by connecting the batteries of the robot to charging port through the mechanical cum electrical contact. What remained was how the user was to control the movement of the robot for we did not want the robot to continue like this in an infinite loop for reason known only to public. They

are similar to the fact that people generally appreciate things which they can control themselves. Keeping this in mind we planned to go for a user remote control which had to be wireless for we didn't want any wires going around and the battery charging contacts on the T-shaped rod had almost exhausted it's width. Further adding more terminals onto the rod would have increased likelihood of failure owing to loose contact during docking. Thus we decided to go with an RF remote control to initiate the robot. To make things a bit more interesting we added an LCD panel with a puzzle and a telephonic keypad to enter the answer to the puzzle. Only a right answer would give the user a chance to start the robot and see as it moves smoothly down the white line, takes a cool 180 degree turn and return back to its starting position and docks onto the charging station to make up for the energy it spend during the entire process. This idea had no loopholes as far as we were concerned and so we decided to go by it.

The work for the same started in September but it came in front of the public only in the first week of December. Even then it was not reliable and we took lot of pain in correcting the system and having lot many rounds of iteration. Everytime after fixing the problem we would think that the system would survive for ever now and everytime we would find ourselves faced with a new kind of problem *(** one never faced before)*, details of which have been compiled separately. Anyhow all's well that ends well.

The Robomuse Day

Robomuse was inaugurated by Dr. Surendra Prasad, Director, IIT Delhi on the occasion of 26th January 2009 right here in SAC. Many other faculty members were present there and they really enjoyed the show. Though there was an all round feeling that the Robomuse idea could have been done at a more sophisticated level rather than just a line following demonstration but even then they appreciated the effort put in and the bold initiative taken by the Robotics Club as a whole. After the inauguration and a few test runs by the crowd present there we went upstairs in front of the Robotics Club where another show was

waiting, live demo of Robocon 09 robots. It all ended with a light interaction of the faculty with the students and later on by filling the feedback diary for Robomuse.

FUTURE OF ROBOMUSE

It has been some two months since Robomuse has been non-functional as its parts were used for 2009 robots. It was put back on track on 15th of April 2009 for the IIT residents.

If it is able to survive in the coming time then maybe Robotics Club can take up more such endeavors in near future under the guidance of Prof. S.K.Saha. Its not necessary that we continue with the current model and it may be replaced later on with a better version of it. Further it would be really great to see the present simplistic line following technology on display evolving into more complex and sophisticated robotic models. They may even not be directly related to robots built for Robocon but belong to the category of Robotic Systems. It should be remembered that creating a system that is reliable and maintenance free is THE most important question and such initiatives such as Robomuse can be an answer.

FIG 8.1 Robomuse

Chapter 8 is contributed by Prateek Agrawal

9. FUTURE VENTURES OF CLUB

There are few ideas which come to mind which we feel, would be great to share with all you readers.

1. Increase the efficiency of the club with enthusiasts coming and building robots of their own interest. Use club facilities to make a micromouse, flying robot, solarbots, beam robots. Maybe if few like minded people come in, it would motivate others also to materialize dreams. It may not be only club members but other students of IIT too, who are really interested.
2. Club can start doing tutorial workshops each weekend or may twice a month for new entry students of IIT. This will improve their presentation skills and public speaking capability. This could be done in cycles, so each member gets a chance.
3. Club can manage a public library system for students of IIT who want to make robots. This library not only includes books, but motors, soldering machines, microcontroller boards, drilling machines etc. Membership can be done with a reasonable amount or may be free. Late return or tampering of borrowed stuff could attract fines.
4. Automate club room in SAC, make it something a place where geeks live in. Maintenance will be needed.
5. Club members could at least motivate 1st year students to participate in competitions apart from Robocon which can also improve the students exposure level when he/she comes to Robocon.

Chapter 9 is contributed by Manish Chauhan

10. PHOTO GALLERY

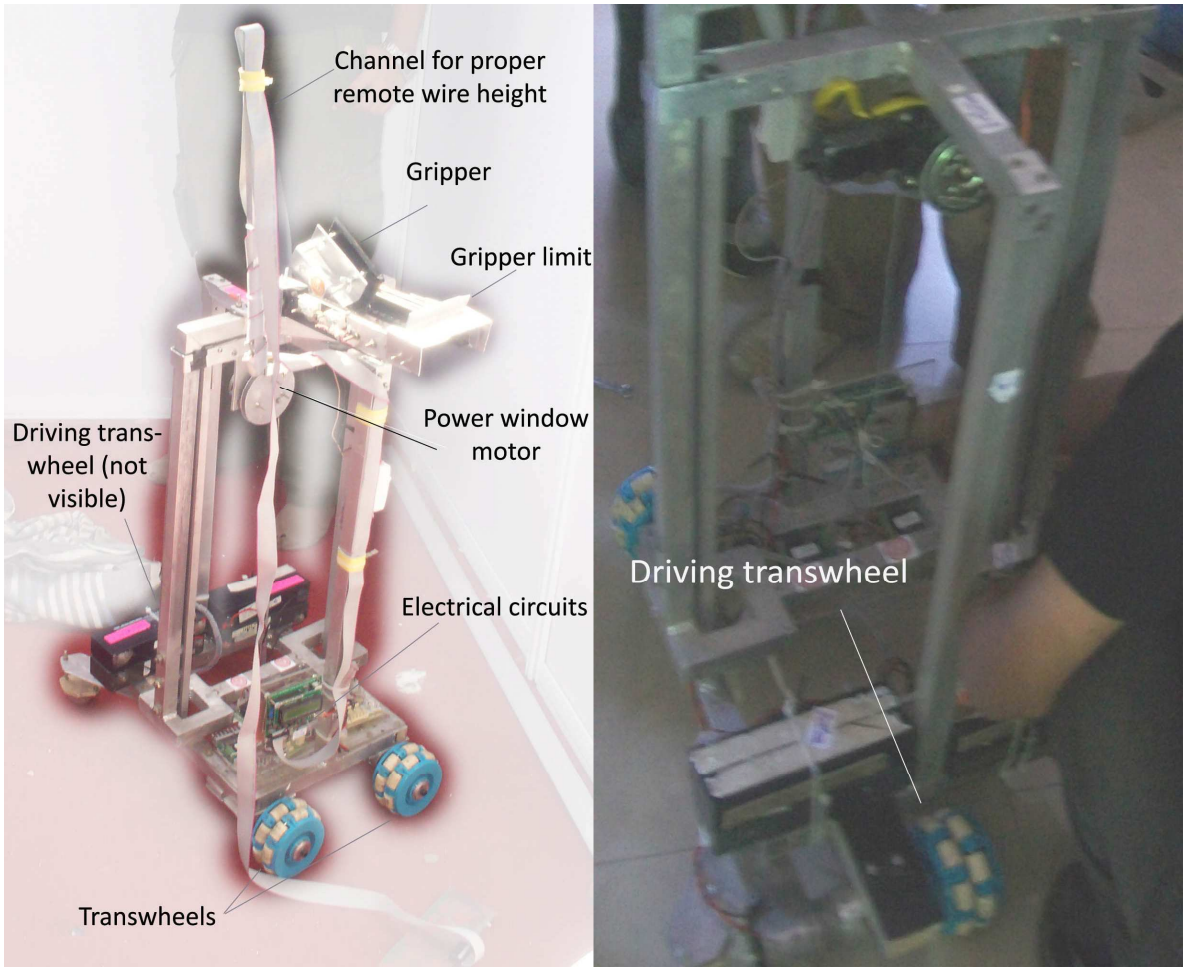


FIG. 10.1 Final manual robot

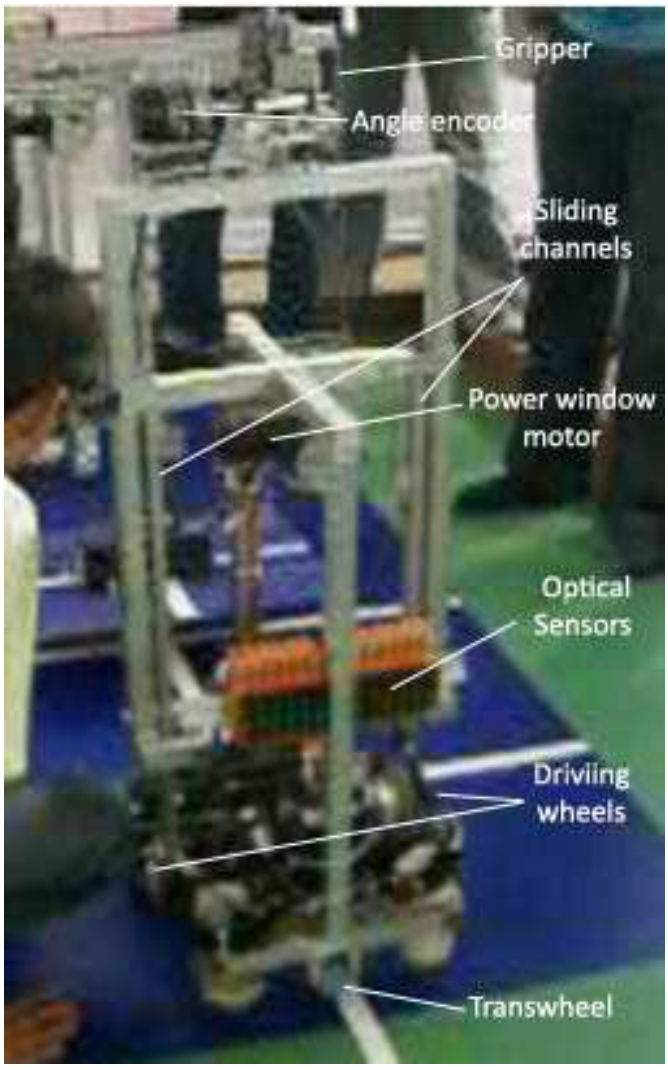


FIG 10.2 Final automatic robot

Chapter 10 is contributed by Abhijeet Rathore