Educational Toy Design With Robotic Elements

Guide:
Prof. B.K. Chakravarthy

:
Abneet Chauhan
Roll No. 07613802

Industrial Design Centre
IIT Bombay

Need of the project

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For better teaching of abstract concepts of science, experiments and activity are given for better understanding of actual phenomena.

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somethings are taught and some child grasps from his own experiences. Both ways of learning, have an equal and important role.

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as a child grows up, distance between playing and learning starts increasing. The two major causes are:
1. Due to lack of experiential learning, the relation between play and learning become weak and students are forced to study compared to playing.
2. Other cause can be the abstract manner of course concepts, it becomes hard for them to digest.

This project is an attempt to introduce an active and attractive medium to make learning & teaching playful and interesting. These playful science activity can encourage kids to learn on their own, where cognitive learning, teaching of science and play happen together at single platform.

Why robotics ?

It is a multi-disciplinary field which combines mechanical, electrical, electronics and computer programming domains of science.

How robotics is good for children:

it excites students about science, technology & maths.

In compare to other electronic toy like video game etc.
these can interact with and within their environment.

Compatible

Why robotics ?

What is being given by robotic toys:

Children are crazy about these sensor enabled gizmo toys because:

Robot toys look ‘Live Characters ‘.

It pronounces very empowering statements like, ‘I am at your command’!

Machine man kind hero of their fantasy

What is the current scenario of playing & teaching through robotic toys:

Robotic education

Play and learning

Lego Mindstorm

WOWWEE

My vision:

The interest in robotics has surprisingly increased in few last years. This new way of offering education is playful and full of energy. But this associated science education is being served tacitly. Beyond the experiential learning, will we be able to design a robotic aid which will teach some concepts of science fundamentals, math, and other subjects of their course.

The passion and energetic behavior of kids towards such toys can be useful in learning complex science terms. This will be extended version of their classroom activity/ experiments with robots. This will encourage children to sharpen the concepts and will push development of their minds.

Objective

Design and development of robotic enabled play & learning aid , which will encourage children to learn science fundamentals by involving them into some activities. This will establish & strengthen the connection between the abstract concept of science fundamentals and practical experience.

With robotic as an attractive playful media, children will learn some robotic fundamentals also simultaneously.

PROJECT BRIEF

OBJECTIVE :

Design and development of robotic enabled play & learning aid , which will encourage the child to establish & strengthen the connection between the abstract concept of science fundamentals and practical experience.

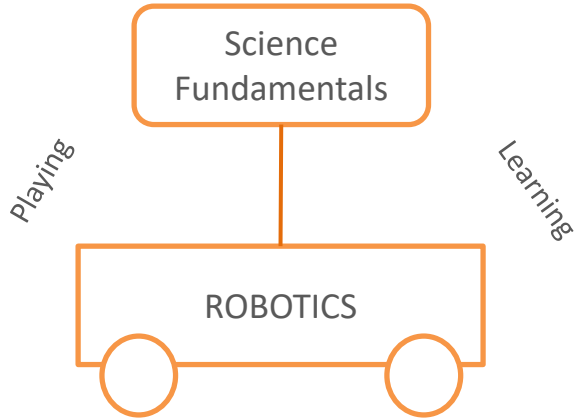
TARGETED USER:

School going children

Age group 11 – 15 years (7^{th} -9^{th} grade)

Both male & female

Upper middle class



Designing of educational games to teach some science topics

Phase 1	Designing of educational games to teach some science topics
Phase 2	Designing of a robotic toy to be used in these games

Designing of educational games to teach some science topics

PRODUCT BRIEF

Structure of the concept should be in such a way that any one of targeted user group could start the activity with his level of intellectuality .

Education conduction will be happened through *Interaction With Programming Interface .*

PRODUCT BRIEF

Game Application

A Game application must have following features:

On screen **GUI application** for front hand uses.

A **robotic language** is required to program the robot. it is to work in back hand of GUI.

Wireless setup between robot and computer.

There will be a need to **setup some protocols**, through which data transmission will take place.

PRODUCT BRIEF

Game Application

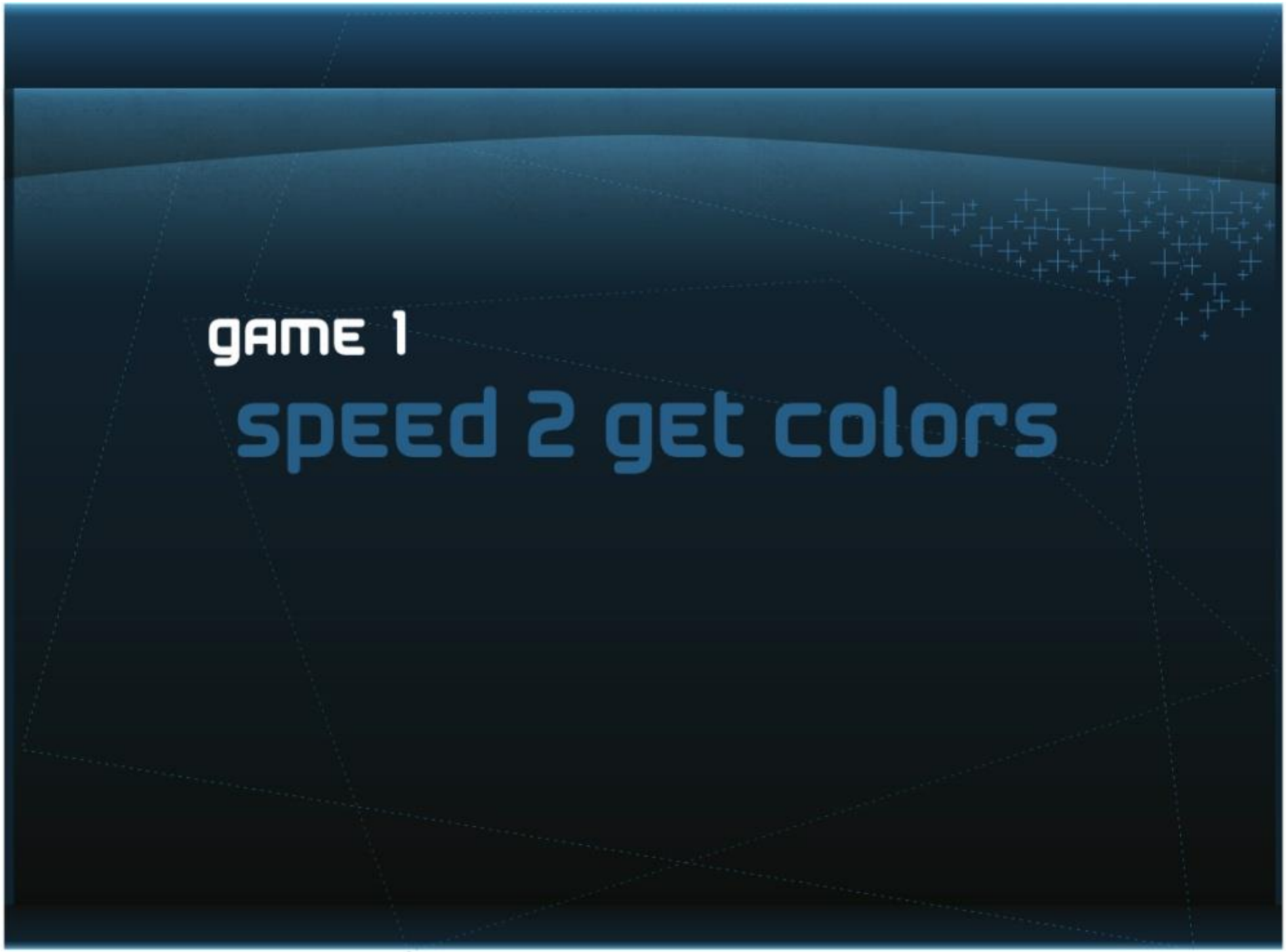
guidelines for ‘on screen interaction’ with **GUI Application:**

Interface will bind children to follow instructions of the game.

Interface will generate interest through its characteristic and features.

There should not be any chance of faking the system to win or to fail the system.

Graphics on the Interface should satisfy their emotional need and match the level of thought of their age group which generally fantasizes powerful alien characters or robotic heroes (theme and colour scheme)


GAME 1
speed 2 get colors

No. of players : one / two

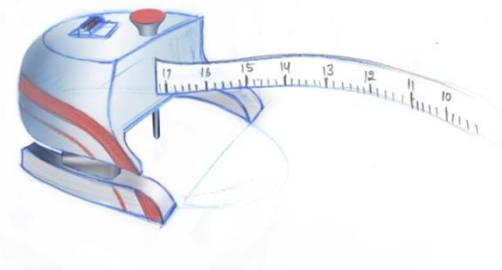
Name of game : speed to get colors

Learning topic : Speed

Kit

Motionobo (Robot)

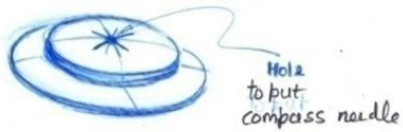
Colored buttons

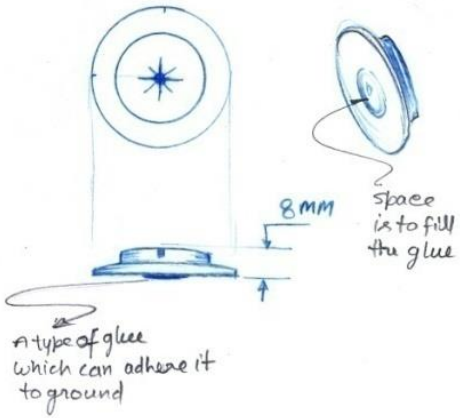


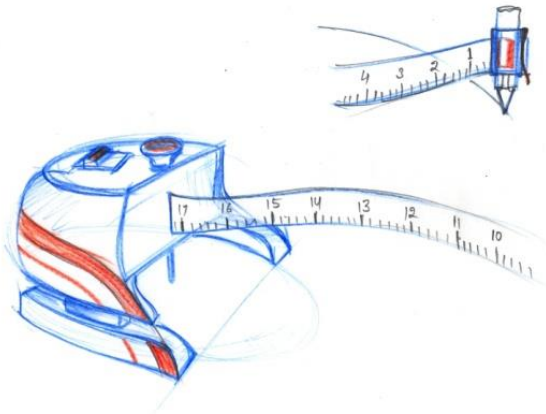
Measuring tape (with compass)

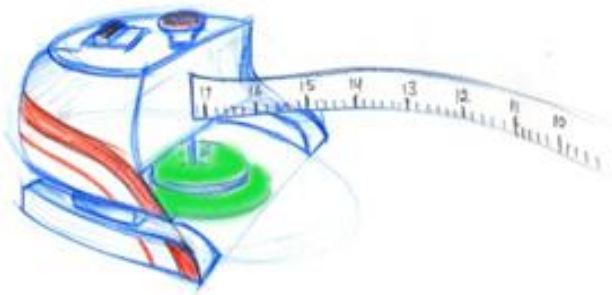
Kit

Computer

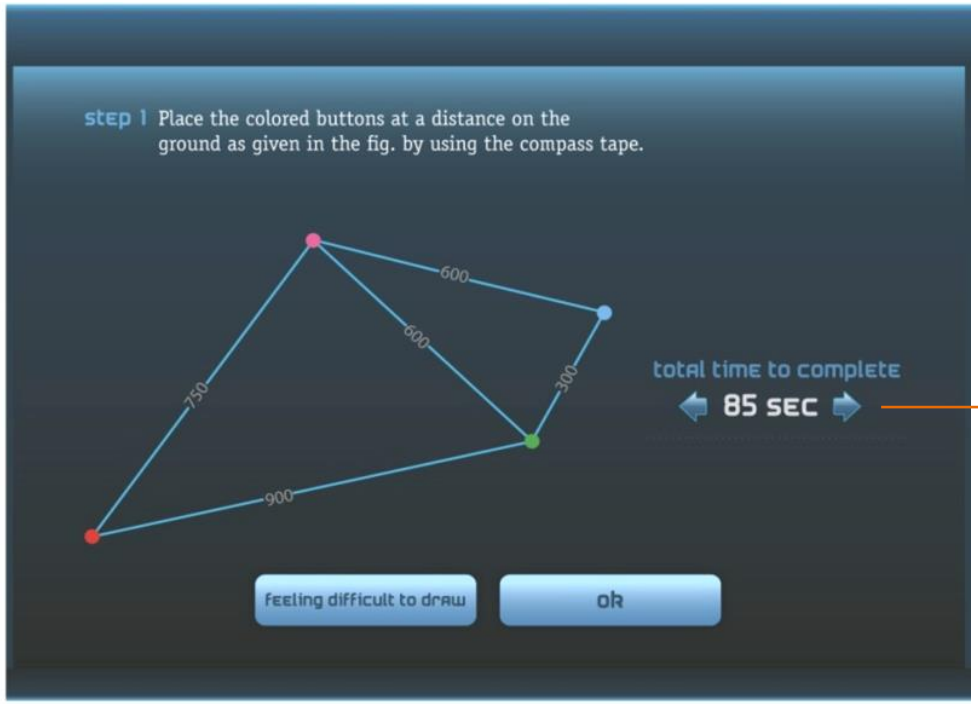

Hole
to put
compass needle


8MM
space
is to fill
the glue
A type of glue
which can adhere it
to ground


4 3 2 1
17 16 15 14 13 12 11 10


17 16 15 14 13 12 11 10

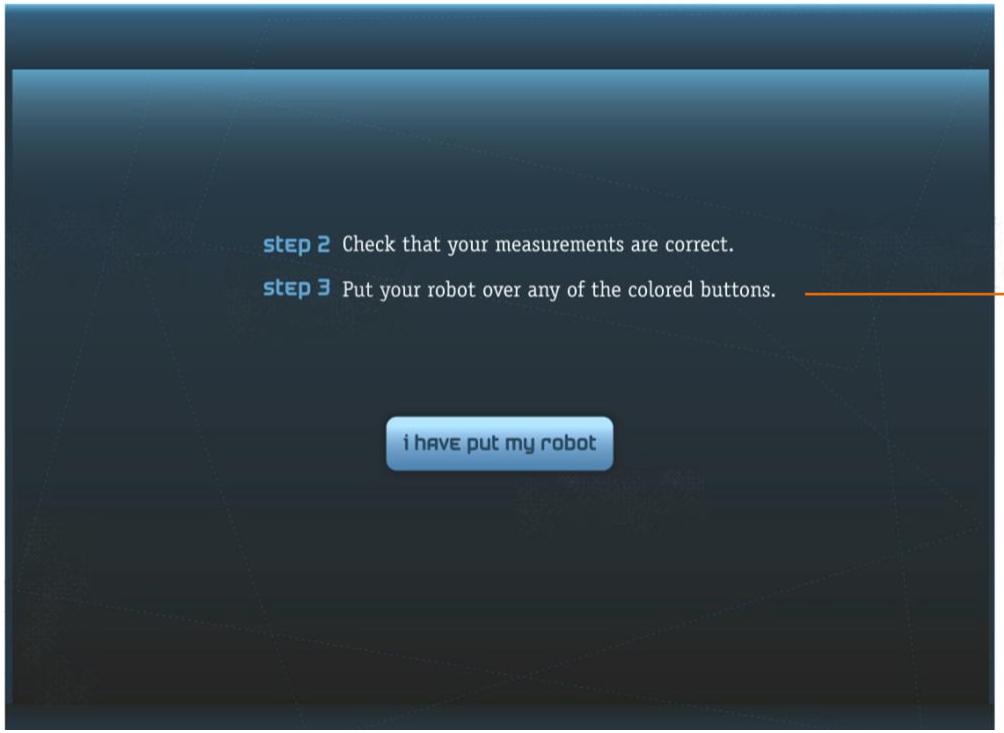
How to play



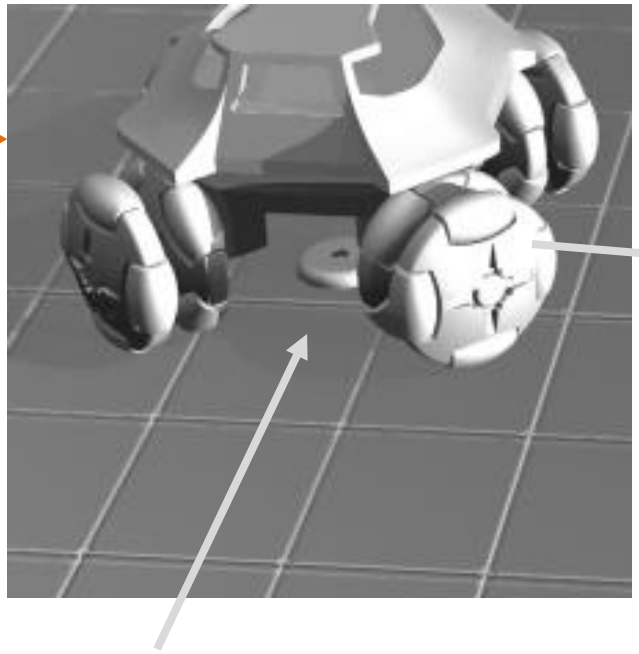
Computer Interface
Screen 1

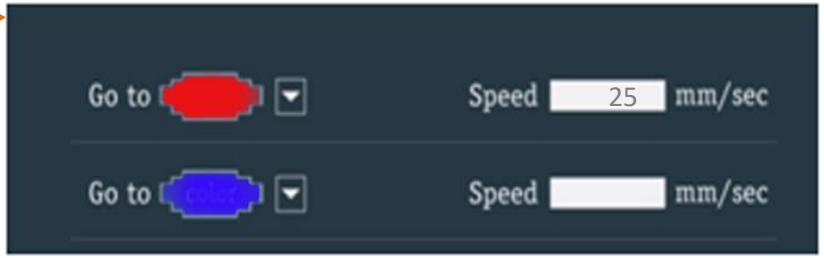
To find more tracks

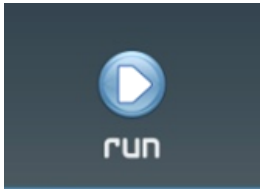
On the ground



Computer Interface
Screen 2



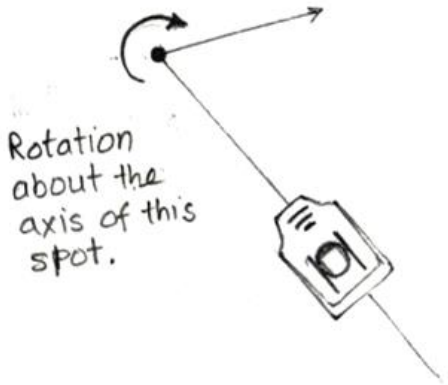




Computer Interface

Screen 3

Movement of robot



Spot turning (to turn at a position about its axis of center of mass without moving in an arc)

Body of the robot turns in the direction of motion.

Display on the robot

Score of the game:

Score will be collected from individual segments.

If player reaches exact on time at selected color, will get 10 points .

On delay or fast of 1-2 sec, he will get 8 points.

On delay or fast of 3-5 sec, he will get 5 points.

On delay or fast of >5 sec, he will get 0 point.

Learning

Science Education :

What is speed in a moving object And Its co-relation with distance & time

Learning

Science Education :

What is speed in a moving object And Its co-relation with distance & time

Tacit learning :

Fast calculation

Measurements

To trace the geometry

Knowledge of handling robot

Perceiving of effect of sensors

Play values (Game analysis)

N= No; Y= not satisfactory;
YY= Satisfactory; YYY= Excellent

Game strategy must encourage them to learn.	YY	Strategy to adjust the time in different segment to meet the target, encourages to find suitable speed for each segment.
Ability to attract the repeat play	YY	Sequence of adjustment of time followed by individuals are different. If player could not achieve the targeted Total Time.
Maintaining uncertainty	YYY	Multiple tracks are given and one track can have N no. of solutions. It creates enough degree of uncertainty in the game. Children of this age group will be able to make their own track after spending sometime with it .
Balance of luck & strategy	YY	Here, strategy is more than luck. If certain time will be given to complete the game, luck factor will be there. From which colour does the player starts moving the robot, will affect the winning.
Quick and easy learning	YY	GUI for game is clear to be informative. Sequence of asking for data inputting, guides to player to do desired task, will encourage learning through out the process smoothly and automatically.
Ability to hold interest for long time.	YY	Uncertainty factor works for it. Game has lot of interesting things like marking on the ground, measuring, putting colour buttons, setting of robot, movement with intelligent behave of robot. Playing the game, calculations, performance etc.
Possibility of player becoming an expert with practice, intellect or both.	YYY	After playing multiple times they will become skilled in finding the suitable speed by calculating faster.


GAME 2
direction to
final destination

No. of players : one / two

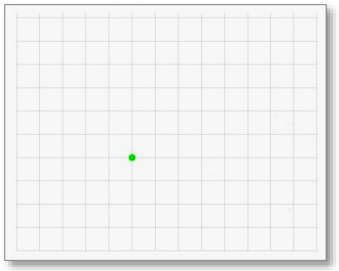
Name of game : Direction to Final Destination

Learning topic : Velocity

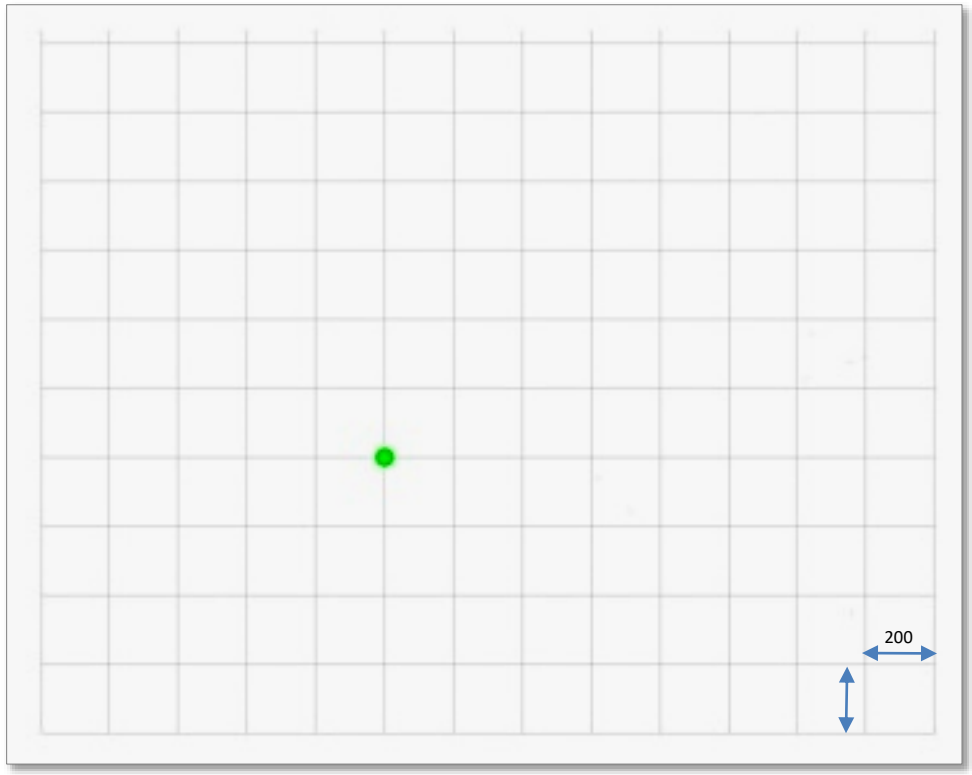
Kit

Motionobo (Robot)

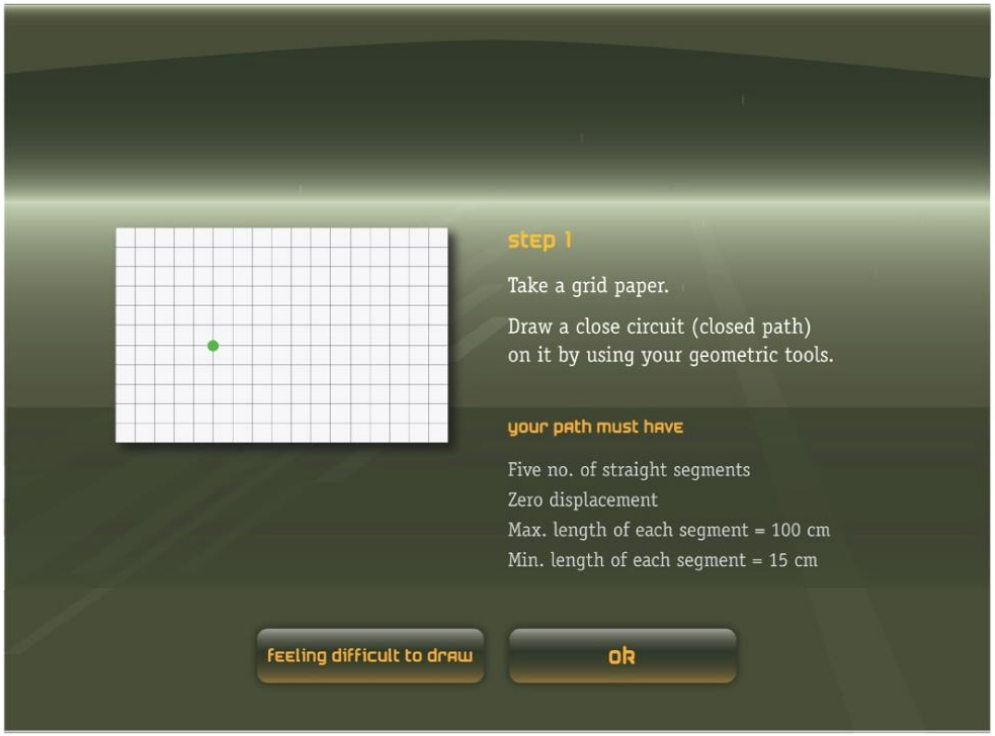
Computer



Grid paper


200

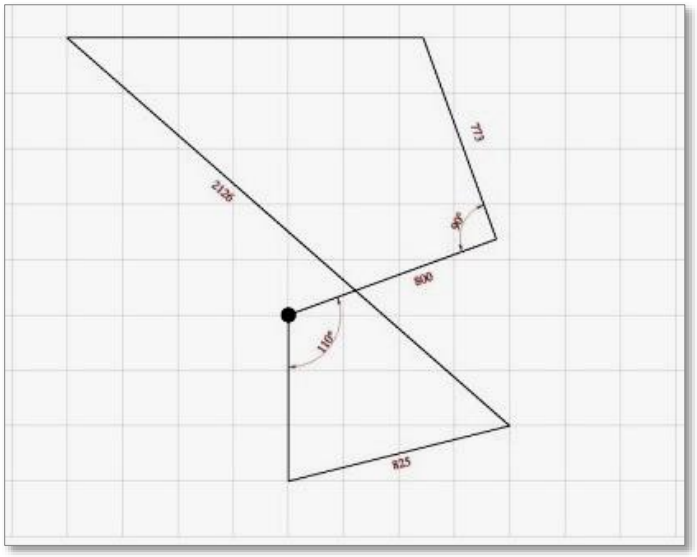
How to play



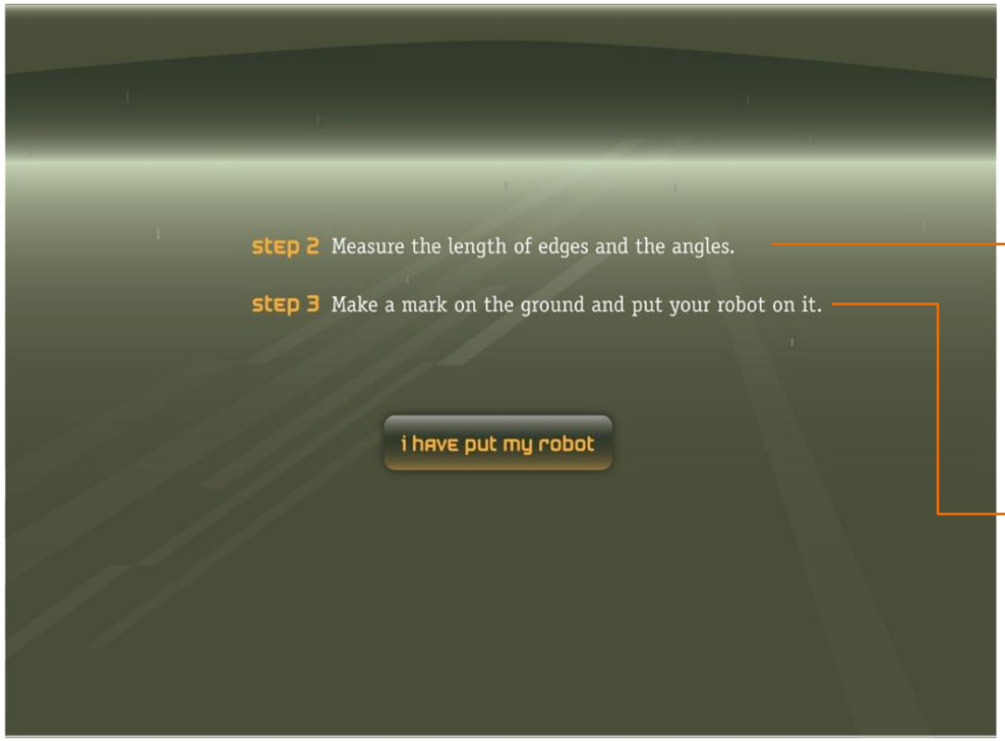
Computer Interface
Screen 1

The path should have

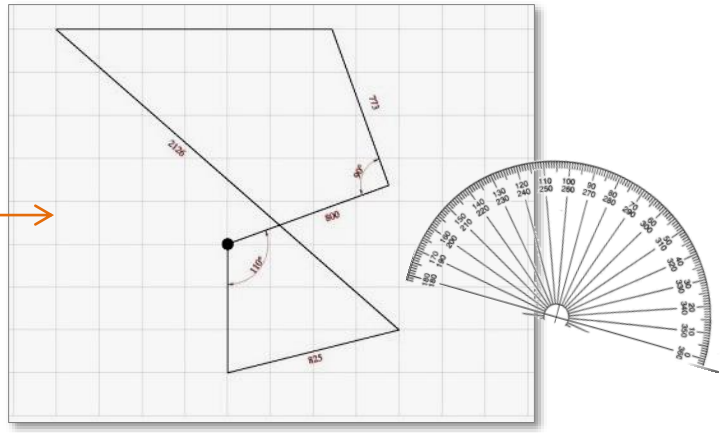
5 no. of straight segments
zero displacement
max. length of each segment =100 cm
min. length of each segment = 15 cm



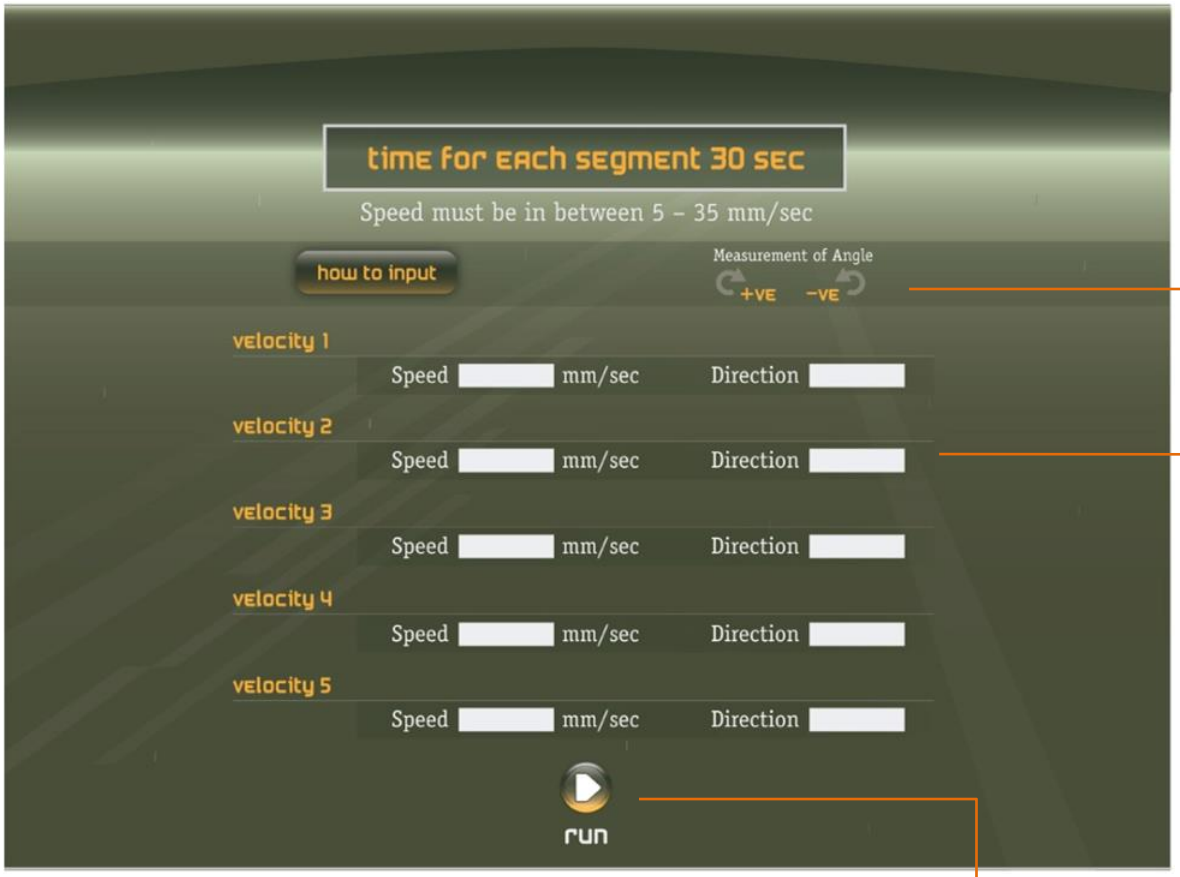
Closed circuit (track) on grid paper



Computer Interface
Screen 2



Relative measurement

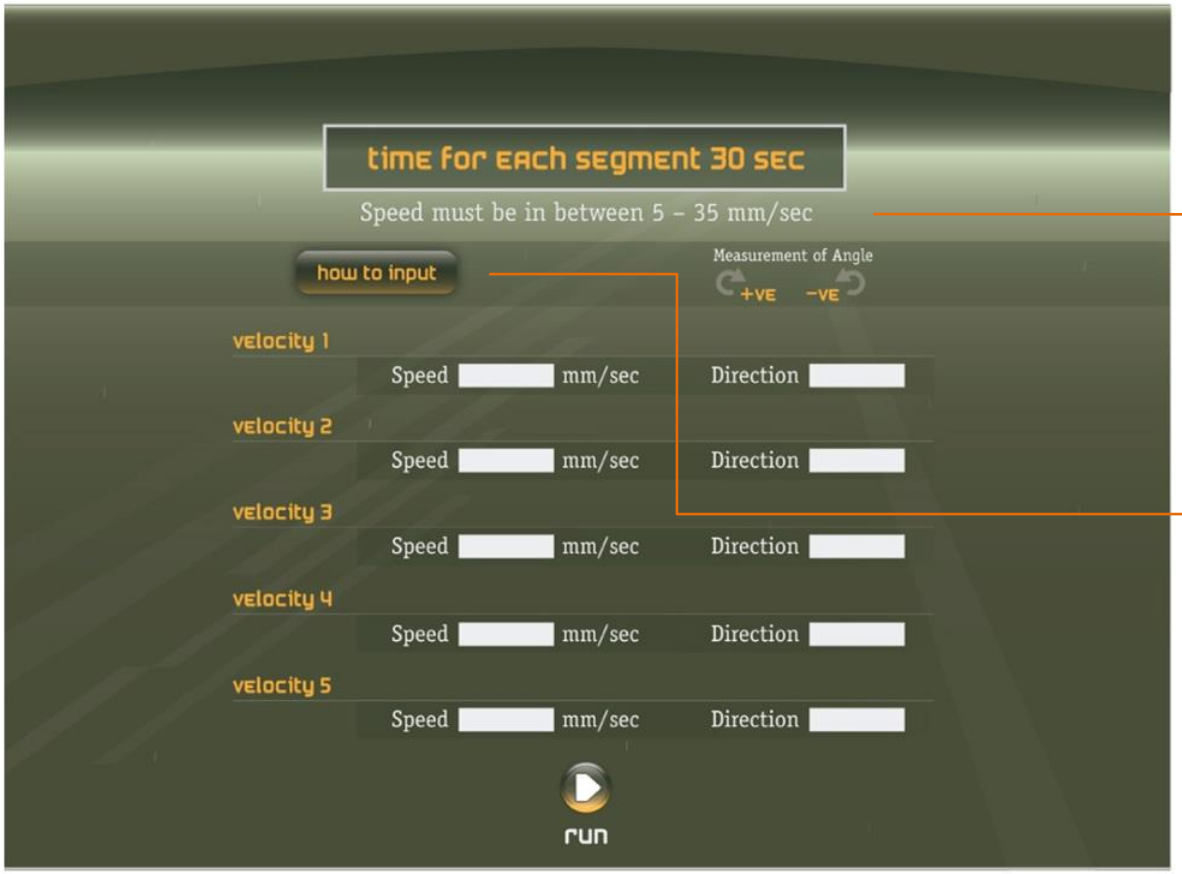


Computer Interface

Screen 3

Velocity

speed direction

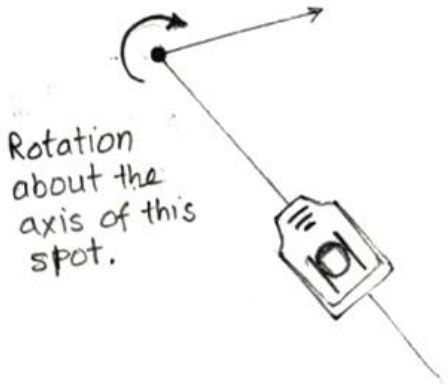


Limit of the speed

Examples
How to calculate the speed and angles

Computer Interface
Screen 3

Movement of robot



Spot turning (to turn at a position about its axis of center of mass without moving in an arc)

Body of the robot turns in the direction of motion.

Score of the game:

The player has to complete his self made circuit .

If the display of robot shows displacement is zero – he will get 100 marks

if displacement is 1-5 cm , he will get 70 marks.
if displacement is 5-10 cm , he will get 40 marks.
if displacement is >10 cm , he will loose the game.

Display on the robot

During run time, path travelled by robot will be tracked on the screen display. Robot LCD display will shows the distance covered in each segment, so that the player can fix the error, if any.

No. of errors direct affect the rewarded score.

Learning

Science Education :

Rate and direction of the change in the position of an object, is velocity.

Velocity = Speed + Direction

Learning

Science Education :

Rate and direction of the change in the position of an object, is velocity.

Velocity = Speed + Direction

Tacit learning :

To draw the geometry on grid paper.

Fast calculation.

Measurements of angle in absolute and relative system

Knowledge of handling robot

Perceiving the effect of sensors

Play values (Game analysis)

N= No; Y= not satisfactory;
YY= Satisfactory; YYY= Excellent

Game strategy must encourage them to learn.	YY	In every segment of closed track, player has to input speed and direction to define velocity as a complete term. it clarifies that *velocity = speed + direction*
Ability to attract the repeat play	YY	What ever player draws on the grid paper, robot perform by moving accordingly.
Maintaining uncertainty	YYY	Player has to draw his own track on the Grid paper
Balance of luck & strategy	YY	Here , contribution of luck factor is very less to win the game. Only intellectuality and practice are main factors which is essentially good for such games.
Quick and easy learning	YY	GUI for game is clear to be informative which conduct the education. Sequence of asking for data inputting, guides to player to do desired task, which encourage learning through out the process smoothly and automatically.
Ability to hold interest for long time.	YY	Uncertainty factor works for it. Game has lot of interesting things like to get performed by the robot on the track made by the player, measuring angle on a grid, setting of robot, movement with intelligent behave of robot. Playing the game, calculations, performance etc.
Possibility of player becoming an expert with practice, intellect or both.	YYY	After playing multiple times children will become skilled in taking +ve and –ve angles which will be lead by their level of intellect and practice of the game


game 3
All About velocity

No. of players : one / two

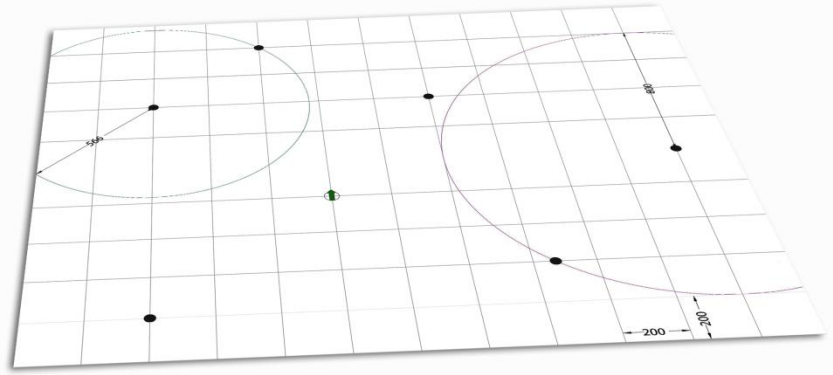
Name of game : All About Velocity

Learning topic : Difference between Speed and Velocity

Kit

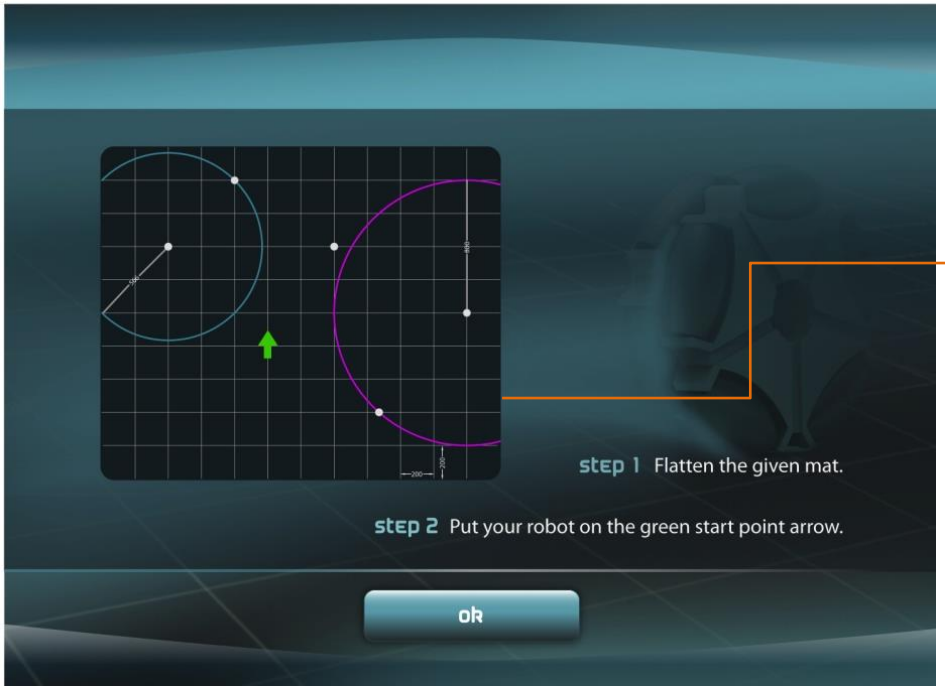
Motionobo (Robot)

Computer Interface

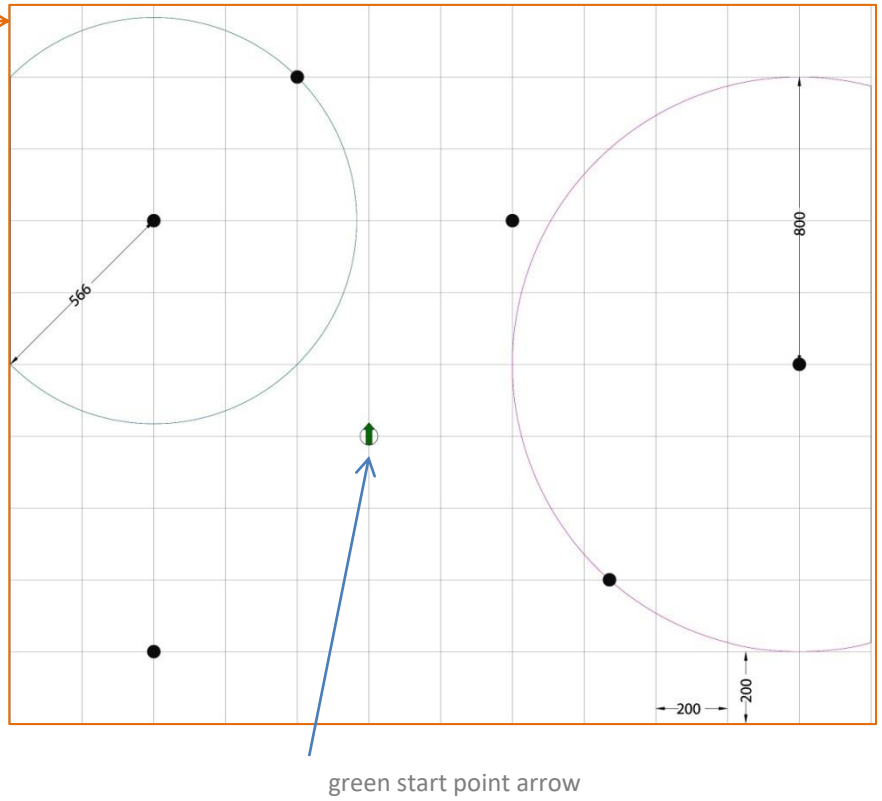


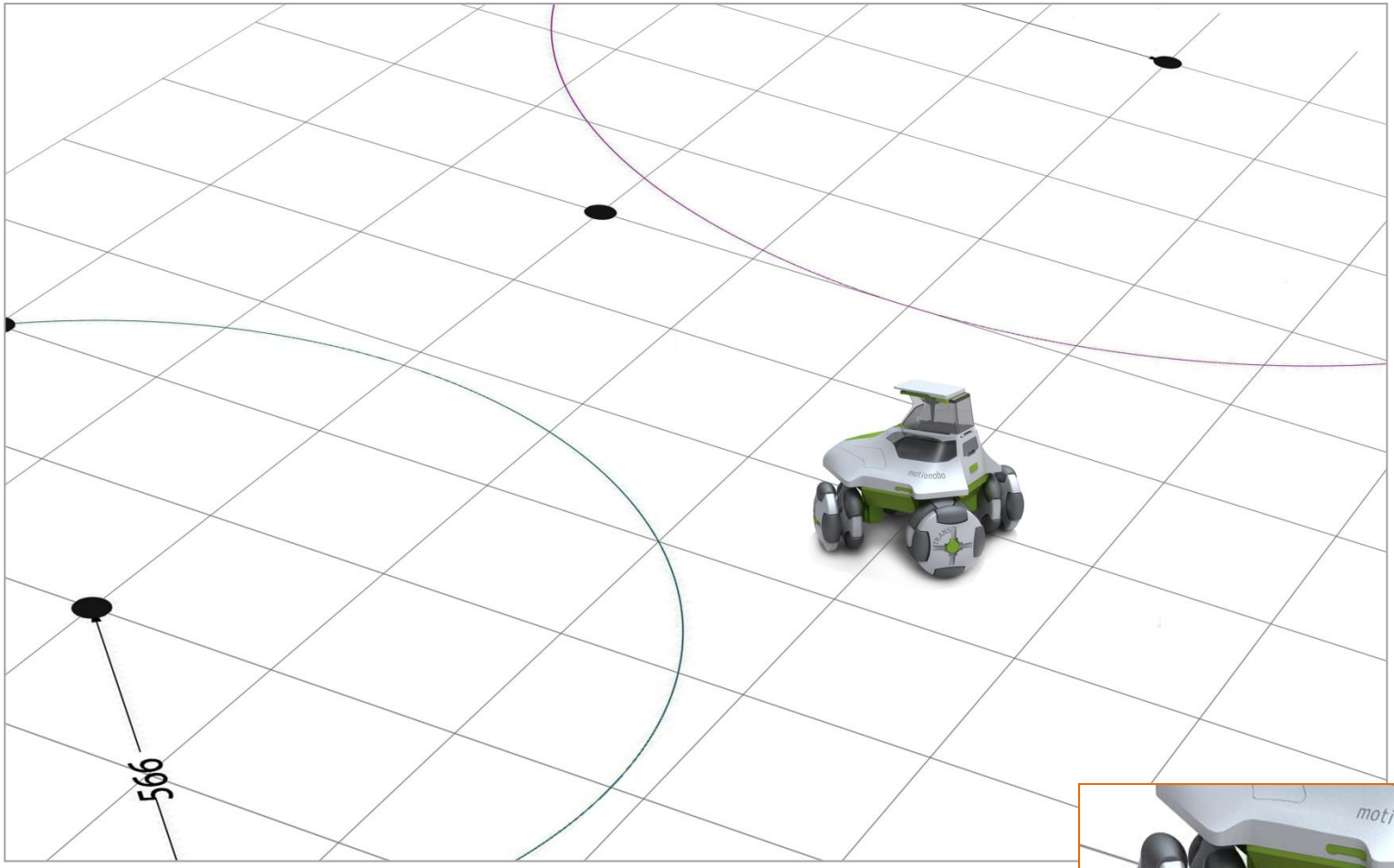
mat

How to play

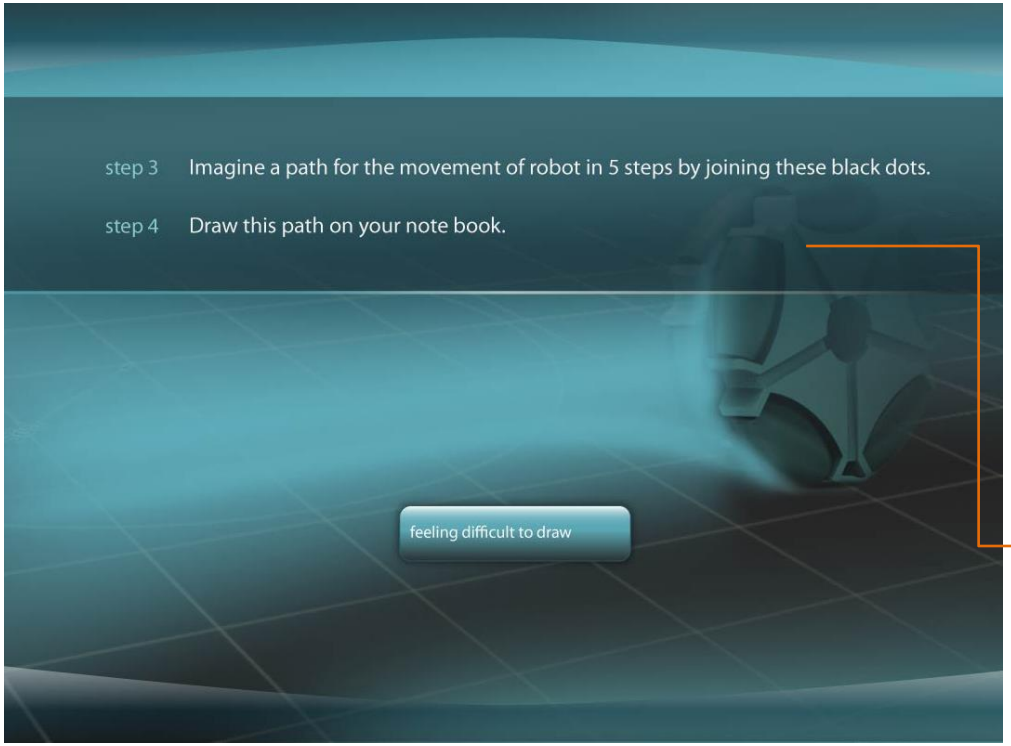


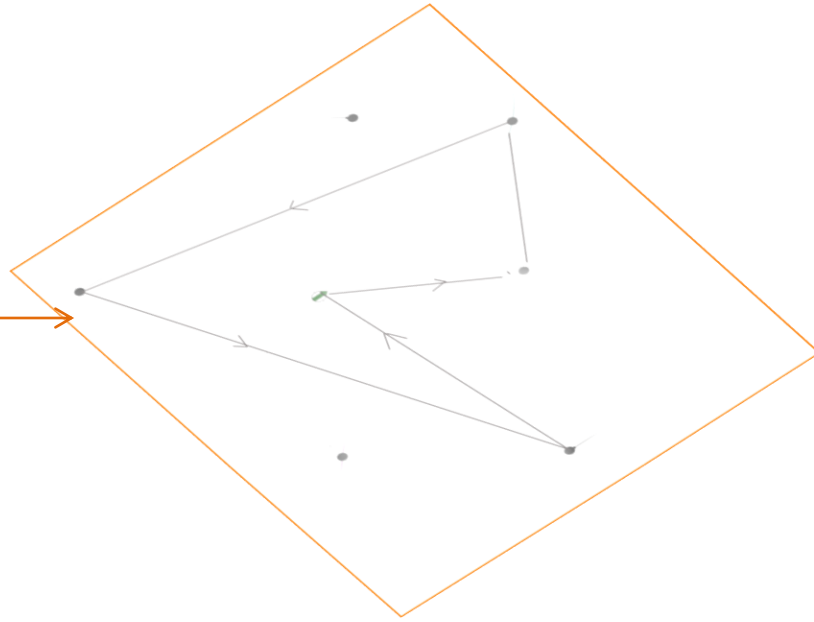
Computer Interface
Screen 1




566


motionobo
TRANS

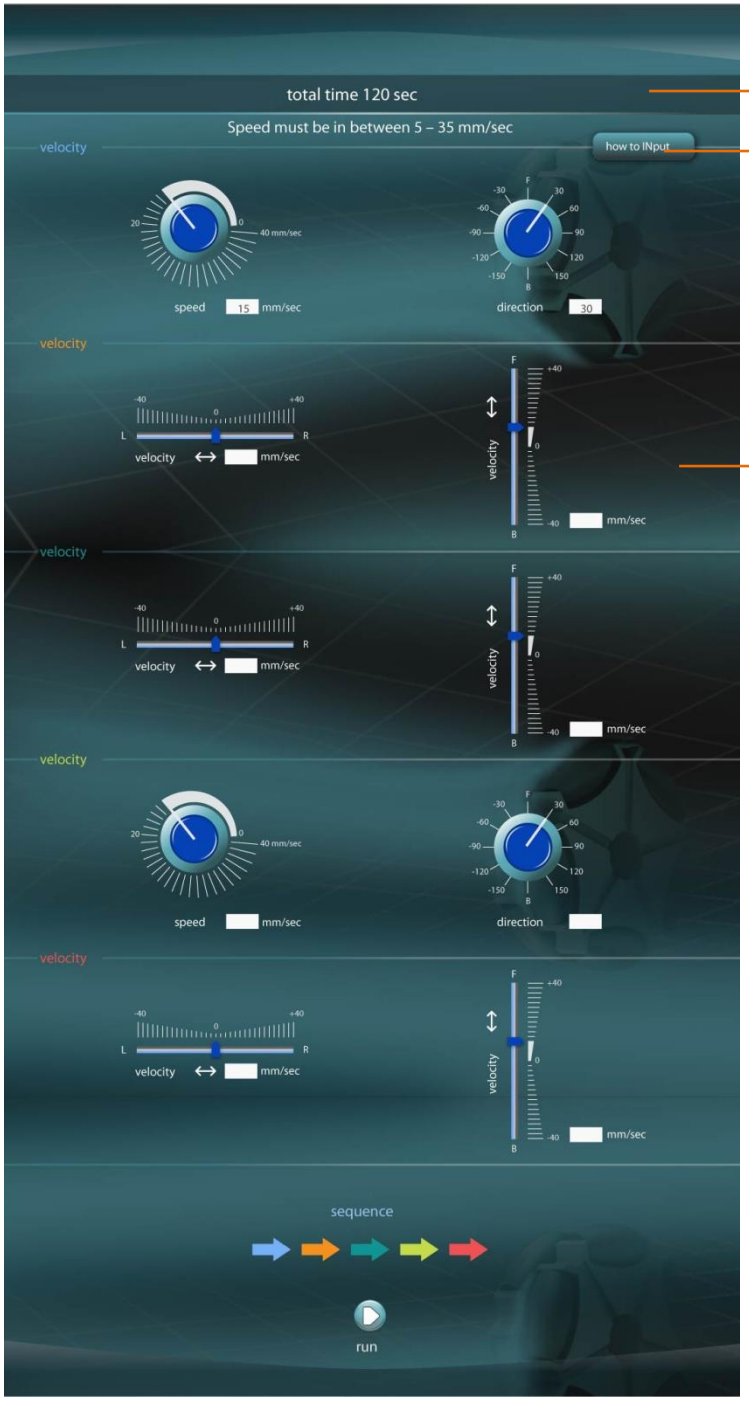




Computer Interface

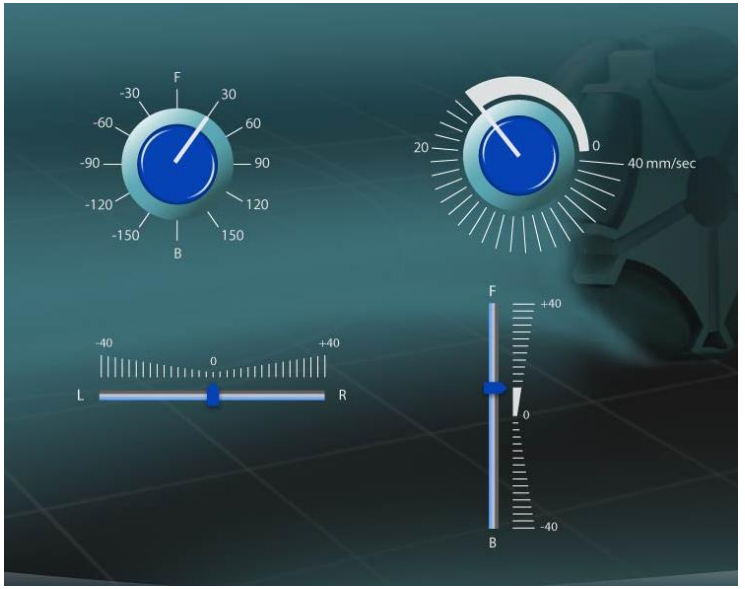
Screen 2

Computer Interface
Screen 3

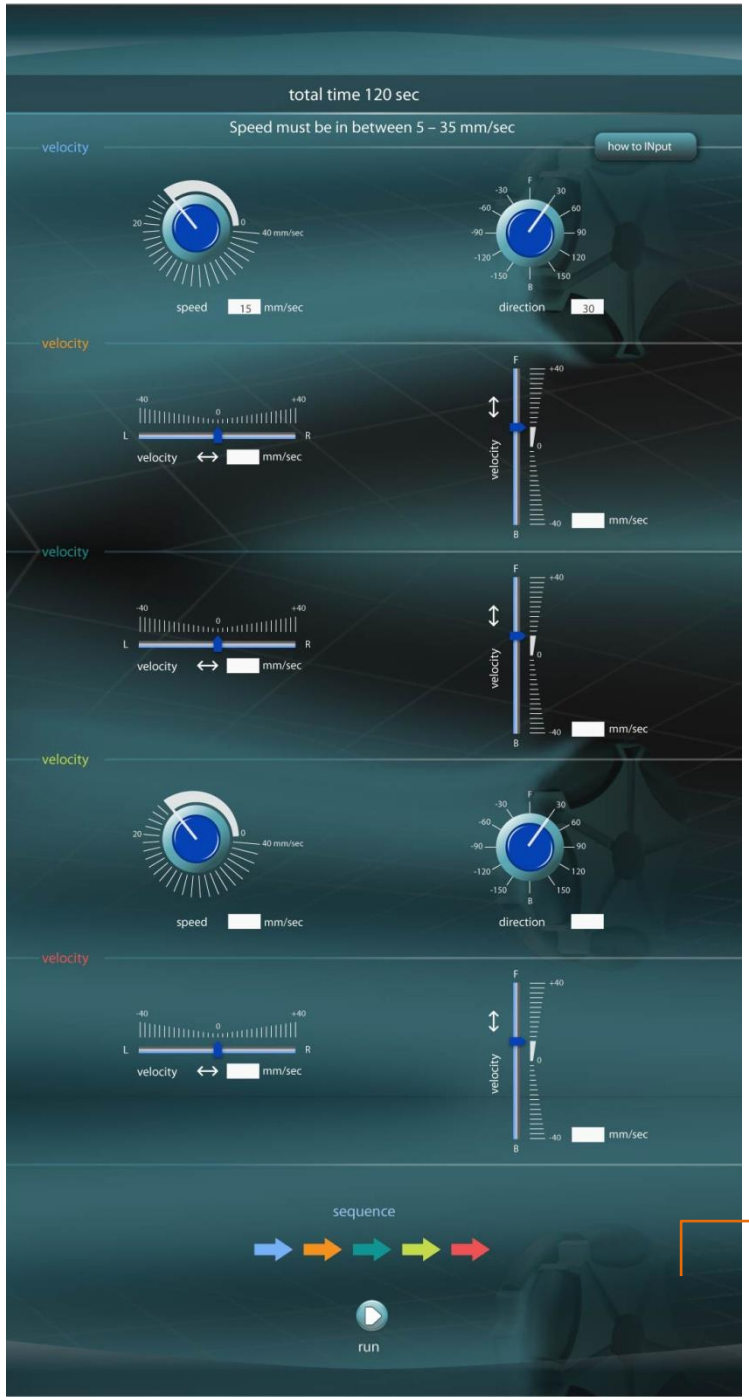


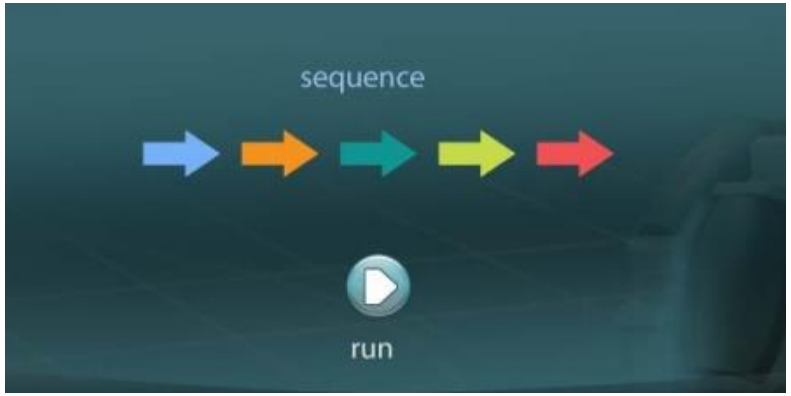
Target time

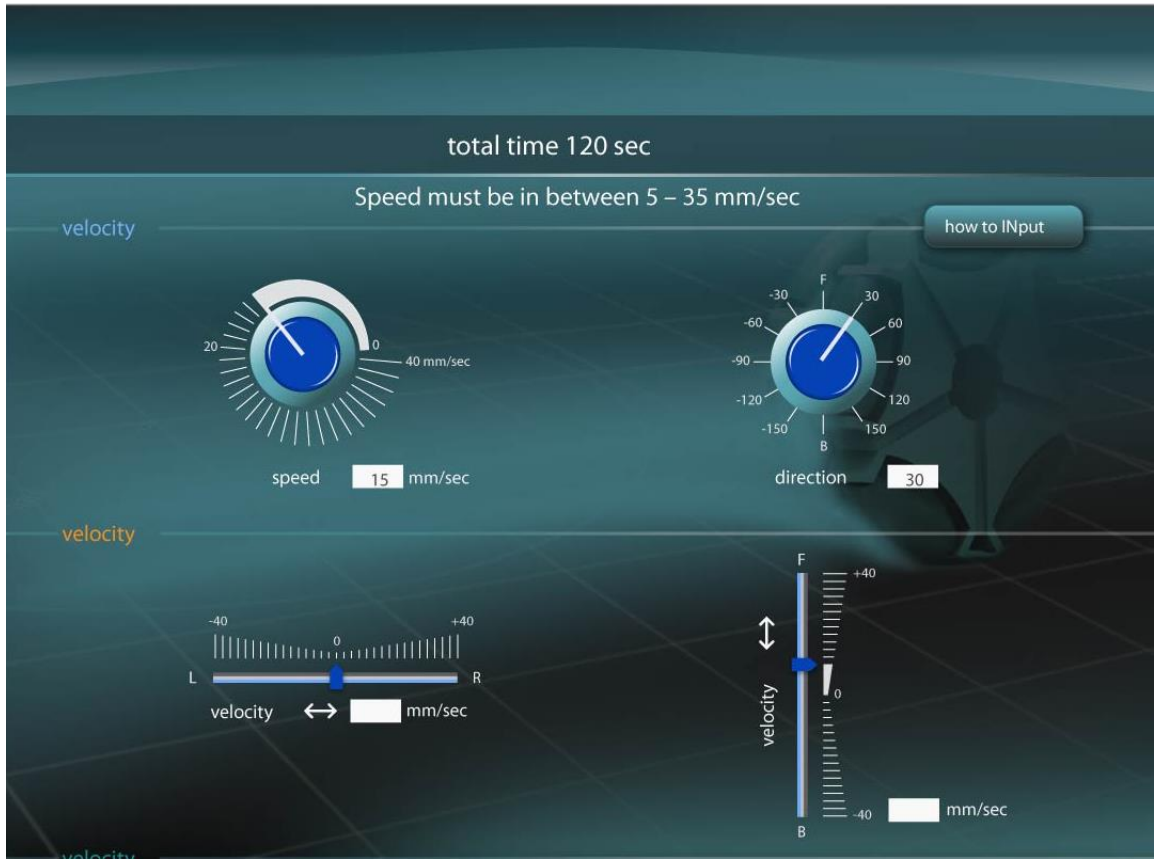
Instructions (with examples) for
"How to calculate"
"How to use the interface to input values "



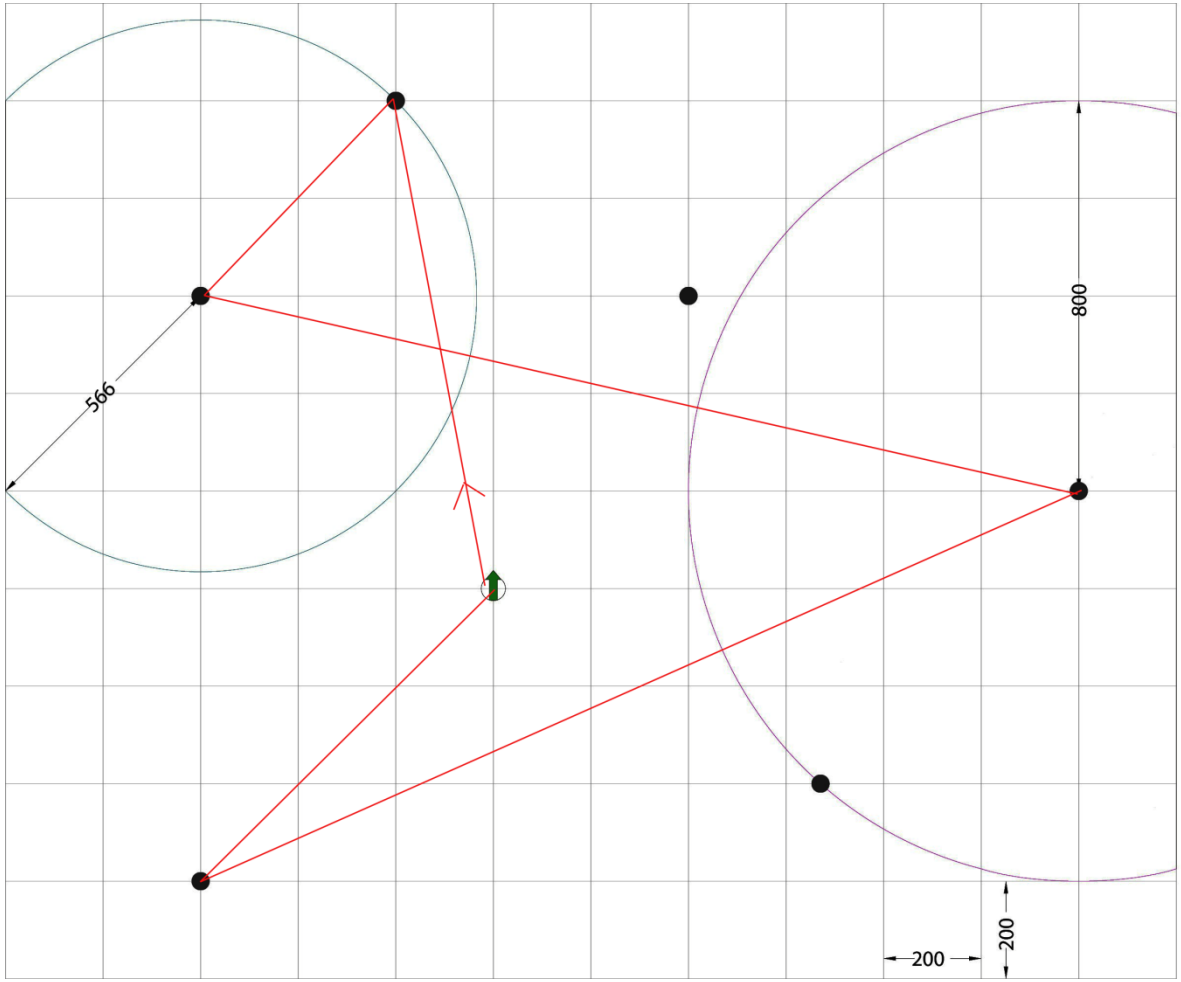
Computer Interface
Screen 3

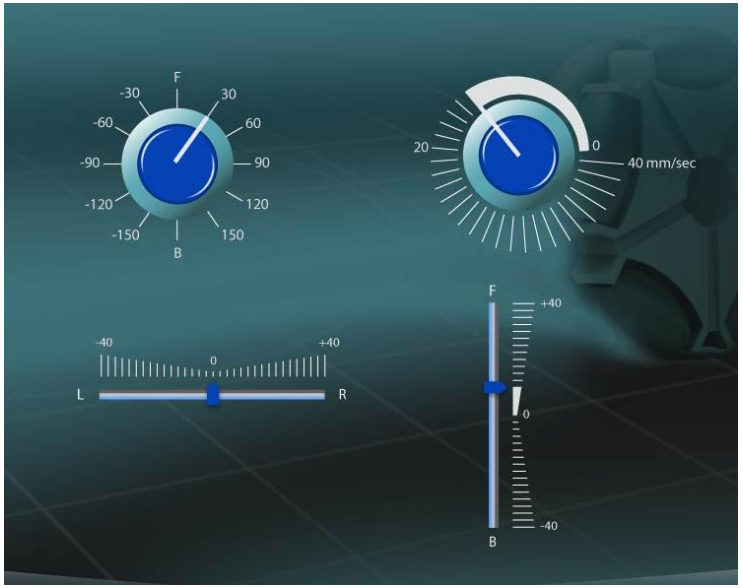




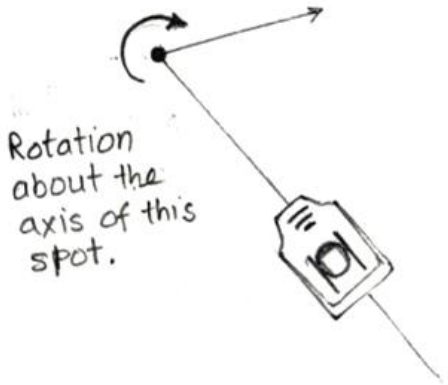

total time 120 sec
Speed must be in between 5 – 35 mm/sec
velocity
how to INput
20
0
40 mm/sec
speed
15
mm/sec
F
-30
30
-60
60
-90
90
-120
120
-150
150
B
direction
30
velocity
-40
0
+40
L
R
velocity
mm/sec
F
+40
velocity
0
-40
B
mm/sec

Interface Interaction

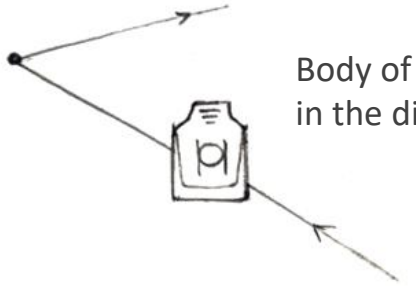




Movement of robot

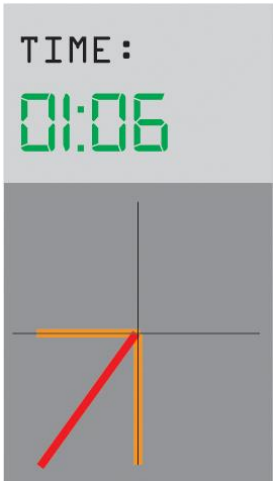


Spot turning (to turn at a position about its axis of center of mass without moving in an arc)



Body of the robot does not turn in the direction of motion.

Display on the robot



Score of the game:

Score will be collected from individual segments of the path.

If player reaches exact at destination dot, will get 10 points .
Otherwise 0 point.

(every dot will have a tolerance zone of 2 cm radius)

Learning

Science Education :

Difference between Speed as a non-vector and Velocity as a vector term

Velocity is always relative (because of direction)

Velocity can be measured in two orthogonal directions

Learning

Science Education :

Difference between Speed as a non-vector and Velocity as a vector term

Velocity is always relative (because of direction)

Velocity can be measured in two orthogonal directions

Tacit learning :

Fast calculation

Measurements

Some geometrical fundamentals

Knowledge of handling robot

Perceiving the effect of sensors

Play values (Game analysis)

N= No; Y= not satisfactory;
YY= Satisfactory; YYY= Excellent

Game strategy must encourage them to learn.	YY	When the player feels that he is not able to find the accurate direction without measuring from the mat. He has to use orthogonal velocities method.
Ability to attract the repeat play	YY	What ever player feeds the sequence on screen, robot performs by moving accordingly. It is different every time.
Maintaining uncertainty	YYY	Hundreds of track can be possible on the mat which gives some degree of uncertainty in no. of times it can be played .
Balance of luck & strategy	YY	Here , contribution of luck factor is very less to win the game. Only intellectuality and practice are main factors which is essentially good for such games.
Quick and easy learning	YY	GUI for game is clear to be informative. Sequence of asking for data inputting, guides to player to do desired task, encourage learning through out the process smoothly and automatically.
Ability to hold interest for long time.	YY	Uncertainty factor works for it. Game has lot of interesting things like to get performed by the robot on self made track, measuring angle on a grid, setting of robot, movement with intelligent behave of robot. Playing the game, calculations, performance etc.
Possibility of player becoming an expert with practice, intellect or both.	YYY	After playing multiple times children will become skilled in visualizing , which method can be used for particular segments and they will become expert in resolving velocity vector in two orthogonal directions

Robotic toy

Robotic toy

Objective

Designing of a generic robotic kit which can be used to play not only these recently developed On Screen Interface based Science Games (which are to teach : Speed, Velocity, Difference b/w Speed & velocity respectively) but also more similar kind of educational games in future.

Required components

Game 1	**Qty.**	**Game 2**	**Qty.**	**Game 3**	**Qty.**
Microprocessor	1	Microprocessor	1	Microprocessor	1
Power sources	1	Power sources	1	Power sources	1
LCD display	1	LCD display	1	LCD display	1
Omni directional transmission	1	Omni directional transmission	1	Omni directional transmission	1
Colour detector	1	Obstacle detector	1	Colour detector	1
Obstacle detector	1	Base frame	1	Obstacle detector	1
Base frame	1			Base frame	1

Requirement of Games

Required components

Some components are being considered to be detachable to enhance the value of the product. Because of some reasons:

This makes it flexible to be used for another games which will be developed for the next version to teach some other topics.

This will be the right judgment with robotic kit considering it for upper middle class.

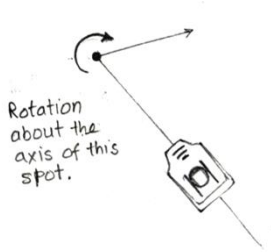
Students of this age group can learn assembly of the components in desired manner and programming of that accordingly.

Required detachable components

TRANSMISSION SYSTEM

Omni Directional Transmission is required because of several purposes:

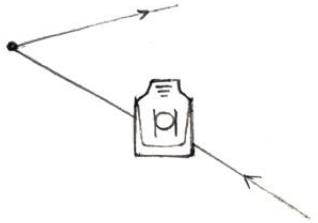
Spot turning (to turn at a position about its axis of center of mass without moving in an arc)



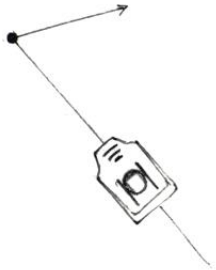
Required detachable components

TRANSMISSION SYSTEM

Omni Directional Transmission is required because of several purposes:



In case of relative angle of direction



In case of absolute angle of direction

Required detachable components

TRANSMISSION SYSTEM

But for some other games (to teach other science terms) it can be normal transmission with differential or without differential where each of its wheel have separate driver motor.

Required detachable components

SENSORS

Different sensors of the robot must be replaceable.

One sensor needs to change its position as per different requirements.

PRODUCT BRIEF

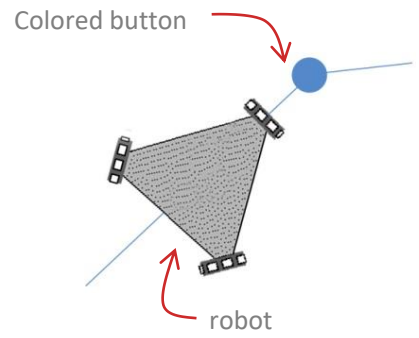
Required components & features

Robotic assembly must be in such a way that whole **transmission system** can be changed as per requirement of any other type transmission and be easy to connect to power source and microprocessor output.

PRODUCT BRIEF

Required components & features

1.



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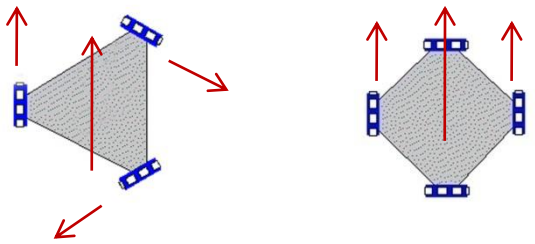
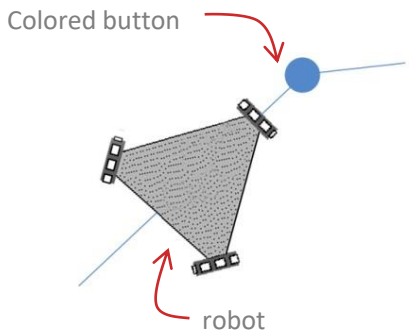


PRODUCT BRIEF

Required components & features

1.



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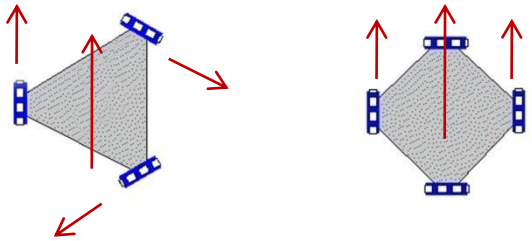
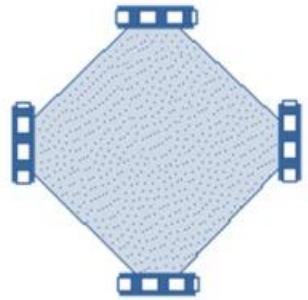
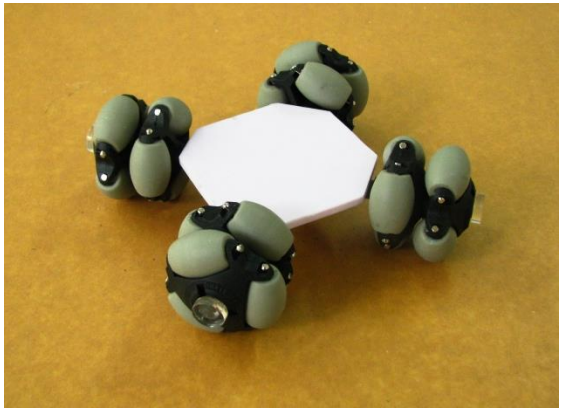




4 Omni-directional transwheels transmission system



PRODUCT BRIEF

Required components & features

Compatibility of base frame of the body with sensors must be in such a way that it allows us to attach and detach different sensors on its peripheral structure without the hurdle of data and power connections.

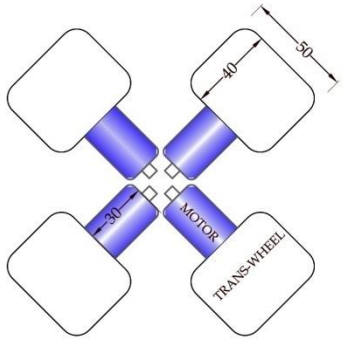
PRODUCT BRIEF

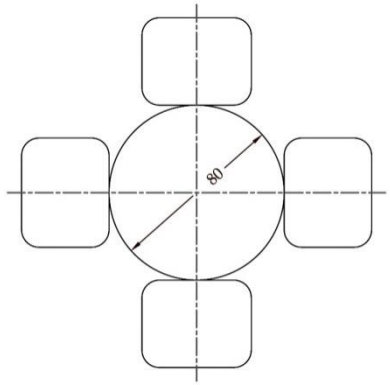
Required components & features

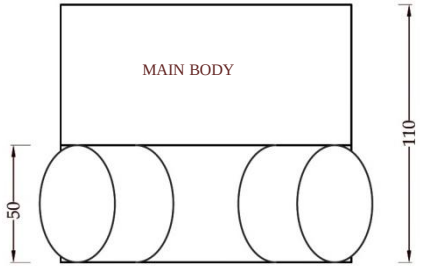
PRODUCT BRIEF

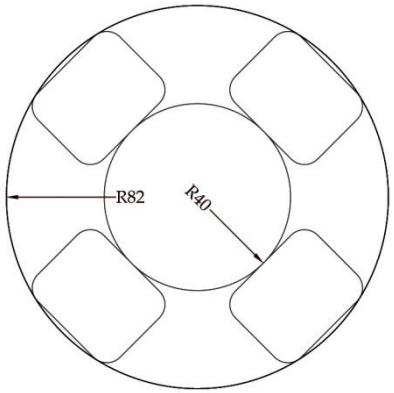
Basic Dimensions

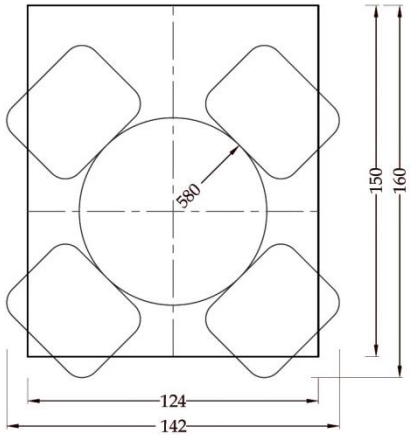
Dimensions are selected on the basis of min requirement and the available standard min size of trans wheels.







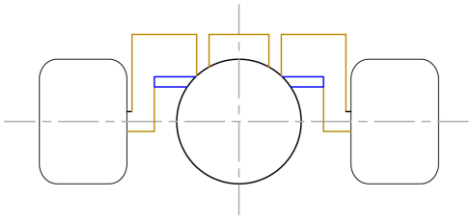


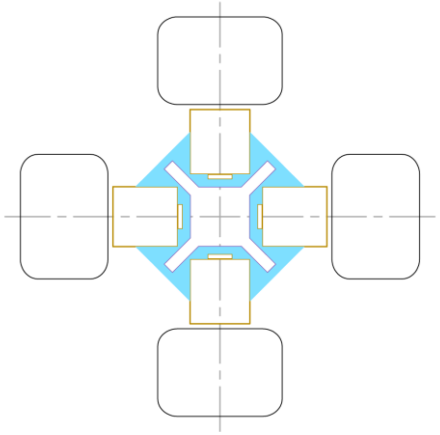


All dimensions are in mm

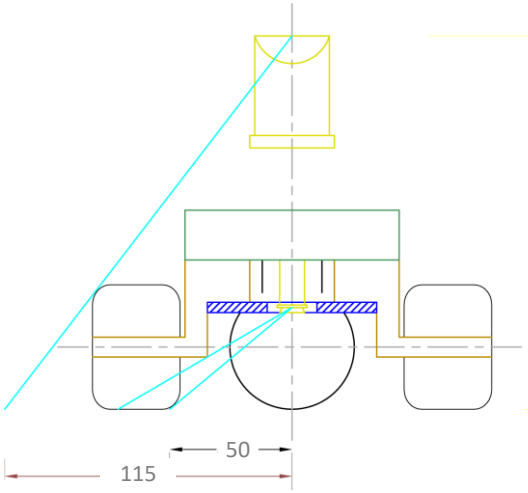
PRODUCT BRIEF

Basic Structure

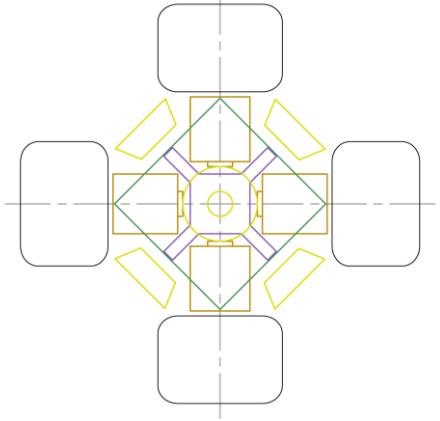




Side-front view and Top view of
Four trans-wheels
Omni Directional Transmission system

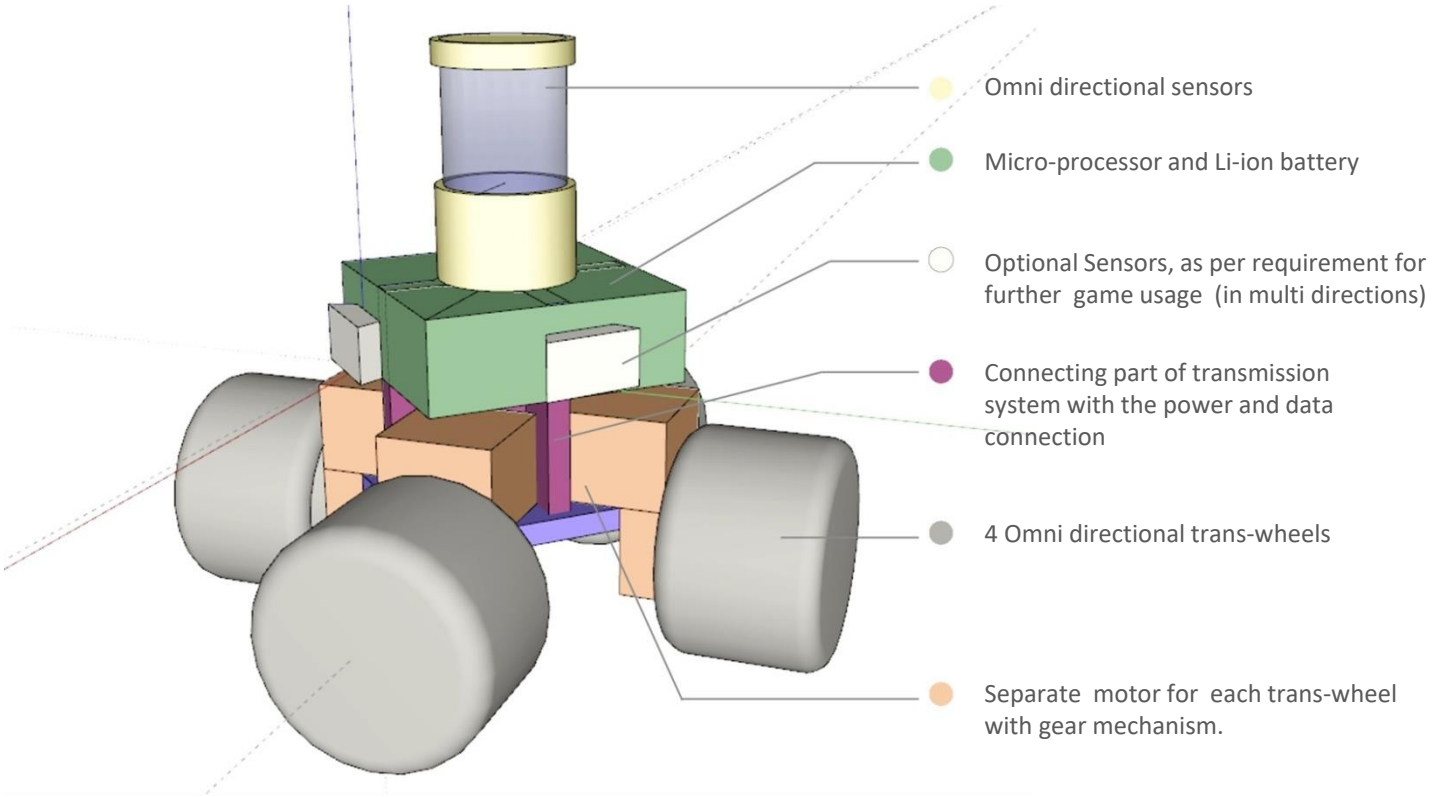


Cross-sectional view of robot
by plane of symmetry .



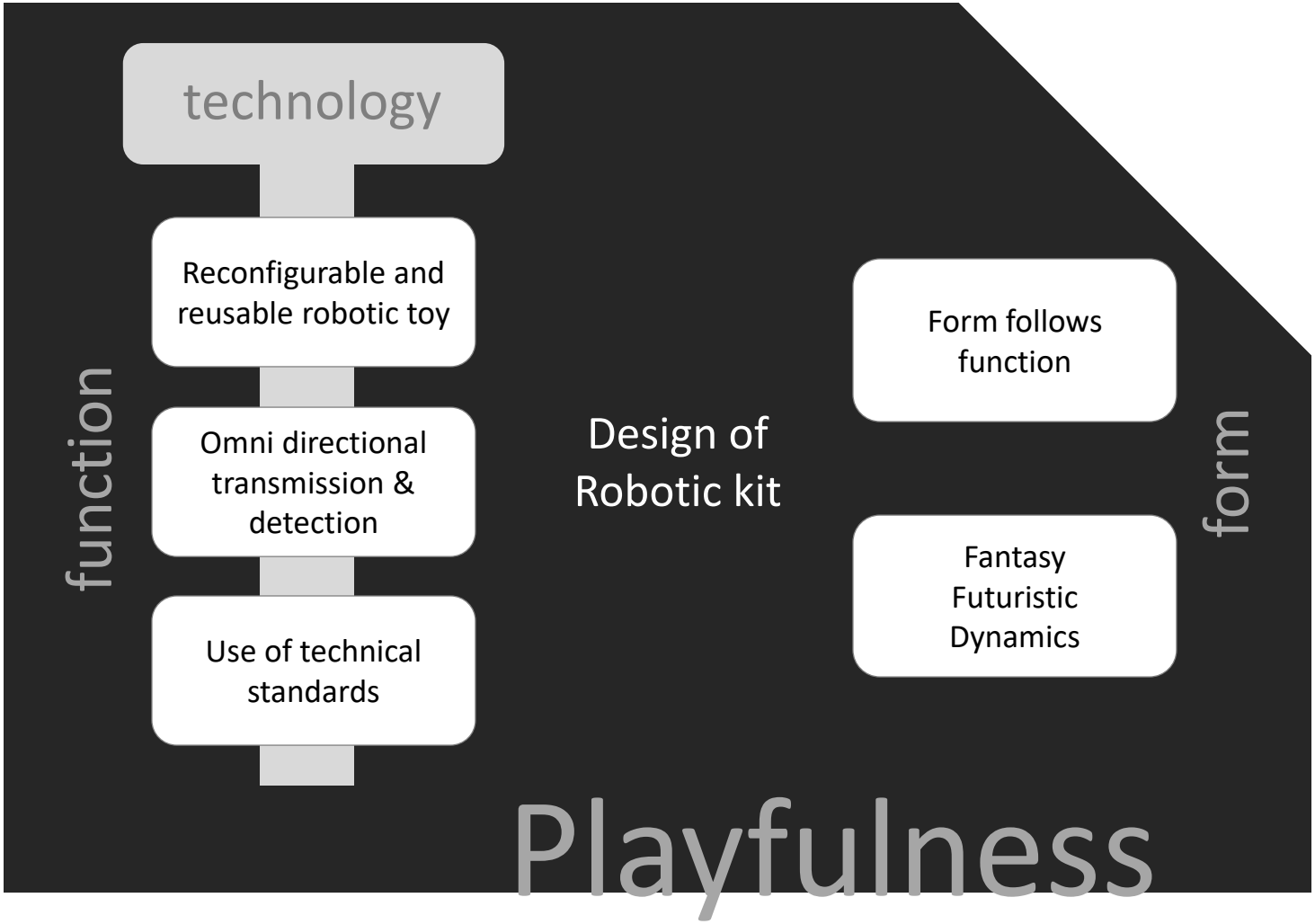
PRODUCT BRIEF

Basic Structure



Basic model in 3d view for the reference of form exploration

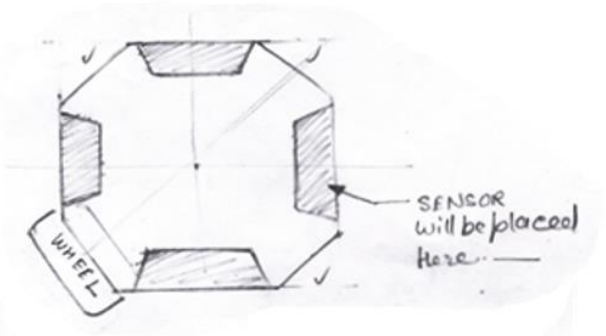
PRODUCT BRIEF

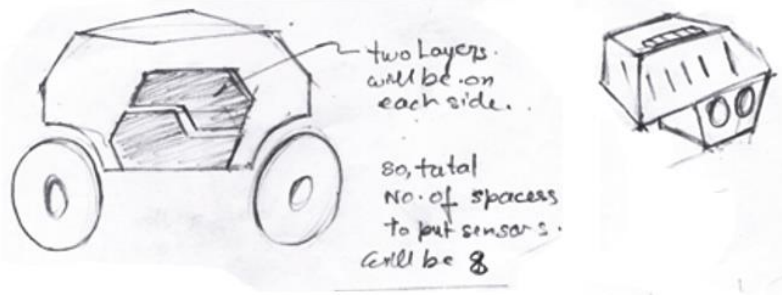


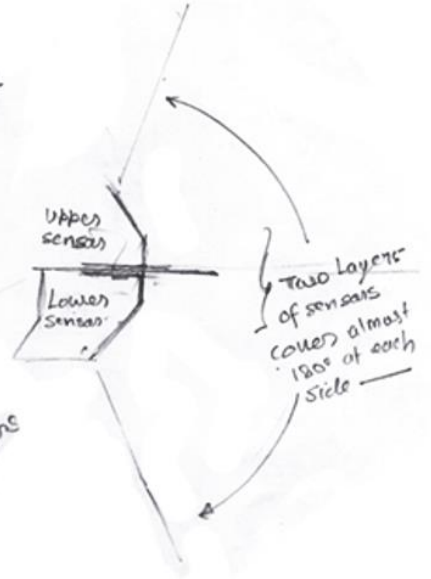
IDEATION FOR DESIGNING A RECONFIGURABLE ROBOT

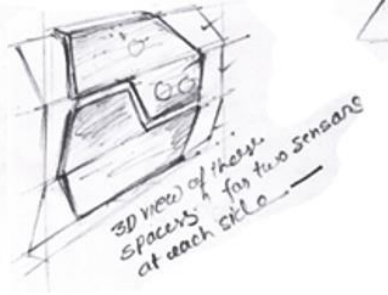
Idea 1

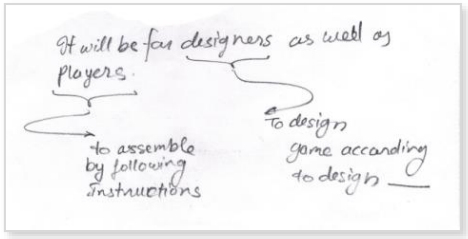
for accommodation of sensors on the body of robot in order to cover maximum envelop to the sense.

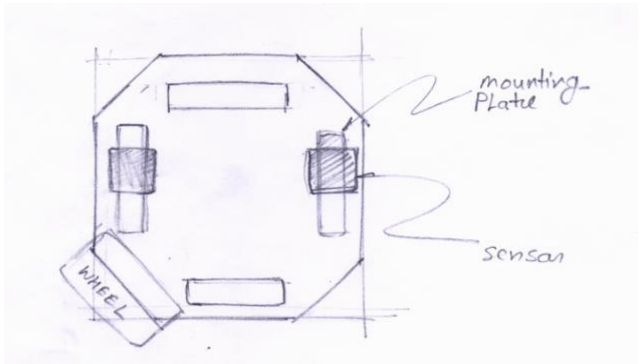


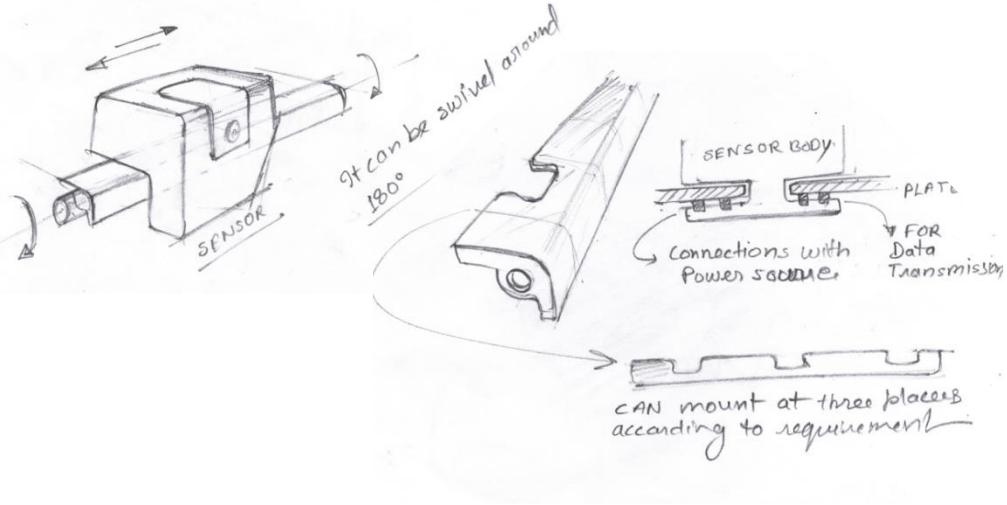


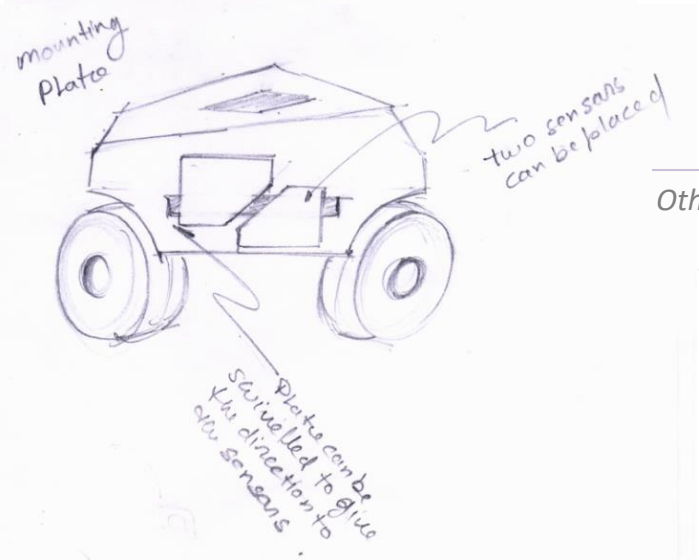




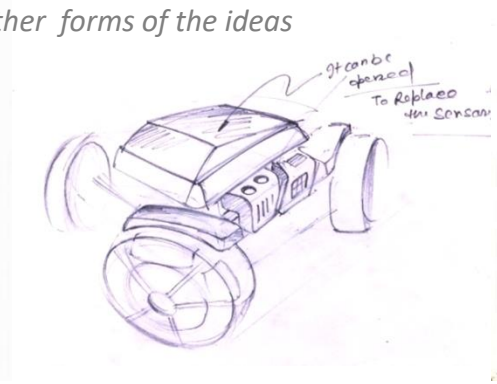


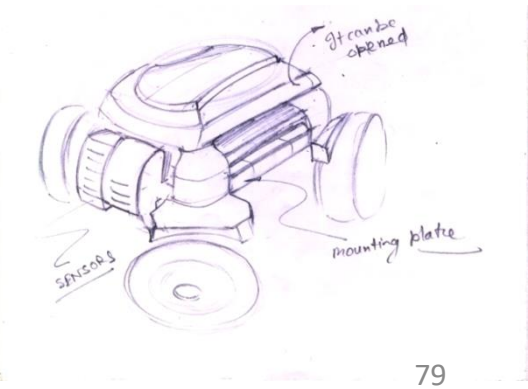


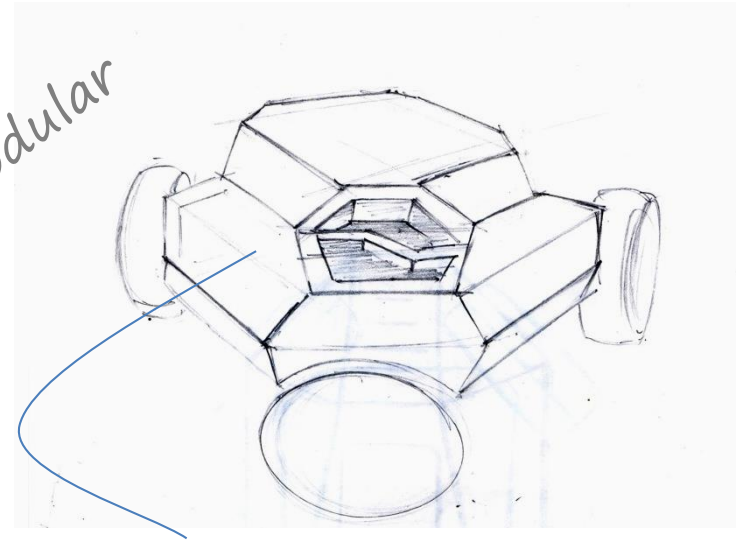


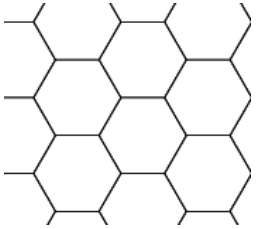


Other forms of the ideas



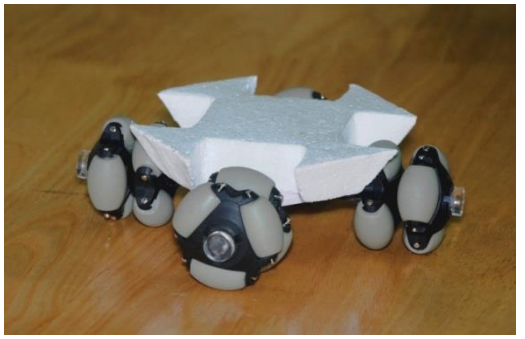


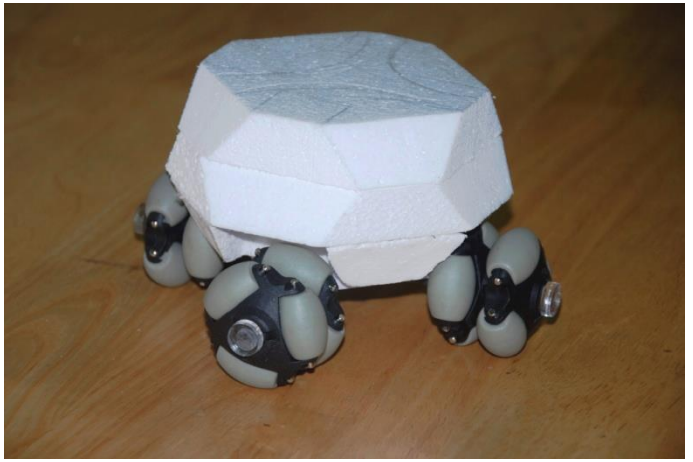




This modular form may be a solution to cover max envelop around the robot

It has different faces in different directions. Two faces make a hexagon . So each face is equal in shape n size which allows any type of sensor in any cavity.

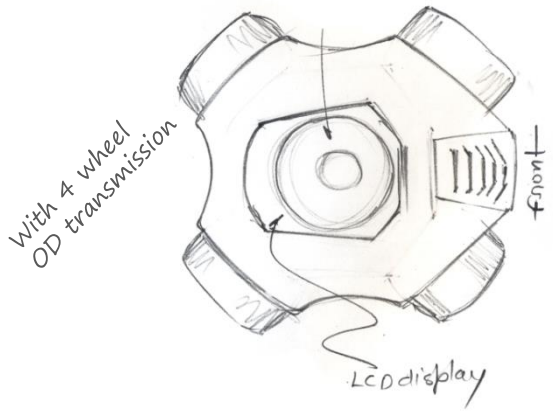


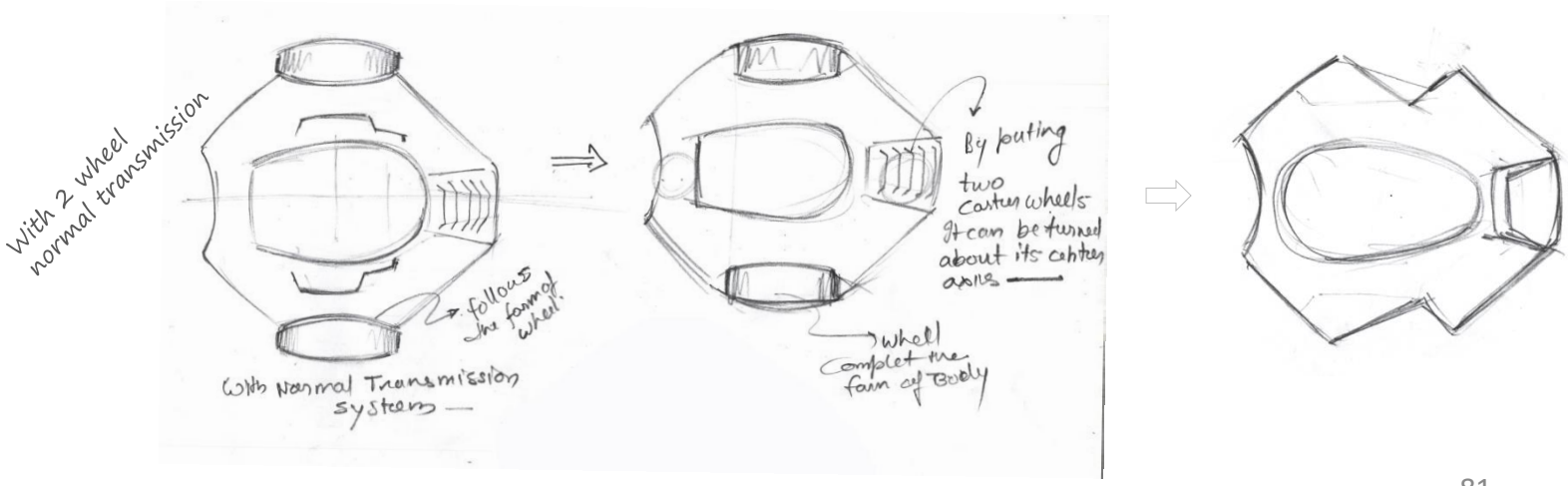


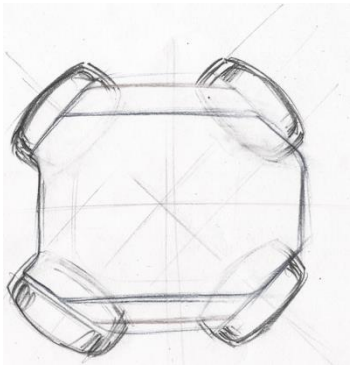
Replaceable transmission System

Body must be compatible for all kind of transmission system (function wise and form wise both)

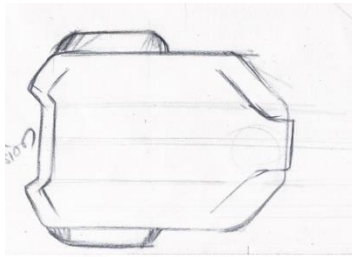
After combining they should look integrated.



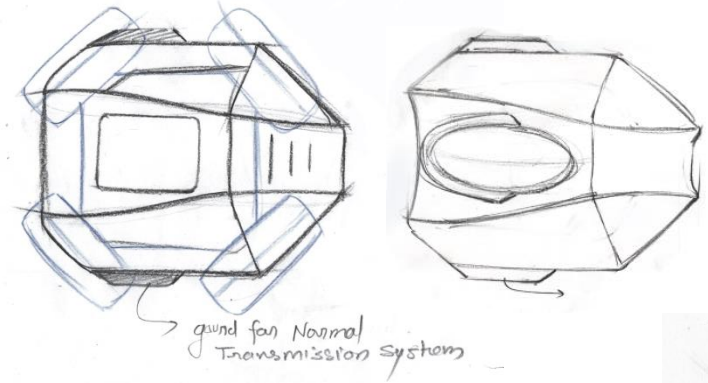


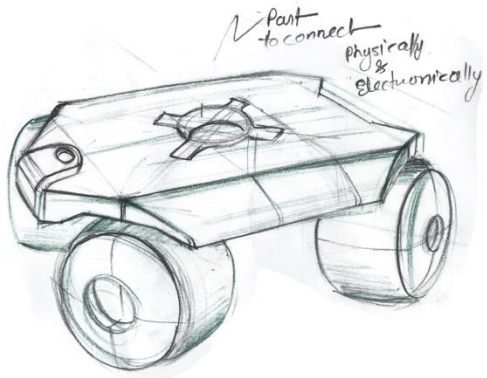


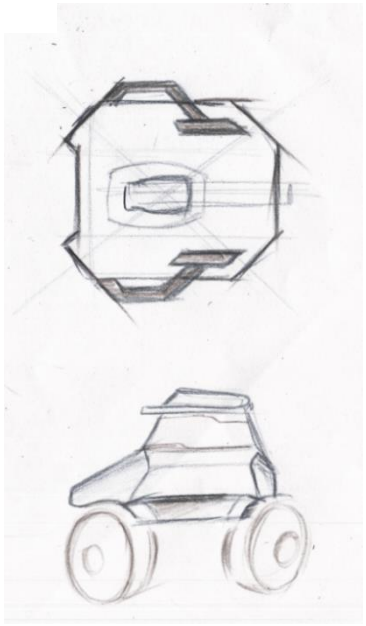
With 4 wheel
OD transmission



With 2 wheel
normal transmission





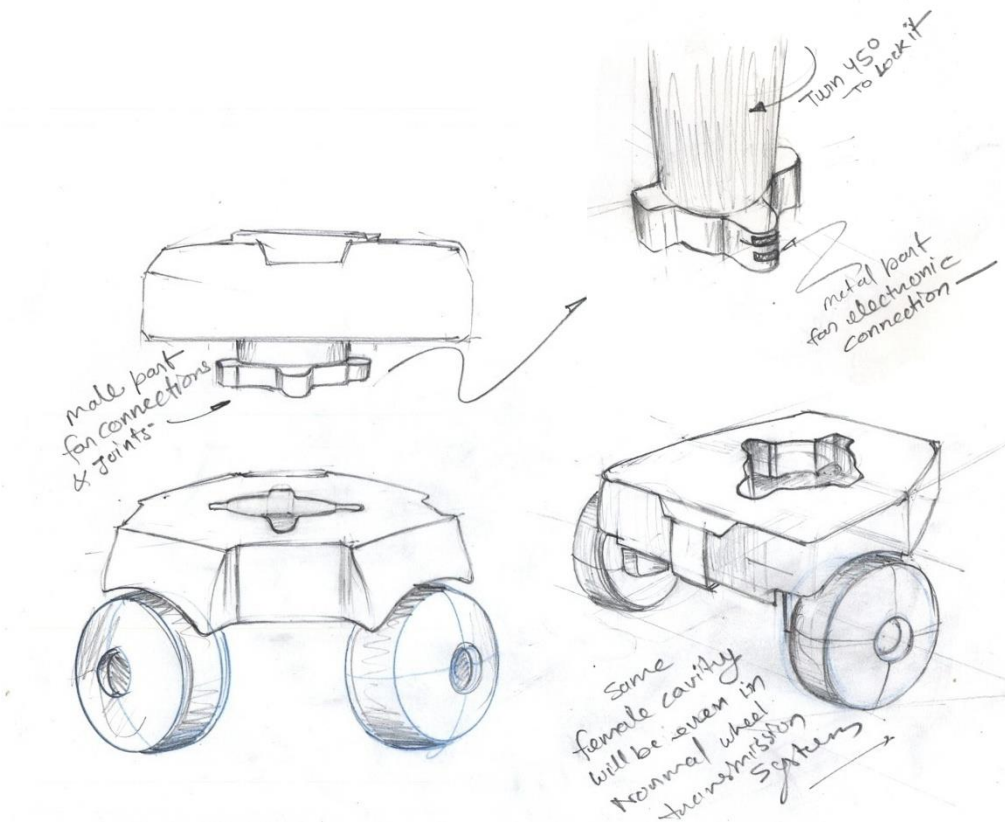


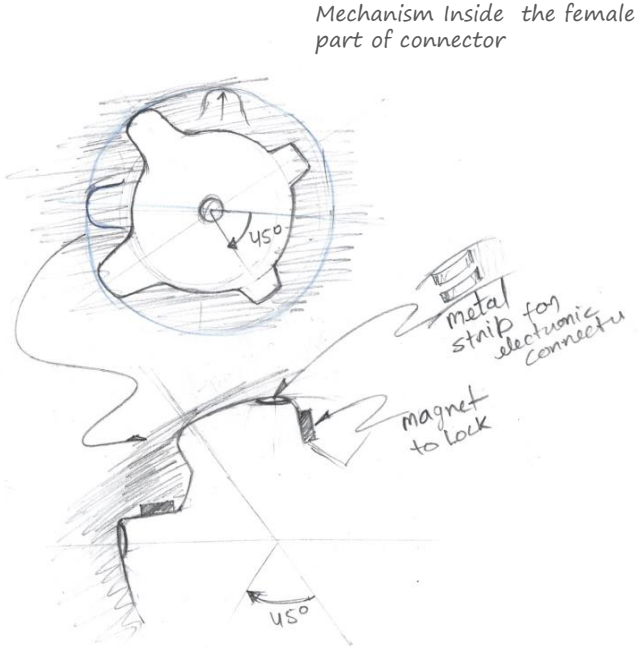
others

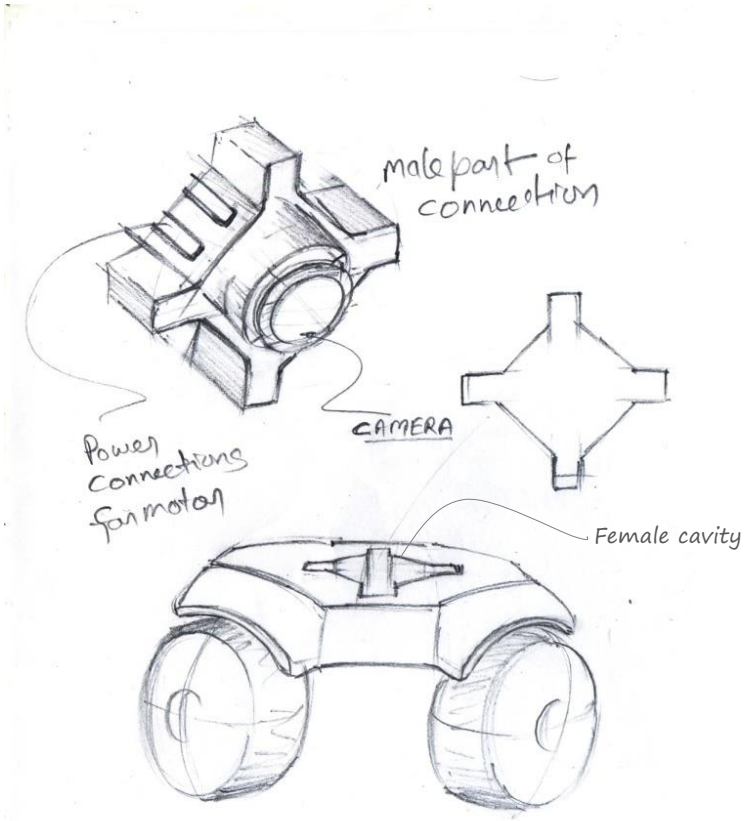
Idea 1

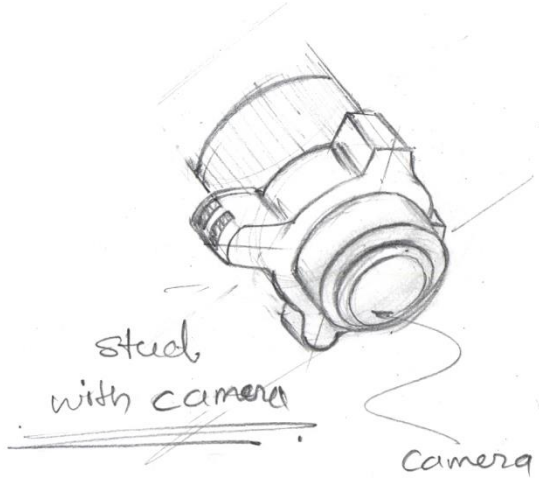
Replaceable transmission System

Connection of basic frame and replaceable parts must be hassle free, proper, easily replicable.





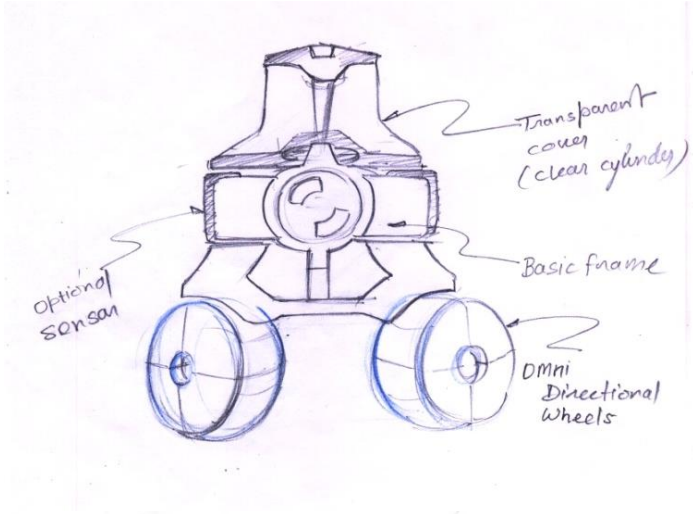


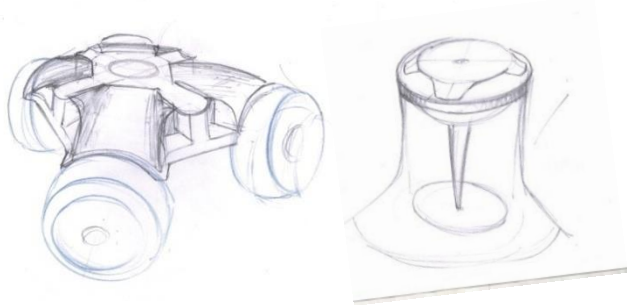


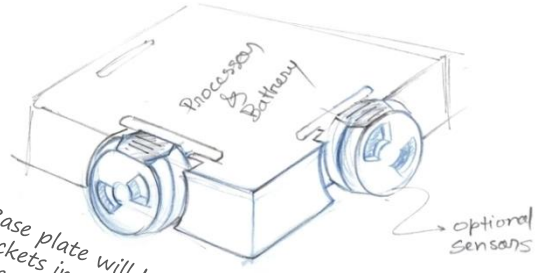
Camera installation with the connector of IDEA 1

Accommodation Of Optional Sensors

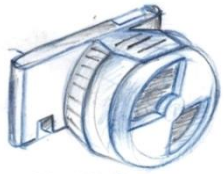
Ideation to accommodate one or more optional sensors which may be needed for other games in future. These must cover all possible direction.

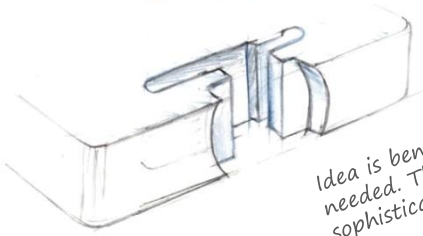




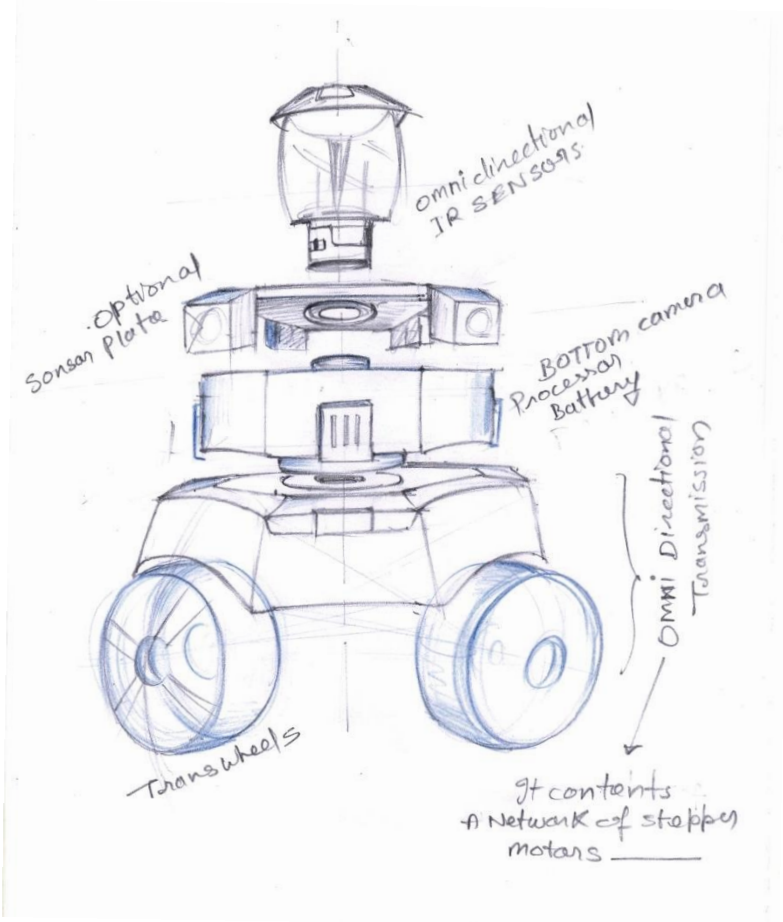


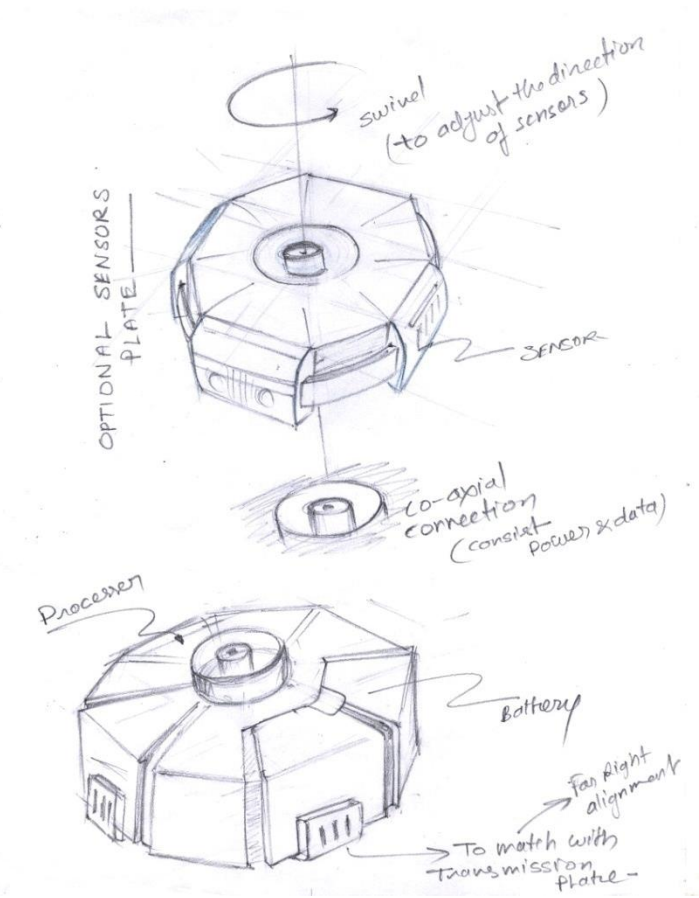
Base plate will have sockets in different directions to accommodate the optional sensors.

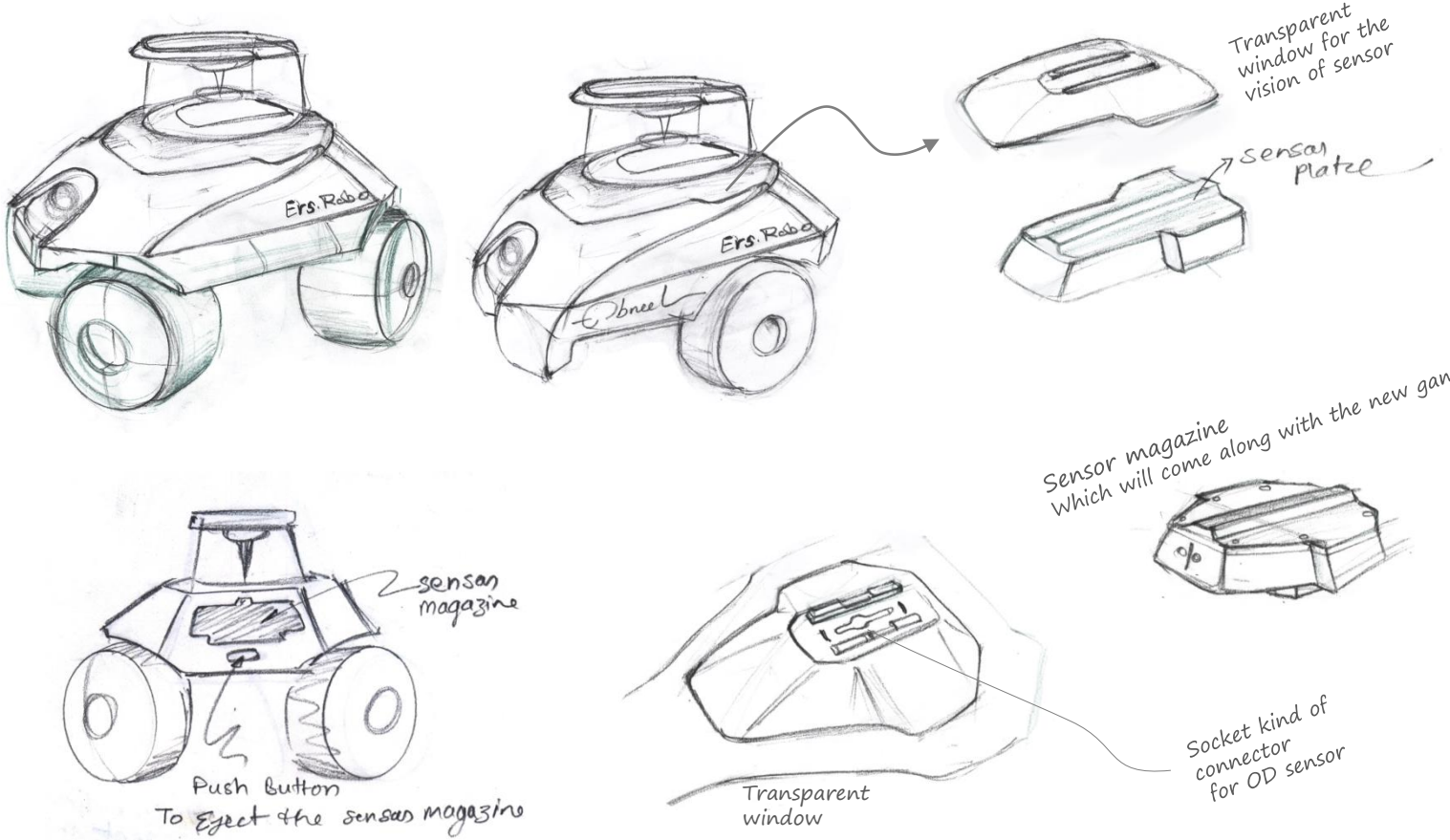




Idea is beneficial, If only one sensor is needed. There is no need to put any sophisticated assembly for installing that.


omni directional
IR SENSORS
Optional
Sensor Plate
BOTTOM camera
Processor
Battery
OMNI Directional
Transmission
Transwheels
It contains
A Network of stepper
motors

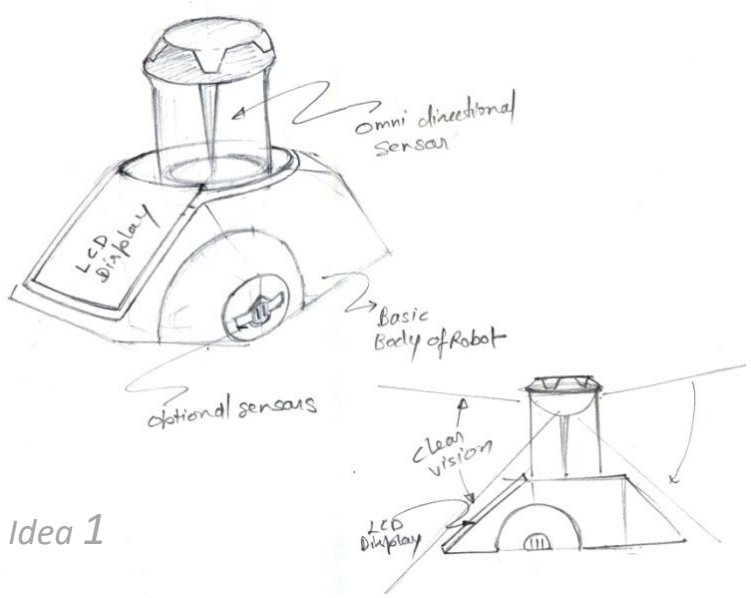

swivel
(to adjust the direction
of sensors)
OPTIONAL SENSORS
PLATE
SENSOR
co-axial
connection
(consist
power & data)
Processer
Battery
For right
alignment
To match with
Transmission
Plate


Transparent
window for the
vision of sensor
sensor
plate
Sensor magazine
Which will come along with the new games
sensor
magazine
Push button
To Eject the sensor magazine
Transparent
window
Socket kind of
connector
for OD sensor

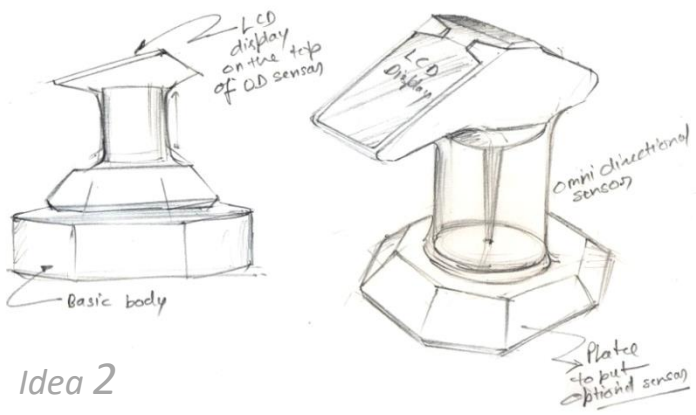
IDEATION FOR DESIGNING A RECONFIGURABLE ROBOT

Placement of LCD display

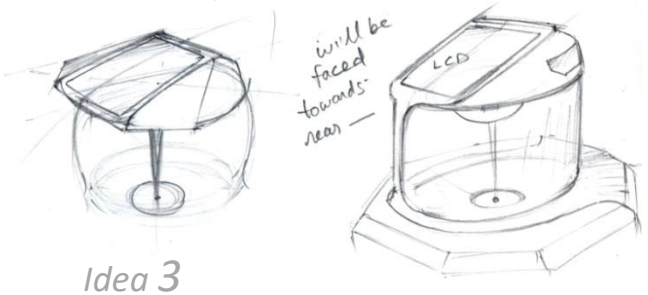
Placement of LCD display on the body of robot should not disturb the vision of sensors



Idea 1

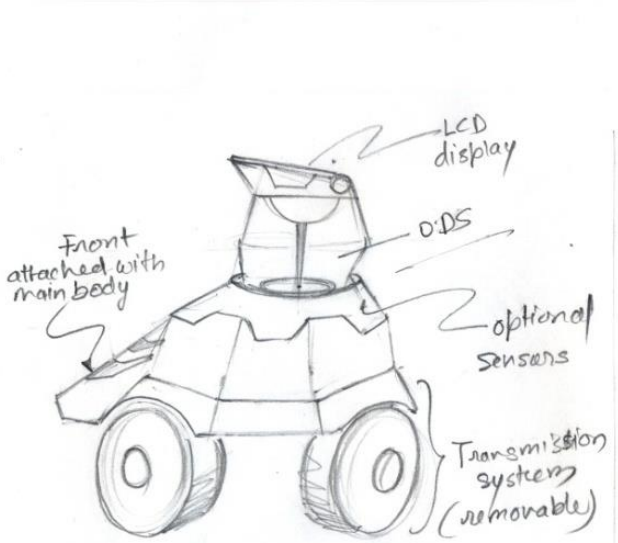


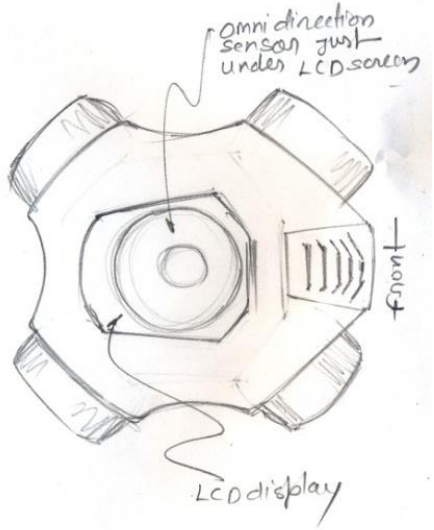
Idea 2



Idea 3

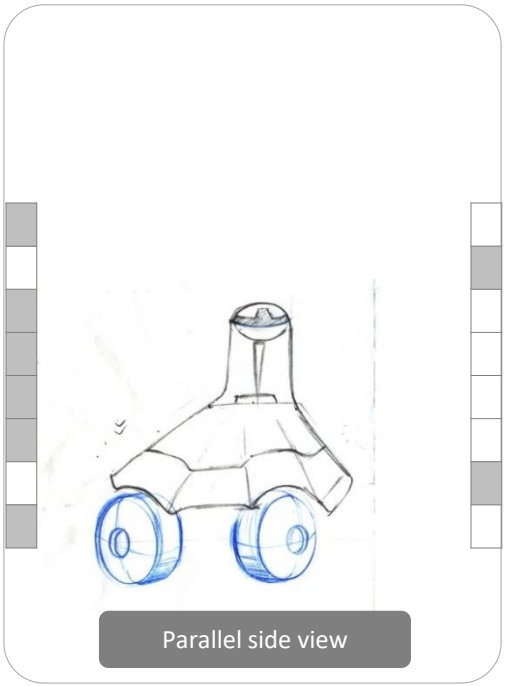
Front of the vehicle to create language of direction of movement



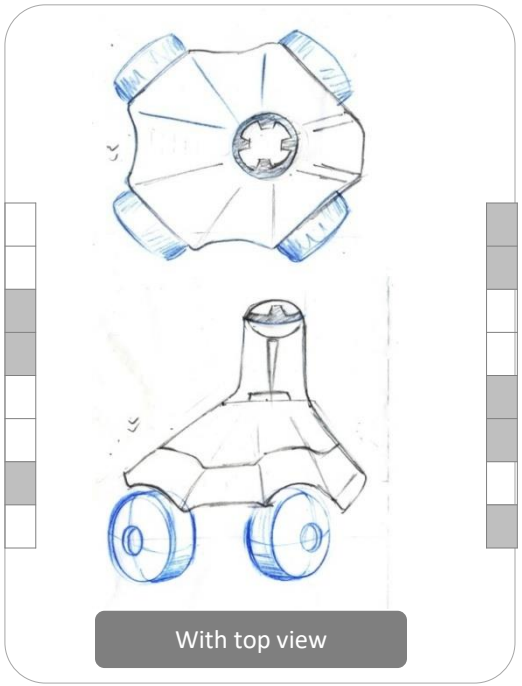


Study to find the characteristics which are responsible to make a side of the vehicle as its front

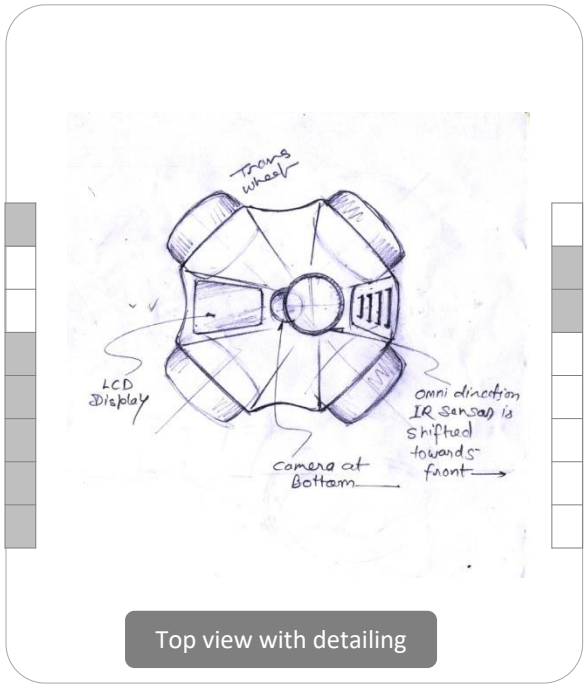
People were asked to perceive, which side is appealing to be the front of this new vehicle? These were shown to them one by one ….



Parallel side view



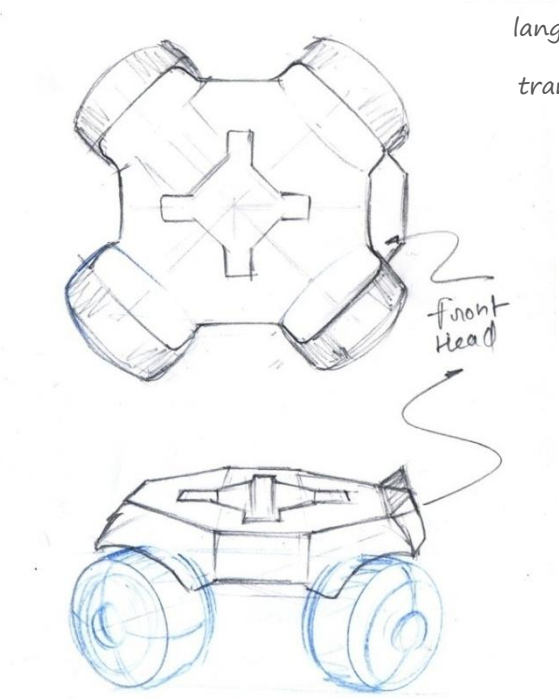
With top view



Top view with detailing

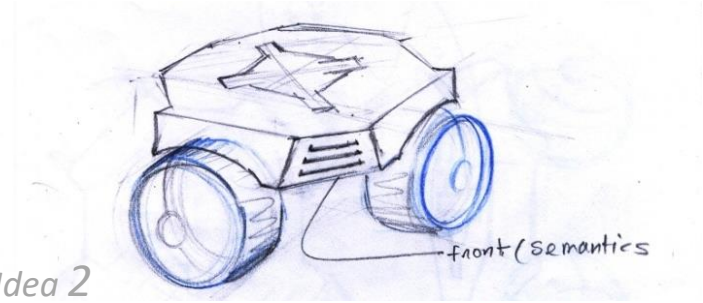
One gray block means that one mentioned the front in that side.

IDEATION FOR DESIGNING A RECONFIGURABLE ROBOT

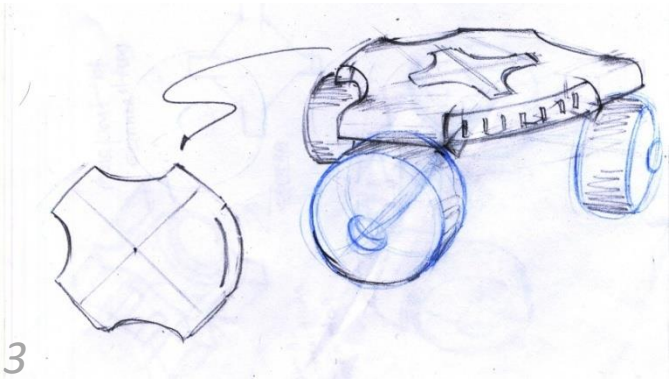


Idea 1

language of direction of movement in transmission part only

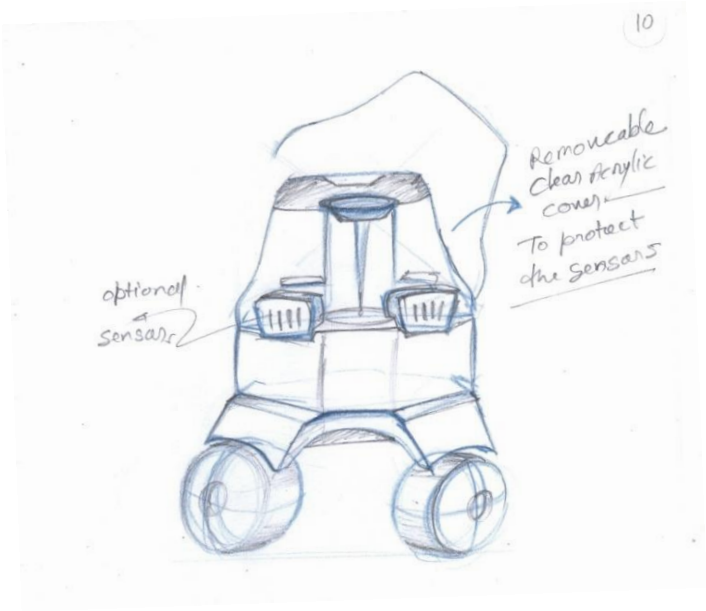


Idea 2

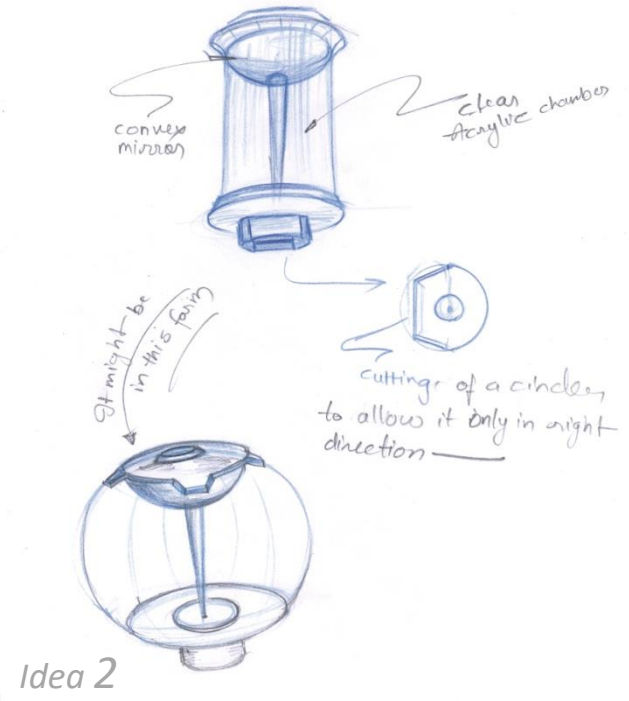


Idea 3

Protection Of Omni Direction Sensors



Idea 1

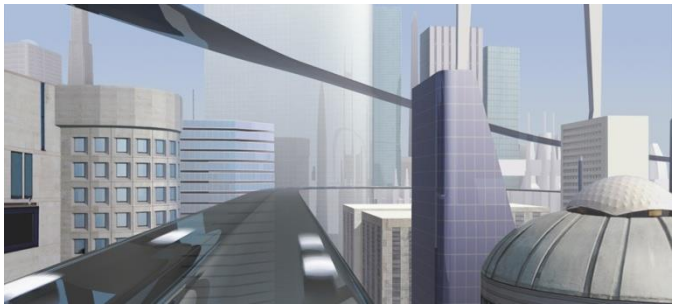


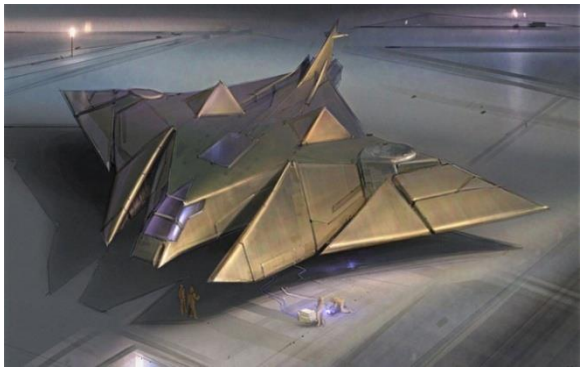
Idea 2

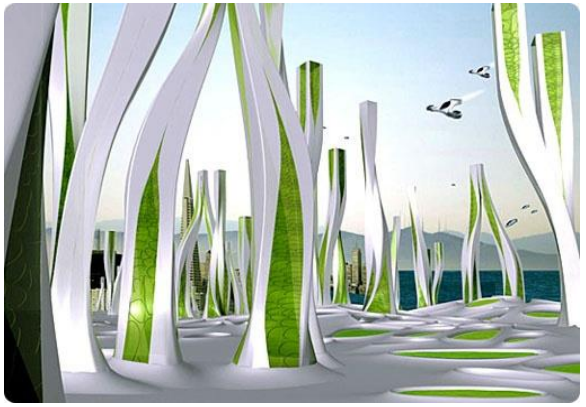
FORM
EXPLORATION

FORM
EXPLORATION

Image Board







Sophisticated

Flashy colour / jazzy

Big / giant size

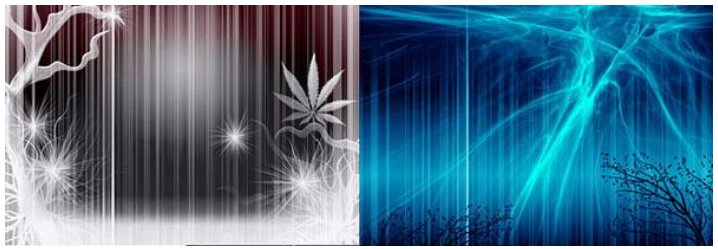
Precision

So much details

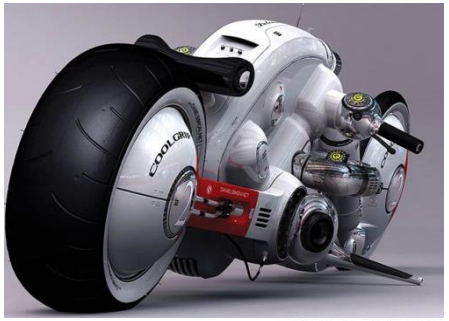
Geometric + organic forms

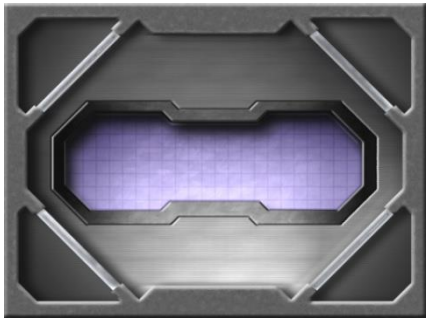
Fantasy (exaggeration, dreamy)

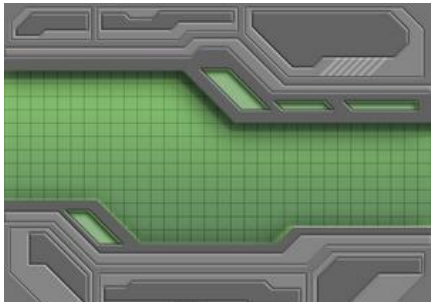
FORM EXPLORATION



- Sophisticated
- Flashy colour / jazzy
- Big / giant size
- Precision
- So much details
- Geometric forms
- Fantasy (exaggeration, dreamy)

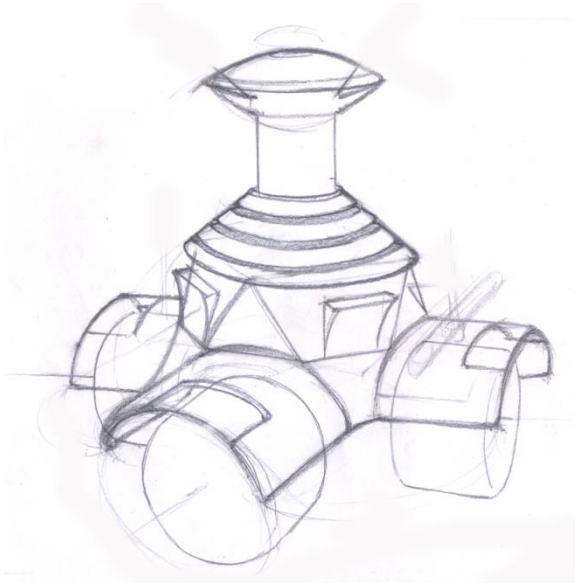


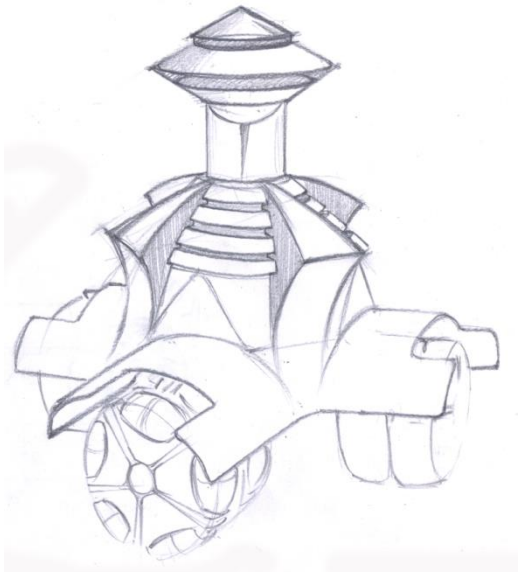




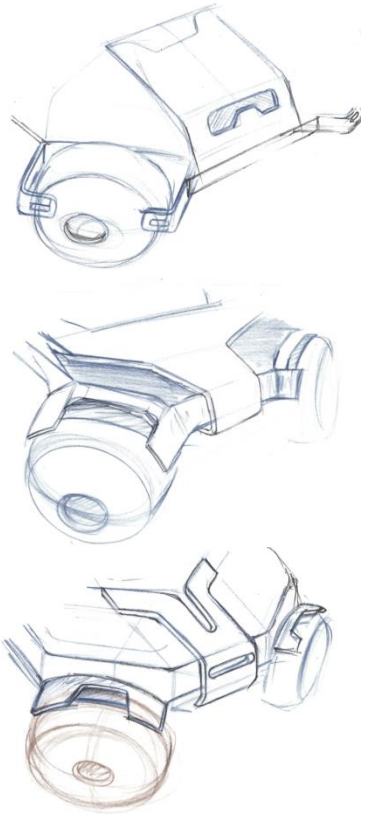
FORM EXPLORATION

Form of a toy is tried on the basic structure . But it has to be a sophisticated functional robotic product not just a toy .



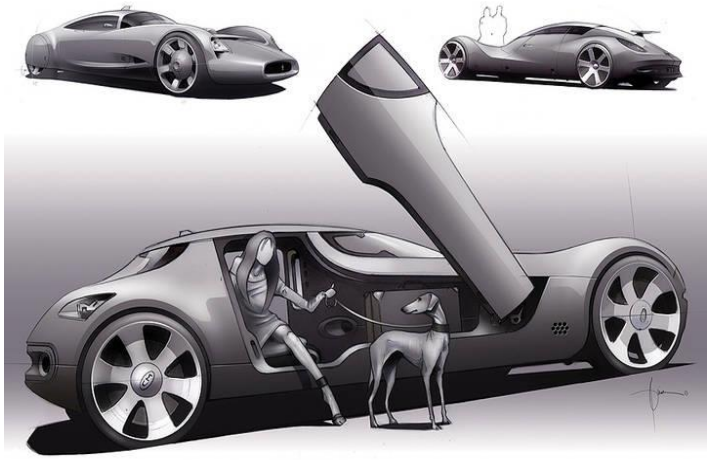


Attempt of trying geometric lines to integrate transmission with main body.

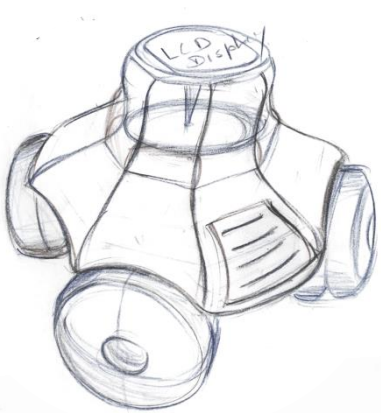


FORM
EXPLORATION

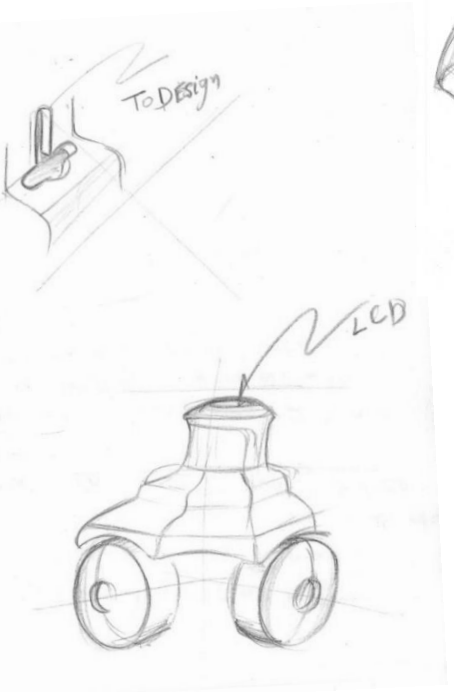
An image board of vehicles,
to take inspiration from
semantics of vehicle

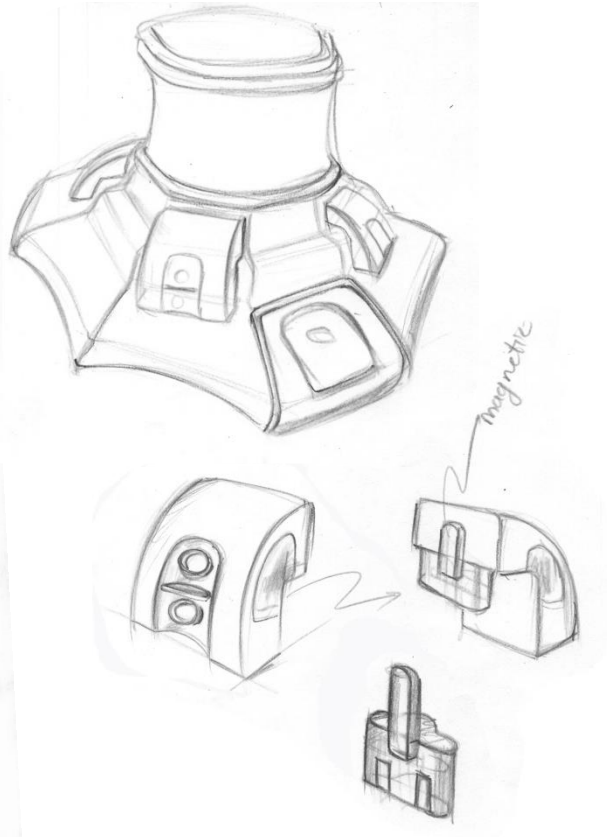


Form follows functions

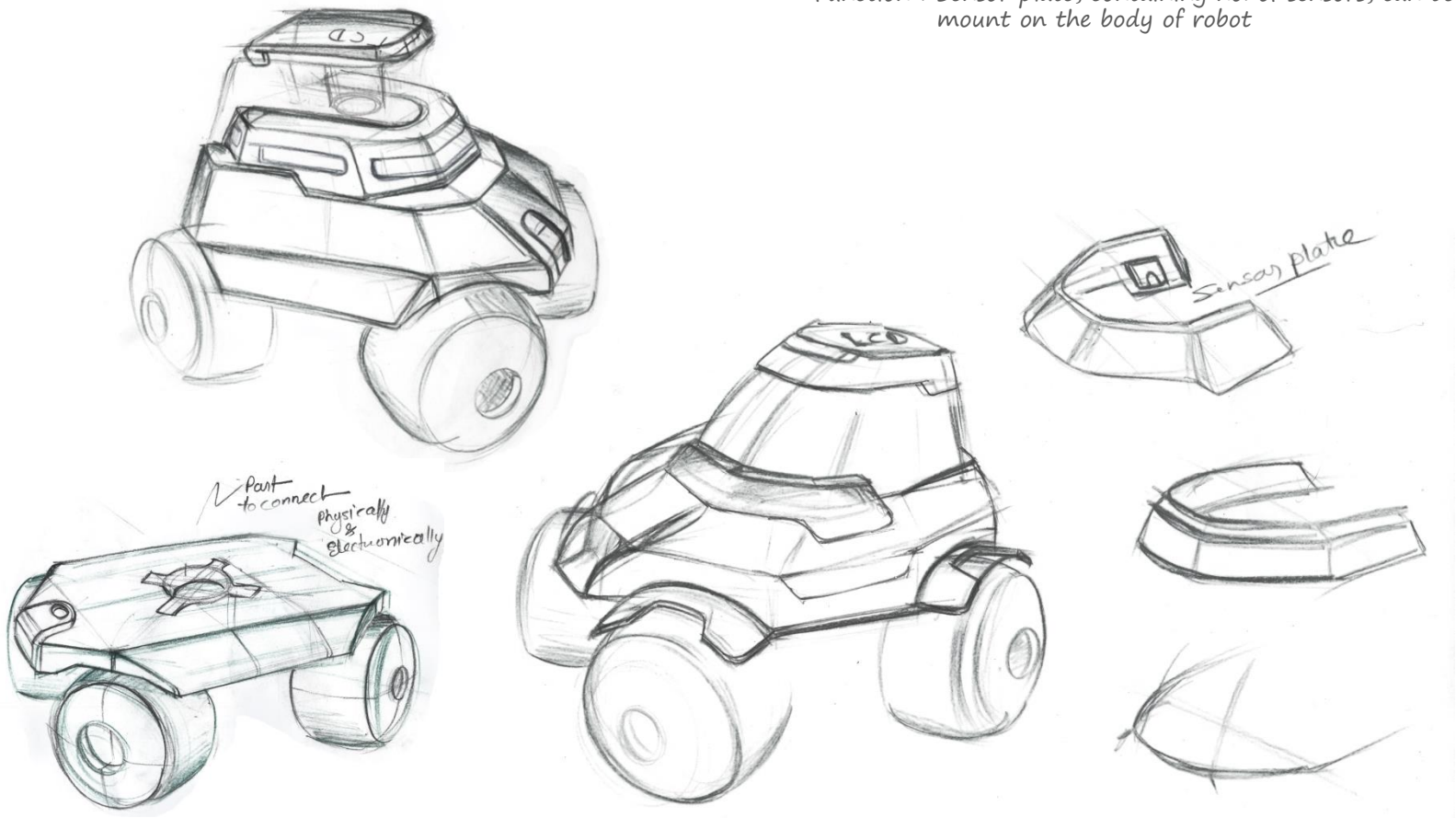


Function : Individual sensor can be installed on the body of robot

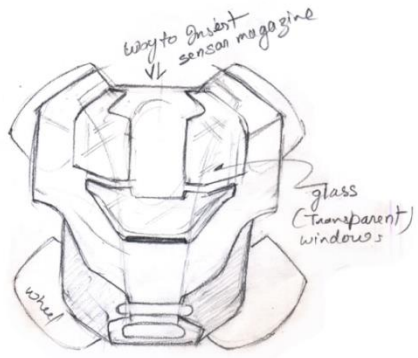


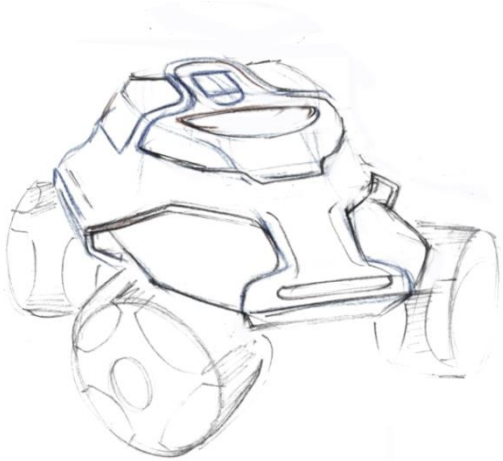


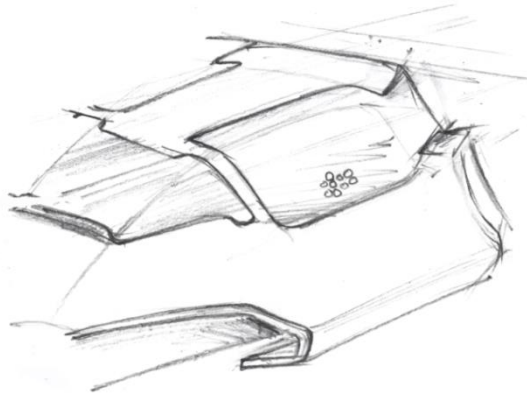
Function : Sensor plate, containing no. of sensors, can be mount on the body of robot

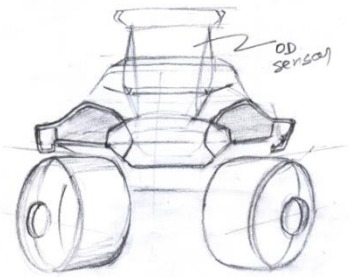


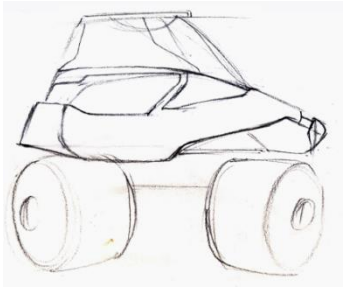
Function : Sensor magazine, containing no. of sensors, can be inserted into the body of robot

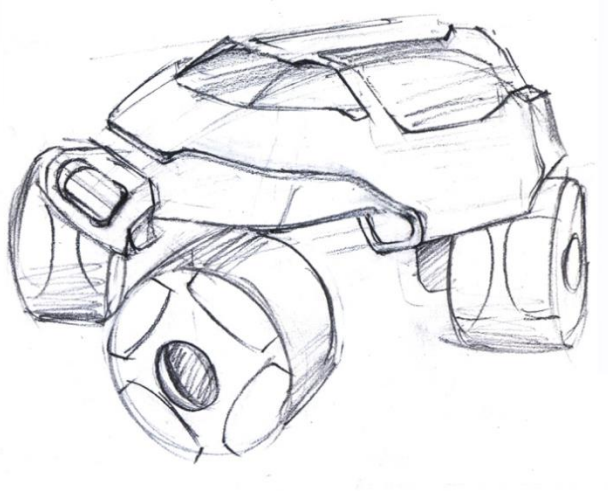






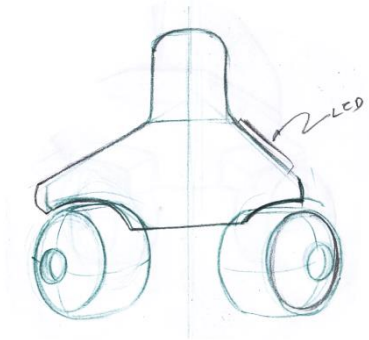


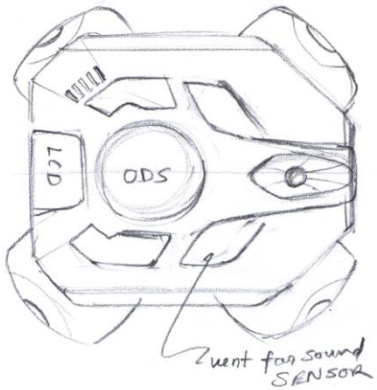


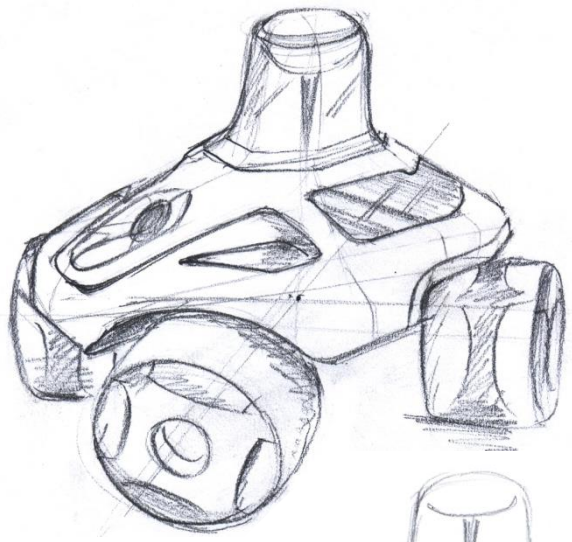


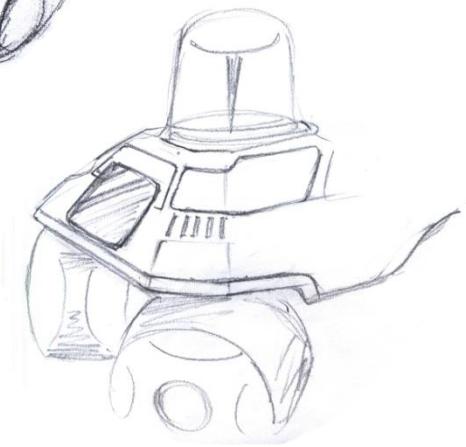
FORM EXPLORATION

Ability of easily modality of clay is used to bring the flow of material in the form.





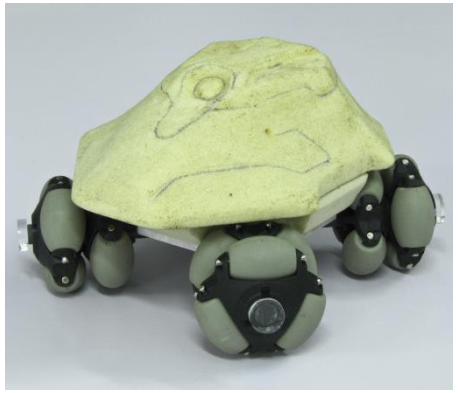




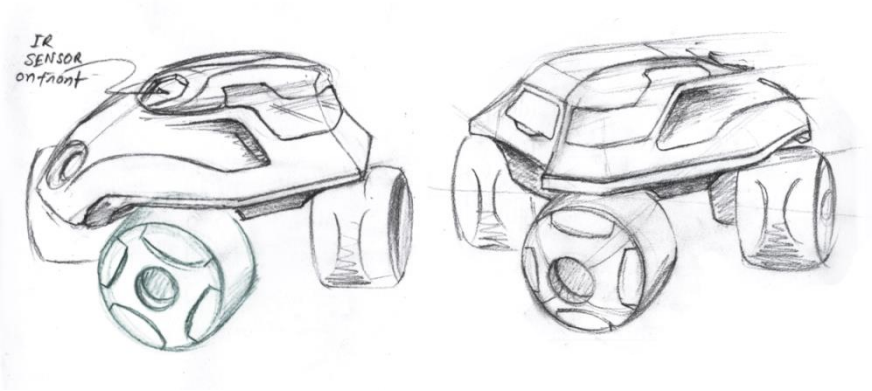
Refinement

Some exploratory mockup models

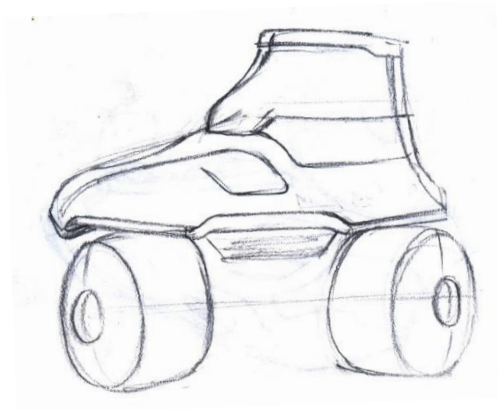
A form which I like most to consider it as a robotic product. But this form doesn't go with the function.

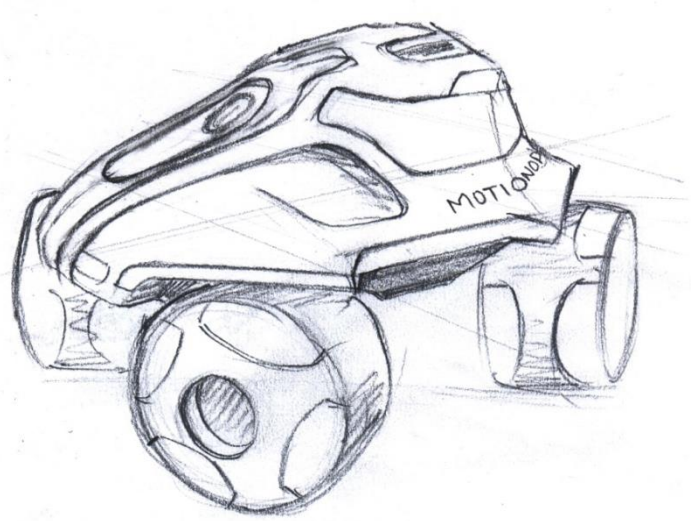


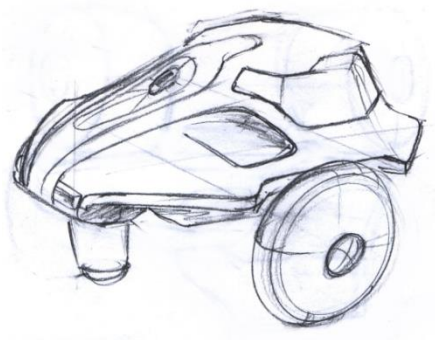
FORM
EXPLORATION



FORM
EXPLORATION

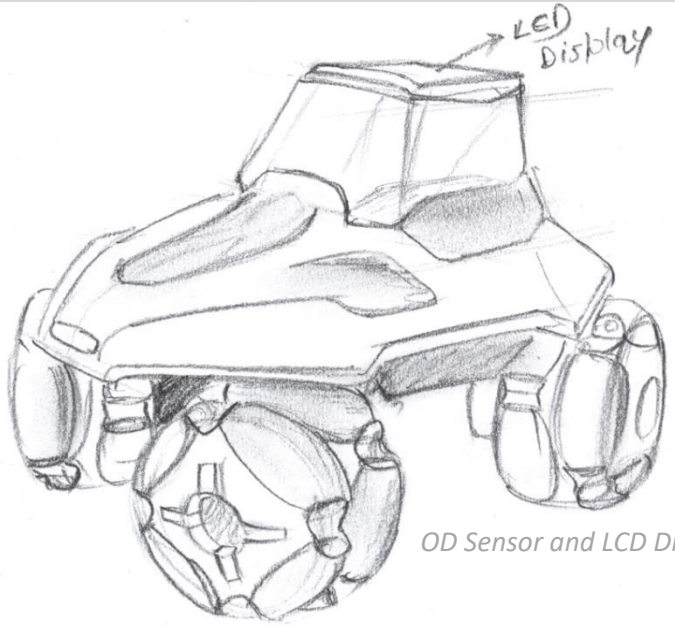




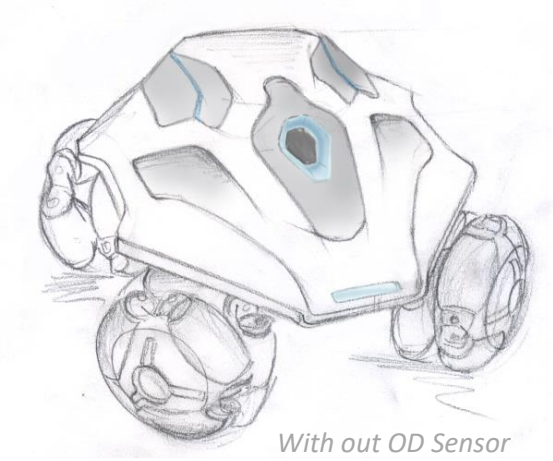


FINAL CONCEPT OF ROBOTIC KIT

Final Form of Robot



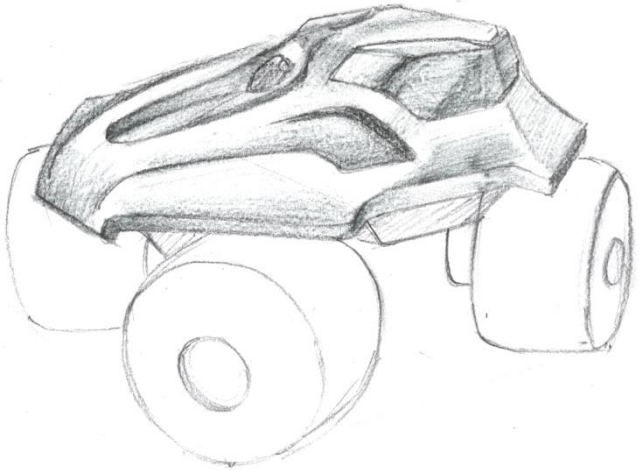
With
OD Sensor and LCD Display

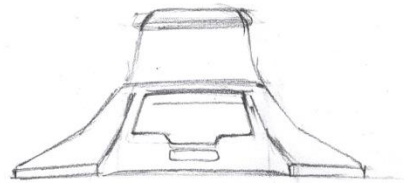


With out OD Sensor

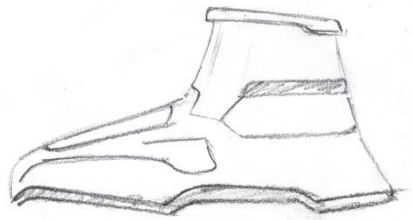
Mockup model

FINAL CONCEPT OF ROBOTIC KIT

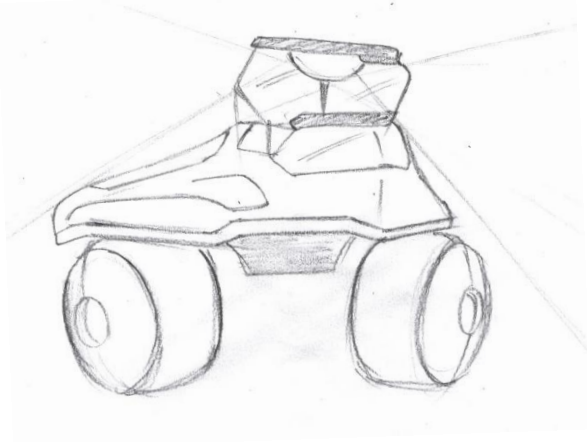


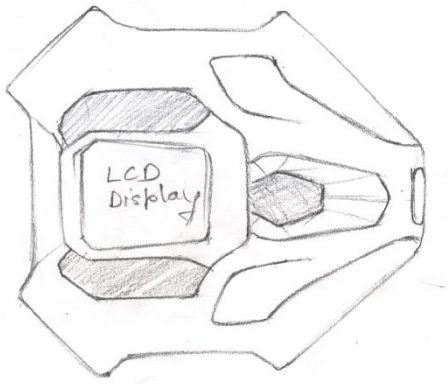


Rear view

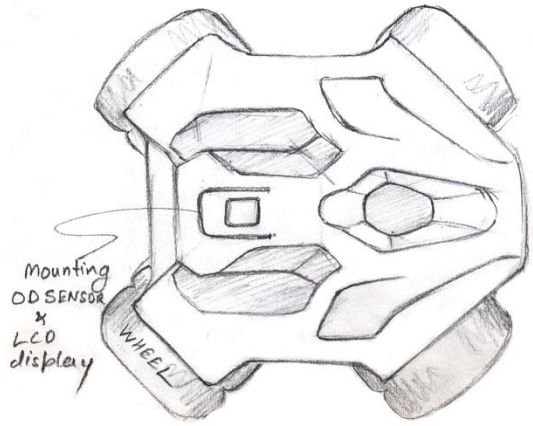


Side view





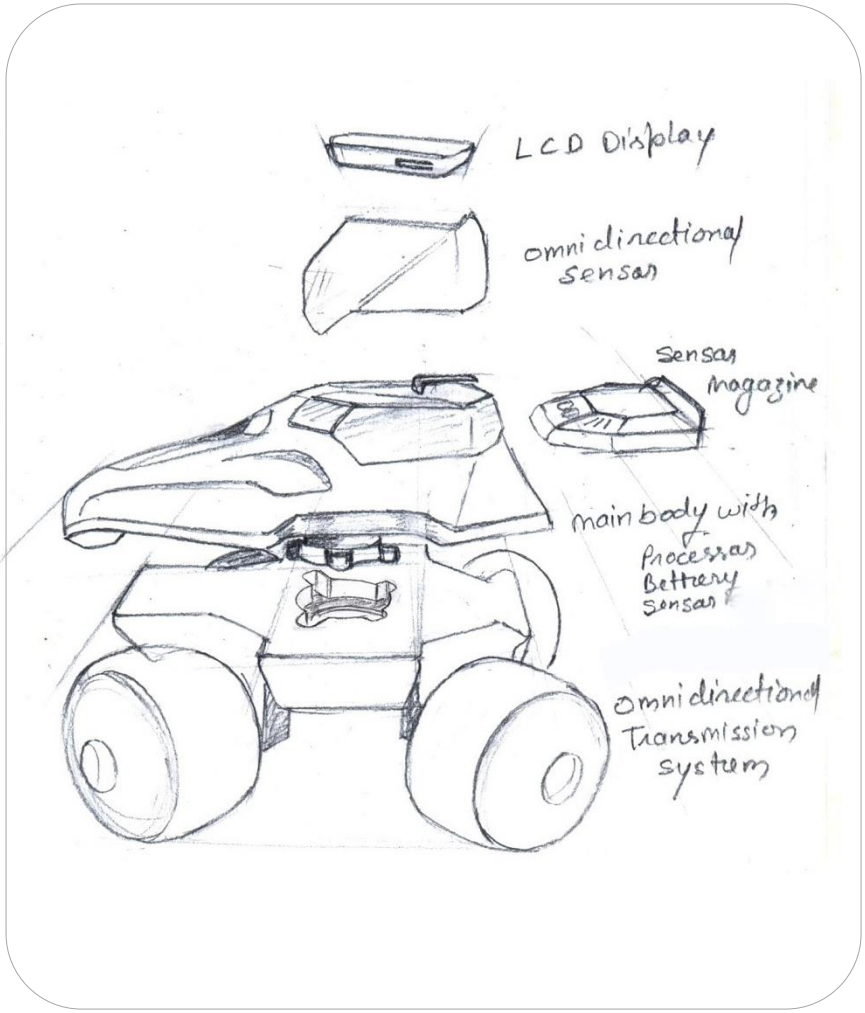
With OD Sensor and LCD Display

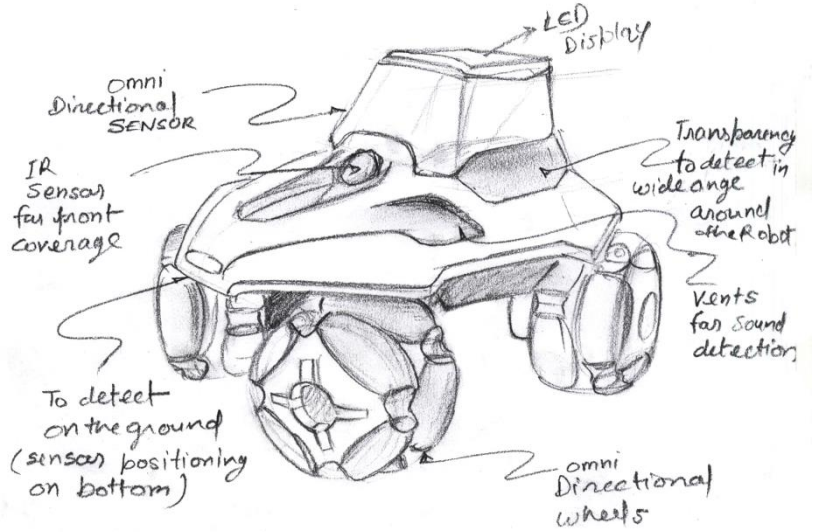


With out OD Sensor

FINAL CONCEPT OF ROBOTIC KIT

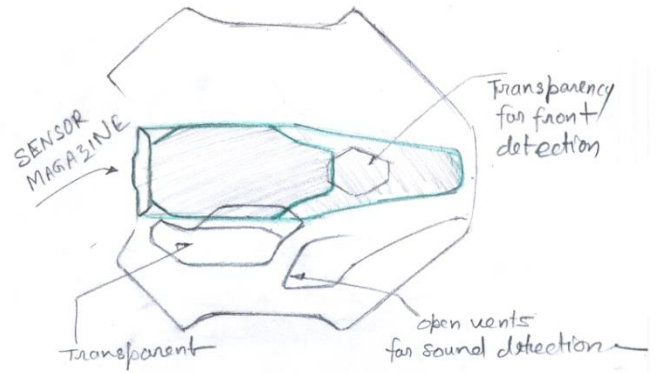
Main parts of robot

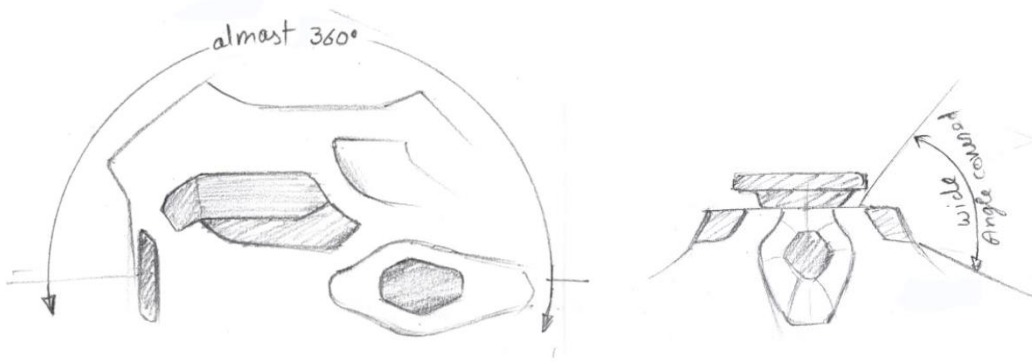




FINAL CONCEPT OF ROBOTIC KIT

features





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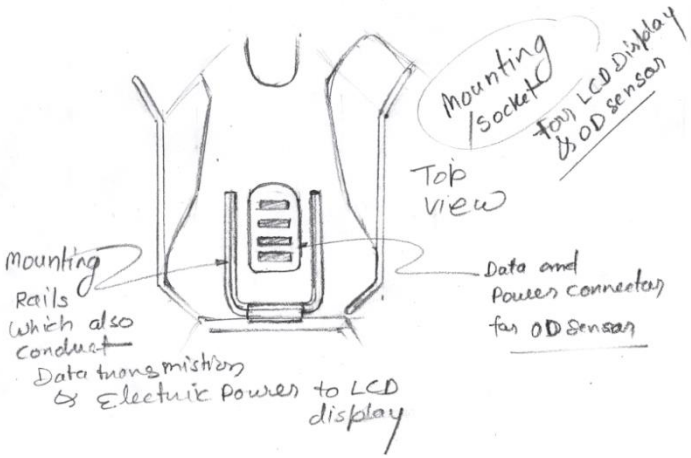

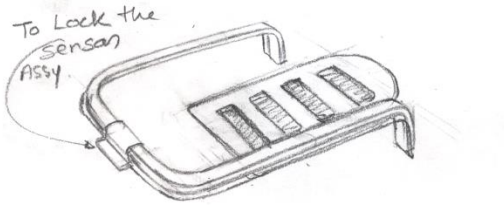

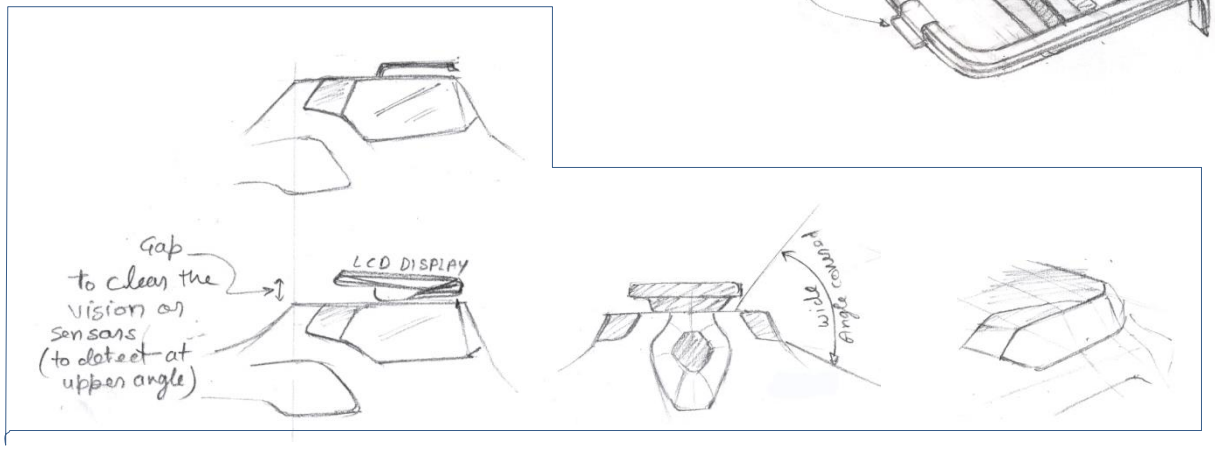

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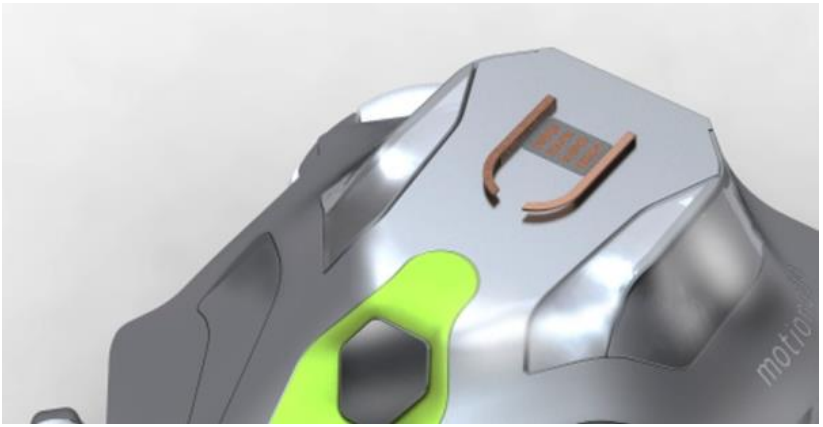

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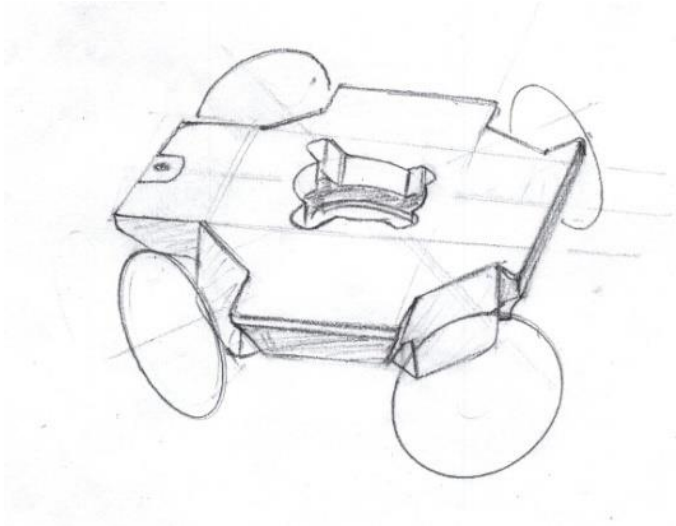
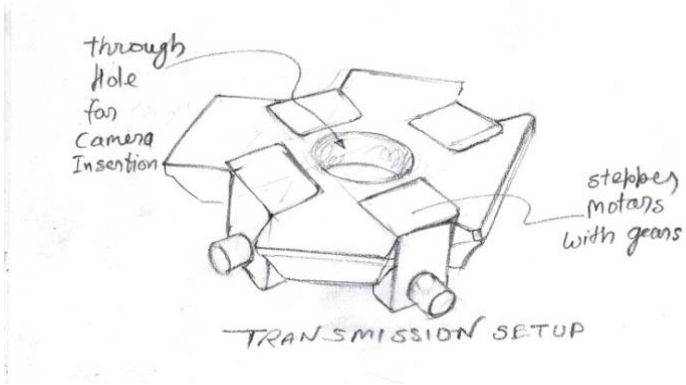
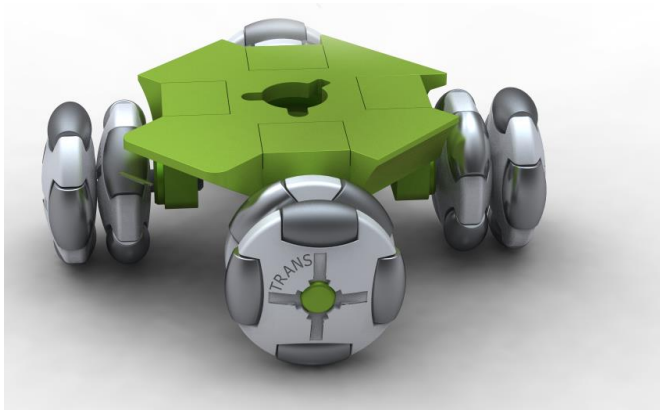
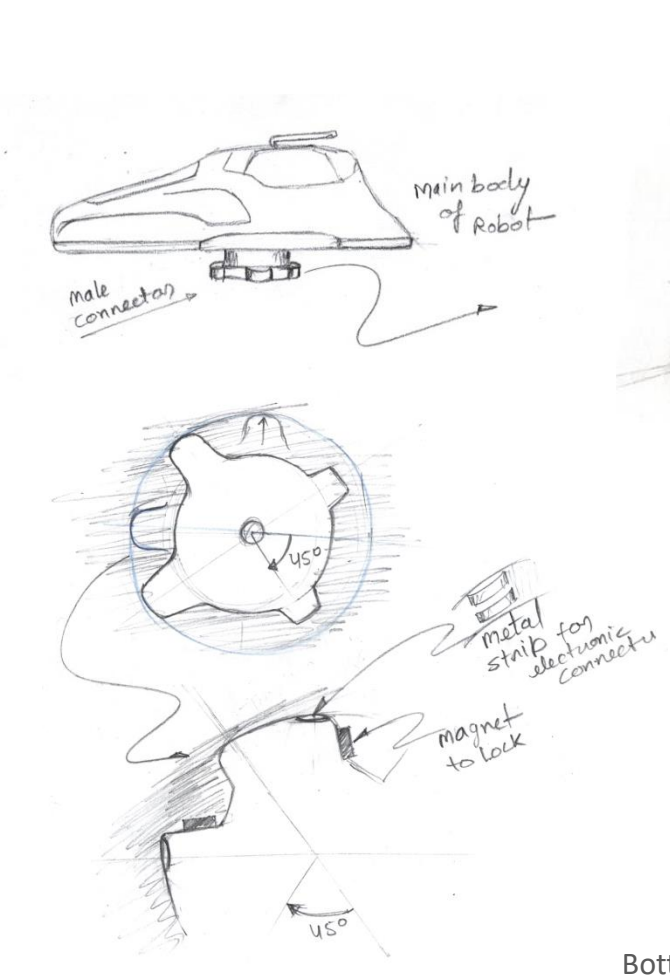
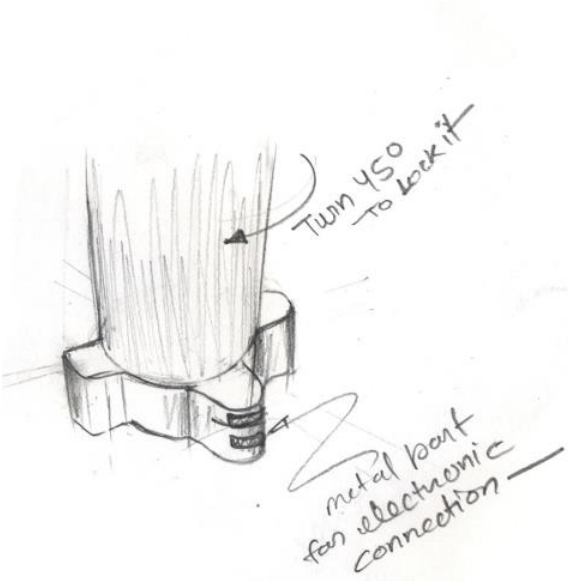


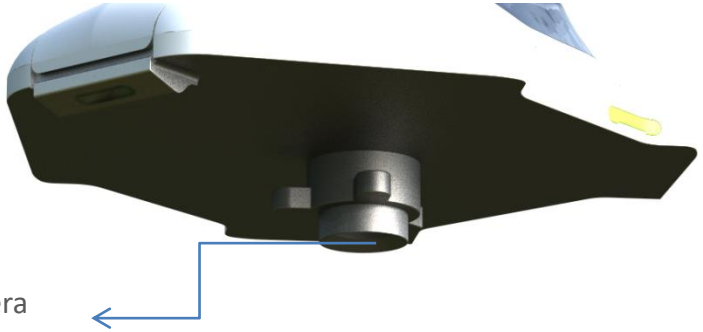




FINAL CONCEPT OF ROBOTIC KIT

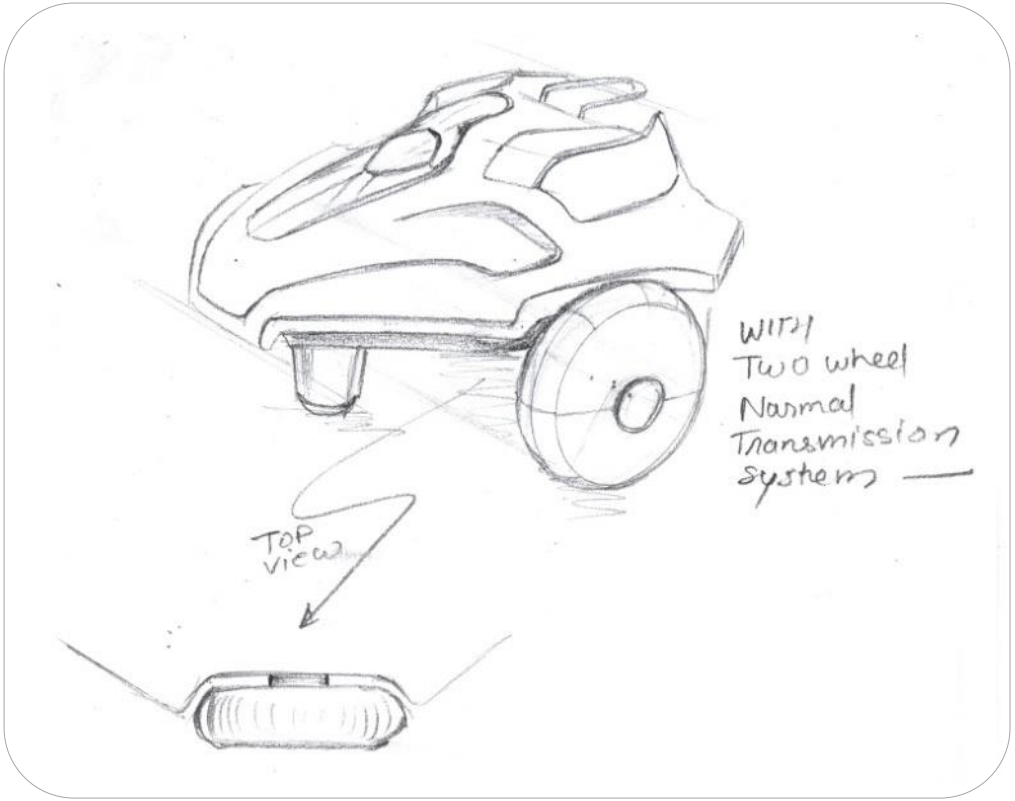






Bottom camera

FINAL CONCEPT OF ROBOTIC KIT



FINAL CONCEPT OF ROBOTIC KIT

Lock mechanism
For LCD Display

Lock mechanism
for locking it with
main body

LCD Display