

Step

Rовоково Intelligent Robot School

The world for prospective scientists, who will lead the future

Future Robot World

From seven years of age upward.



Robot Education Research Group of Engineering doctors of Seoul National University Research Society for Education of Intelligent Robot

Safety Precaution

- 1 Do not put the parts in your mouth.
- 2 Do not operate or bend/ remove the parts forcibly.
- 3 Do not put your hand into moving parts.
- 4 Do not throw or swing components or products to people.
- 5 Be careful when touching sharp edge of the parts.
- 6 Keep away from flammable or corrosive solvents (including water)* and gases.
- 7 If the chemical from a battery gets into your eyes, mouth, or on your skin, follow the instructions below.
 - If the chemical gets into your eyes: Flush them thoroughly with clean water, and then see a doctor immediately.
 - If the chemical gets into your mouth: If swallowed, do not induce vomiting.
 See a doctor immediately.
 - : If the chemical just gets into your mouth, wash out your mouth with water thoroughly.
 - If the chemical gets on your skin: Wash the area thoroughly with soap and water.
- ⁸ Please assemble and operate with a guardian or a teacher.
- Our kit includes small parts so children under three years of age are not admitted to use.

Intelligent Robot School 04

Author : Jungmi Park, Gooyong Um, Youngsuk Choi Translation : Minjeong Yoo First Edition : November 30th, 2010 Pub. Date : November 30th, 2010 Publisher : RoboRobo Co., LTD.

Copyright© Roborobo Co., LTD. All rights reserved.

%Printed in the Republic of Korea. This publication is protected by copyright, and permission must be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise. For information regarding permissions, write to: RoboRobo Co.,LTD

5F RoboRobo building, 197-16, Mia-Dong Gangbuk-Gu, Seoul 142-100 South Korea Tel : 82-2-909-5050 Fax : 82-2-917-3511

Table of Contents

1. SupergrabBot 1 **Interface Board** 2 How to Assemble 4 Completed SupergrabBot! 10 Try to Decorate! 11 Set the Servo Motor 12 14 Shall we make it move? Let's Play Game! 16 What did you learn? 18

2. SupertankBot		19
	Elasticity and Plasticity	20
	How to Assemble	22
	Completed SupertankBot!	28
	Try to Decorate!	29
	Controlling step by step with Remote Control	30
	Set the Servo Motor	31
	Shall we make it move?	34
	Let's Play Game!	36
	What did you learn?	38

3. BowlingBot		30
	Origin of Bowling	40
	How to Assemble	42
	Completed BowlingBot!	48
	Try to Decorate!	49
	Set the Servo Motor	50
	Shall we make it move?	52
	Let's Play Game!	54
	What did you learn?	56

Table of Contents

4. BullBot		57
	Bull Fight	58
	How to Assemble	58
	Completed BullBot!	66
	Try to Decorate!	67
	Set the Servo Motor	68
	Shall we make it move?	70
	Let's Play Game!	72
	What did you learn?	74

5. TrailerBot		75
	Driving System of Vehicle	76
	How to Assemble	78
	Completed TrailerBot!	88
	Try to Decorate!	89
	Set the Servo Motor	90
	Shall we make it move?	92
	Let's Play Game!	94
	What did you learn?	96

6 FutureRot		07
U. I ULUI GDUL		91
	Household Robot	98
	What did you learn?	100





SupergrabBot is a robot that moves the objects by using the Gripper which is assembled to the Servo Motor as a human hand. Let us find out the principle and usage of the Interface Board that makes robot more powerful and play the game. Who will move objects to the enemy 's camp the most?

Interface : The surface where two things touch each other/ connection, link, boundary, border, frontier

2010-12-10 오후 4:30:57



Interface Board



Generally, 'Interface' means the device or system to connect two separated things. For example, a remote control is an interface between a human and a television, and language is the interface between humans. Also a keyboard becomes the interface between the human and a computer. The Interface Board in the kit is also a device to connect a signal between the CPU Board, the DC Motor and the Servo Motor.

Now, look at the picture of the Interface Board above, and let's figure out how signal connection works? If you look at DC MOTOR on the Interface Board, the signal cable from the CPU Board is connected as divided into two, from 1~4 and 5~8 of MOTOR DRIVER.

This means that the Interface Board divides the signals from CPU Board into two and sends them to the MOTOR DRIVER. Let's give an example. If you operate the four DC Motors, how many OUT Ports (of the CPU Board) do you need? Yes, you need four OUT Ports. However, if you have the interface board, you can move the eight DC Motors.





(Signal Connection Diagram of Interface Board)

Have you ever used more than two Servo Motors in the class? Your robot might have malfunctioned or the Servo Motor might have given out due to lack of power source. When the power source is not enough, you can solve this problem by using the Interface Board.

This is because the Interface Board uses the battery only for itself which is separated from the CPU Board. The two connectors enable the Interface Board to use eight batteries. This provides power to the DC Motor and the Servo respectively so the Motor operates with more power and endures longer.

Now, shall we make more powerful and stable robot together? The Interface Board will help you make it.





Assemble the Battery Case, Motor Frames and the L-2x2 Frames to the Main Frame using bolts, nuts and 35mm Supports.



Flipped fra	ame	e sho	t						
E			_		1			E	
3	-	•	• 🚳		•	• •	•	3	
A 💽				•	•	• •	•		
C				000	. •	• •	•	•	
C C C					:	• • •	••••	:	
C					•	• •	•	•	
0				•	•		•	9	
2	٩	•)	01 0	•	00	•	is -	

2 Refer to above two pictures taken from different angle. A) Leave it empty without fixing any bolt like the blue circle.





3 Assemble the Servo Motor and DC Motor to the Motor Frame that is fixed to the Main Frame and then insert Wheels.



4 Refer to above two pictures taken from different angle.





5 Fix the Battery Case to the Support by the 35mm Support and assemble the link-structure (like a joint) on the Servo Motor and L-Frame.



6 Refer to above two pictures taken from different angle. A) Put the Motor Frame outside of the L-Frame and fix a bolt to make it spin.





Fix the Servo Motors to the 8-Holes Frames and then make two grippers and fit them into the Servo Motor axle.



8 Refer to above two pictures taken from different angle.

How to Assemble



9 Fix the CPU Board and DC Motor Drive Boards on the Support and then fix it to the Remote Control Receiver and Interface Board.



10 Refer to above two pictures taken from different angle.





11 Connect the Power Cable of the Battery Case to the Power Connectors of the CPU Board and Interface Board. Connect the DC Motor Cable to the DC Motor Drive Board.



12 Connect the 3Pin Cable to the OUT Port 1, 2, 3, 4 of the CPU Board and the Interface Board (DC CPU) 1, 2, 3, 4. Connect the 3Pin Cable to the 1, 2, 3, 4 of Interface Board (DRIVER) and DC Motor Drive Board 1, 2, 3, 4.



13 Connect the 3Pin Cable to the OUT Port 5, 6, 7 of CPU Board and 5, 6, 7 of Interface Board (SERVO CPU). Connect the Servo Motor cable to the Interface Board (SERVO MOTOR) 5, 6, 7. Connect the 3Pin Cable to the IN Port 7 of the CPU Board and Remote Control Receiver.

Completed SupergrabBot!













Set the Starting Point of the Servo Motor

- Main Function : Set the starting point and rotation radius of the gripper.
- Application : Set the zero point and then fit the Motor Guide to the starting point. Then, Set the radius of rotation with the Servo Motor Chip.

[Starting Point Set up Position]

[Radius of Rotation]



In case of Servo 5, set the zero point as 214 on the program and then fit the Motor Guide. In case of Servo 6, set the zero point as 1 on the program and then fit the Motor Guide.





Set the Starting Point of the Servo Motor

- Main Function : Set the starting point and rotation radius to raise the gripper.
- Application : Set the zero point and then fit the Motor Guide to the Starting Point. Then, Set the Radius of Rotation with the Servo Motor Chip.

[Starting Point Set up Position]

[Radius of Rotation]





A Practice!

Set the Servo Motor Chip to lift up and down the gripper to raise an object.



Shall we make it move?

- Make your robot move forward when pressing the button [1] of the remote control, move backward with button [2], turn left with button [3] and turn right with button [4].
- 2 Make your robot to lift up the object when pressing the button [1], [5] of the Remote Control at once and put it down by pressing the button [2], [5] at the same time.





•



•

•

•

•

•

•

- 3 Make your robot to grab the object when pressing the button [3], [5] of the Remote Control and put it down by pressing the button [4], [5].
- 4 Combine all programs to play the game.



.et's Play Game!



Preparation

Nine balls (One should have different color.)

2 How to play

It is a team sport. Each team can score by moving balls into opponent's side. The game is played on a rectangular divided court, and there is a line on the divided part. Balls are set on the certain position on the court in advance. The court is divided into two main sections by the mid-court line.

Game rule

- Both teams should put the balls into the opponent's court in three minutes. At this time, each team can defend or steal the ball.
- All robots and balls should be located by referee.
- While playing the game, the certain part of the robot can cross the mid-court line but not the whole body of the robot.
- Eight balls should be on the designated place, while one different-color ball has to be on the center.



The team who left less balls wins following the end of the game. General ball : 1 point, Mega-ball(different colored ball on the center) : 3 points

Called game

Regardless of the time remaining, the game is over when all the nine balls are moved to the opponent's side.



5 Game example







1. We are trying to make SupergrabBot by using the Interface Board. Connect the 3Pin Cable, the Servo Motor and the DC Motor Cable correctly.





Today's Goal



SupertankBot is a robot that shoots a rubber-band arrow with the Servo Motor and other assembled frames. Let's find out Elastic Force that can stretch and then return to its usual length or size and look for another type of rubber material. And let's think about how the elastic force works in our life. At the last, we are going to see who push down the most paper-cup tower through the rubber-band shooting.

▶ Tank : a large military vehicle that is equipped with weapons and moves along on metal tracks that are fitted over the wheels

19



Elasticity and Plasticity



(Springs)

If we pull a rubber band and release, it returns to its original size. That is, the rubber band has the physical property of a material that returns to its original shape after the stress (e.g. external forces) that made it deform is removed. This property is called Elasticity.

An object with elasticity is called elastic material, while the force of the elastic material that wants to go back to its original size is elastic force. Most solids show some elastic behavior, but there is usually a limit. Things like rubber, a spring, an eraser, a bow, a sponge, a ball, a bed and steel plate etc, all have the elasticity.

You can head the ball because the soccer ball is the elastic material so it deforms itself to lessen the impact when it hits your head. Also our skin is the elastic material. If someone pushes your cheek, you can see that the cheek returns to its original condition.



SupertankBo

Well, why does the object with the elasticity always return to its original shape? A rubber band still has the elasticity if it recovers its original shape when you pull and release it. However, if stretched continuously for long time, it does not easily return to its original condition. Like this, there is an opposite property against the elasticity. It is plasticity that does not return to its size and shape even though the forces causing deformation are removed. The plasticity is the property of a solid body whereby it undergoes a permanent change in shape or size when subjected to a stress exceeding a particular value, called the yield value, nature which does not come back to its original shape even though external force such as lump of clay or flour dough.

How our lives get different if elasticity is gone? We will not be able to use a spring balance, a mechanical pencil, a ballpoint pen and even the stepping board for diving. As an example of steel with very small elasticity, it will be broken, because it cannot return to its original shape when bended for construction. Also we cannot chin-up while hanging from an iron bar because a spine, one of our body parts, uses the elasticity to stretch and shrink.

Our life must be so uncomfortable if the elasticity, which is widely used in many things, disappears. Let's find other examples using the elasticity.

Reference www.britannica.com/EBchecked/topic/182035/elasticity

21



Servo Motor x1 Main Frame x2 Middle Frame x2 4-holes Frame x2



Put the Middle Frames, 4-Holes Frames and Servo Motor on the Main Frames and fix with bolts and nuts.

•	۰	•	•••	۲	•	۲		۲	•	۲	•••	•	•	-
•	۰			۲		۲		۲		۲				
•	•					•		•		•				
•								•						
•						۲	2C	0						0
						6	<u>ه</u> (
2	-			0			5	19		00	000		-	1
							NOT NOT							
•	•	•		•		1	SEP				000		•	
•			000			1	-	.1				۲	•	-
۰			000			0	1200	0			000			9
٠			000	0		0	000	6		٢	000			(
				-		-	000	0		6		•	•	



2 Refer to above two pictures taken from different angle.





Fix the DC Motors, Interface Board and Battery Case to the Main Frame.



A) Overlap two Battery Cases and fix to the Main Frame using 20mm Support. B) Fix the Interface Board between 30mm Support and the Motor Frame.

How to Assemble

DC Motor Drive Board x1 Caterpillar Wheel x2 Wheel Guide x2 Caterpillar Wheel Guide x4 L2x1 Frame x2 L2x6 Frame x2 20mm Support x4 140mm Axle x2 Regulable Nut x4 2.6x10 Bolt x2



Fix the Caterpillar Wheel Guide, Caterpiller Wheels and DC Motor Drive Board to the Main Frame.



6 Refer to above two pictures taken from different angle.





Fix the Remote Control Receiver, Battery Case and CPU Board to the Main Frame. Make two lanes as connecting the 45 Caterpillars and fix to the Caterpillar Wheel Guides and Caterpillar Wheels.



A) Put the 4-Holes Frame under the Battery Case and fix it to the Motor Frame with bolts.





Make the cannon as connecting the various frames, supports and the Servo Motor.



A) Fix the upper hole of Motor Frame and the bottom hole of Servo Motor with bolts.
B) Overlap two 3-Holes Frames on the Motor Guide and fix it to the Main Frame with 3x10 Bolts.





Connect the Power Cable of the Battery Case to the Power Connectors of the CPU Board and Interface Board. Connect the DC Motor Cable to the DC Motor Drive Board.



12 Connect the 3Pin Cable to the OUT Port 1, 2, 3, 4 of the CPU Board and the Interface Board (DC CPU) 1, 2, 3, 4. Connect the 3Pin Cable to the 1, 2, 3, 4 of Interface Board (DRIVER) and DC Motor Drive Board 1, 2, 3, 4.



Connect the 3Pin Cable to the OUT Port 5, 6, 7 of CPU Board and 5, 6, 7 of Interface Board (SERVO CPU). Connect the Servo Motor cable to the Interface Board (SERVO MOTOR) 5, 6, 7. Connect the 3Pin Cable to the IN Port 7 of the CPU Board and Remote Control Receiver.

Completed SupertankBot!



Try to Decorate!





Remote Control Operation

- Main Function : User can operate in various ways by one button of the Remote Control.
- Application : Insert R/C Chip into another R/C Chip and put the Chip the user wants to move when pushing the button and Delay Chip. Insert the Chip to move when not pushing between R/C END Chip and While Chip.



chip 2 : The action when you press the button for the time which is set on 'Delay'.

Practice!

Set the remote control like the following. Go forward if you push the [1] button but go backward if you keep pushing the button for more than one second.





Set the Starting Point of the Servo Motor

- Main Function : Set the starting point and rotation radius of the Servo Motor that moves cannon to left and right.
- Application : Set the zero point and then fit the Motor Guide to the starting point. Then, Set the radius of rotation with the Servo Motor Chip.

[Starting Point Set up Position]

Practice!

[Radius of Rotation]



Set the Servo Motor Chip as the cannon heads to the right, front and left.





Set the Starting Point of Servo Motor

- Main Function : Set the starting point and rotation radius of the Servo Motor that moves the cannon up and down.
- Application : Set the zero point and then fit the Motor Guide to the starting point. Then, Set the radius of rotation with the Servo Motor Chip.

[Starting Point Set up Position]

[Radius of Rotation]



Set the zero point as 40 in the program and fit the motor guide.

Practice!

Set the Servo Motor Chip as the cannon heads up, middle and down.




Set the Starting Point of Servo Motor

- Main Function : Set the starting point and rotation radius of the Servo Motor that moves the cannon up and down.
- Application : Set the zero point and then fit the Motor Guide to the starting point. Then, Set the radius of rotation with the Servo Motor Chip.

[Starting Point Set up Position]

[Radius of Rotation]



A Practice!

Set the Servo Motor Chip as it loads a rubber band with holding for five seconds and fires the cannon.



Shall we make it move?

Make the cannon head onward \rightarrow left \rightarrow onward \rightarrow right when pressing the button [1], [5] on the Remote Control.

2 Make the cannon head toward the middle → up → middle → down when pressing the button [2], [5] on the Remote Control.







•

•

•

•

•

•

3 Fire the cannon when pressing the button [3]. [5] of the Remote Control.

Combine all programs to play the game.



.et's Play Game!



Preparation

Rubber-band Paper cups for obstacles.

2 How to play

Put the paper cups in a circle around the SupertankBot. Load the rubber-bands on the robot and fire against the cups to pull them down.

Game rule

Score : The number of fallen obstacles.

e.g.) If you pull down a pile of two cups, you get two points.

- Points are counted when paper cup is fallen on the side.
- In case of two or three piled obstacles with two or three cups, the point can be acknowledged only if all the cups are fallen including the very bottom.

4 Game Example







Preparation

Rubber-band Paper cups to build up the tower.



Build a tower in each camp. It is a game to destroy the tower in the opponent's camp.

Game rule

- Both teams should destroy the tower in three minutes. At this time, each team can defend.
- While playing the game, the certain part of the robot can get into the Restricted Area but not the whole body of the robot.
- Rubber-band can be reloaded only in the armory and anyone has no access to the robot during the game.
- Called game : When the opponent's tower is completely destroyed(incl. bottom line) the game is over and it wins although time left.

4 Game Example





1. Find the elastic materials and mark a complete row like a bingo game.



Homework	Teacher 's Check

Today's Goal



BowlingBot is a bowling robot that grabs the ball with the gripper structure which is connected to Servo Motor and then rolls the ball to the target pins. Let's figure out the origin and etiquette for bowling game! And let's hit the strike with your BowlingBot!!

Bowling : An indoor game in which you roll a large heavy ball along a wooden track in order to knock down a group of pins

- ▶ Strike : Bowling term, All of the pins have been knocked down with the first ball of a frame.
- ▶ Etiquette : The formal rules for polite behaviour in society or in a particular group



• • • Bowling • • •



{Bowling Alley>

Have you ever played bowling? Bowling is a sport for men and women of all ages in which players attempt to score points by rolling a bowling ball along a flat surface into pins.

Bowling is assumed to be originated from throwing something and hunting the animals to survive in primitive age. That is, human practiced hunt by throwing hunting tools or stones into target. How can we know the bowling game came into play long ago?

BowlingBot

While English archeologist was excavating the tomb of Egypt, he found grave goods from child's tomb. There were three stone balls, nine pins and few pieces of marbles. In those days in Egypt, dead people's favorite things used to be buried with. From the customs, we assume that ancient Egyptian play the bowling game in one form or another and these goods are considered as the first bowling equipment on Earth today.

Bowling is a 1:1 game unlike baseball or football which requires many people. Each player has order and they should show their bowling ability at their turn. Maybe, this is why bowling has much more rules compared to other sports.

The most important etiquette is consideration for others who enjoys bowling together. If someone hits the strike or spare is made, encourage with clap. Another thing is, you should look out left and right lanes when rolling the ball. If throwing balls together on both lanes, you should concede to right person.

Also, you should not throw or bump a ball. This could damage the lane or affect other person's game. Of course, making loud noise, drinking and smoking are prohibited.

Can you play bowling now? Please keep the etiquettes and rules in your mind when you play!!

Reference http://www.talkbowling.co.uk http://dictionary.reference.com/browse/bowling





1 Put the Battery Cases and Motor Frames on the Main Frame and fix with 35mm Supports, bolts and nuts.



2 Refer to above two pictures taken from different angle. A) Leave the hole without fixing any bolts.





3 Put the Interface Board and Battery Case on the Support and fix with 20mm Supports and nuts. Fix the DC Motor on the Motor Frame and insert the Wheels.



4 Refer to above two pictures taken from different angle.

How to Assemble



5 Fix the L-2x2 Frames that are connected to the Servo Motor with 25mm Supports and then connect the L-2x6 Frames that are fixed to the CPU Board and make a face of the robot.



6 Refer to above two pictures taken from different angle.





Make the left arm using the Remote Control Receiver, DC Motor Drive Board and various frames.



8 Refer to above two pictures taken from different angle.
A) Fix the L-2x6 Frame and L-2x1 Frame under Remote Control Receiver then connect the Motor Frame to the L-2x1 Frame.

How to Assemble



9 Make the right arm using the Servo Motor and various frames.



Refer to above two pictures taken from different angle.A) Program after setting the zero point of the Servo Motor and then fix the 2.6x10 Bolts that Motor Guides do not get separated while moving.







11 Connect the Power Cable of Battery Case to the CPU Board and Power Connector of the Interface Board. Connect the DC Motor cable to DC Motor Drive Board.



12 Connect the 3Pin Cable to the OUT Port 1, 2, 3, 4 of CPU Board and Interface Board (DC CPU) 1, 2, 3, 4. Connect the 3Pin Cable to 1, 2, 3, 4 of the Interface Board (DRIVER) and DC Motor Drive Board 1, 2, 3, 4.



13 Connect the 3Pin Cable to the OUT Port 5, 6, 7 of CPU Board and 5, 6, 7 of Interface Board (SERVO CPU). Connect the Servo Motor cable to Interface Board (SERVO MOTOR) 5, 6, 7. Connect the 3Pin Cable to IN Port 7 of CPU Board and Remote Control Receiver.

Completed BowlingBot!





Try to Decorate!







Set the Starting Point of Servo Motor

- Main Function : Set the starting point and rotation radius of the Servo Motor that grabs the bowling ball.
- Application : Set the zero point and then insert the Motor Guide to Starting Point.

Then, Set the radius of rotation with the Servo Motor Chip.

[Starting Point Set up Position]

[Radius of Rotation]





A Practice!

Set the Servo Motor Chip as it can grab and release the bowling ball.





Set the Starting Point of Servo Motor

- Main Function : Set the starting point and rotation radius of the Servo Motor that lifts up and rolls the bowling ball.
- Application : Set the zero point and then insert the Motor Guide to Starting Point.

Then, Set the radius of rotation with the Servo Motor Chip.



Shall we make it move?

- Make your robot move forward when pressing the button [1] on the Remote Control, move backward with pressing the button [2], turn left with pressing the button [3] and turn right with button [4].
- 2 Make it grab and lift up the ball when pressing the button[1]. [5] of the Remote Control.





•



•

•

•

•

•

•

- 3 Make your robot release and roll the ball and then return its arm to its original position when pressing the button [2], [5] of the Remote Control.
- 4 Combine all programs to play the game.



Let's Play Game!



Preparation

- ► Bowling ball → Golf ball
- ▶ Bowling Pin → 10 batteries

2 How to play

Locate the bowling pins on the designated position before the game. It is a game played by rolling a ball down a handmade alley in order to knock down a triangular group of ten pins.

3 Game rule

- Put the front wheels on the starting line before the game.
- A player only can grab or lift up the ball inside the approach zone.
- A foul is committed when a part of the robot crosses the foul line.
- If the ball rolls out of the lane, a player will score zero points for the roll. This is known as a "gutterball".
- Players will take ten turns, called "frames", rolling twice in each frame. However, if the player knocks down all ten pins on their first roll, they are awarded with a "strike" and the frame is completed.
- If a player fails to knock down all the pins on their first roll, they then take a second roll. Only the pins that were not downed on the first go are left standing.
- If the player knocks down all the remaining pins on their second roll, they are awarded a "spare".
- If you made strike or spare, the 11th frame chance will be given.

4 Score

- A player generally receives one point for every pin knocked down on each roll of a frame. For a pin to count, it must be knocked over entirely. If it wobbles but stays standing, or moves without being toppled over completely, it is still considered standing and a score is not awarded for that pin.
- If a player knocked down seven pins on their first roll and one of the remaining three pins on their second, they would have a count of eight points for that frame. The number of pins knocked down in the frame is referred to as the "pinfall".
- A player who rolls a ball into the gutter or fails to knock down any pins will receive a zero for their roll.



In the event that pins are left standing at the end of the frame, it is referred to as an "open frame".

> The score for each frame is added up at the end of the game to give a cumulative total.

The maximum score attainable is 300 (see below), while professional level bowling starts with scores of 200.

Example

	1	2		3		4		5		6		7		8		9		10		
8	-	9	/		Х	F	7	0	9									Х	X	9
	8	2	8	4	5	5	2	61		om	nit	on	nit	on	nit	on	nit		90	

1st Frame

Ust turn got 8 pins, 2nd turn got 0 pin. 8+0=8

2 2nd Frame 1st turn got 9 pins, 2nd turn made spare. Spare = current frame score + 1st turn points of 3rd Frame. 8+9+1+10=28

3rd Frame

1st turn got 10 pins (made strike). Strike = 10points of current frame + 1st and 2nd turn points of 4th Frame 28+10+7=45

4th Frame

 \bigcirc 1st turn got 0 pin with foul, 2nd turn got 7 pins. 45+0+7=52

§ 5th Frame

Ust turn got 0 pin by the gutter bowl, 2nd turn got 9 pins. 52+0+9=61

2 10th Frame

1st and 2nd turn made strike, 3rd turn got 9 pins. 61+10+10+0=90

5 Game Example



What did you learn?

1. Jane and John had bowling competition. Jan**s** score is 129 and John is as below, who was the winner?

	1		2		3		4		5		6		7		8		9		10	
Χ		7					/	F	7	8										
								51												

- : no spare / : spare x : strike F : foul

- ▶ 1st Frame : 1st turn got 10 pins (strike) 10+□=19
- > 2nd Frame : 1st turn got 7 pins, 2nd turn got 2 pins 19+0+2=0
- 3rd Frame : 1st turn got 0 pin by the gutter bowl, 2nd turn got 8 pins
- 4th Frame : 1st turn got 9 pins, 2nd turn made spare
- ▶ 5th Frame : 1st turn got 0 pin as foul, 2nd turn got 7 pins □+0+7=53
- 6th Frame : 1st turn got 8 pins, 2nd turn got 1 pin
- 7th Frame : 1st turn made strike
- > 8th Frame : 1st turn got 7 pins, 2nd turn made spare
- > 9th Frame : 1st turn got 9 pins, 2nd turn no spare
- ▶ 10th Frame : 1st turn got 8 pins, 2nd turn made spare, 3rd turn got 8 pins

Homework	Teacher 's Check

Today's Goal



BullBot is bull robot that can have bull fight with techniques of butting or lifting. Let's learn how the bull fight, Korean traditional game, had generated and kinds of techniques of the bull fight. Then, why don't you hold a competition of pushing away using the Servo Motor from both sides like a bull and push away an opponent's bull with the horn!

57

▶ Bull : An adult male bovine mammal.

창의공학교실4(영문).indd 61

2010-12-10 오후 4:32:05



••• Bull Fighting •••



(Working farmers and cows)

Bull fighting is a type of game to make two cows fight. Once upon a time, every town used to have cows for fighting use, and the victory of the bull fighting was the pride and joy for them.

Although there isn't a written record of a origin of bullfighting, it is believed that the bullfighting started as an impromptu game played by herdsmen to kill time when the agriculture was first settled in Korea. As township grew, bullfighting was used as a way to show off a household or a village's power. The game which was played during Choseok(Korean thanks giving day) Holidays, was banned during the Japanese colonial rule as Japan wanted to stop Koreans from engaging in cooperative games.



BullBot

After the game was reinstated after the independence in 1945, it became a major event since the mid-1970s. The bullfighting festival, which was staged to celebrate March 1 Independence Movement Day since 1990s at the Seowon(Town name of Korea) riverside has now grown into the biggest bullfighting event in Korea. In Choengdo(Town name of Korea, famous for bull fighting) bullfighting, bulls graze together in the field before they lock horns while onlookers cheer on. In the beginning, bulls fought regardless of their sizes however in recent years, bulls are divided into three divisions according to weight and once the fight begins, they use various techniques such as head bumping, pushing, neck butting and flank attacking. By the 9th festival in 1998, the event became Korea's largest bullfighting. In 1999, the Culture and tourism ministry selected the event as one of 10 local cultural festivals, recognized the it as the nation's best bullfighting event.

Fighting cow is selected based on endurance, tall height, big size and well-developed neck. The cow usually participates in matches for average of $5\sim7$ years and for the period, it does physical and technical training instead of farming to participate. Mostly, it is trained as pulling tires for physique and trains technique through horn hit and competing strength.

Bull fighting is divided by the cow's weight and then makes program as drawing lots with cow owners. There is no time limitation so the match does not end until one cow loses. Usually it takes few minutes for weak cow to give up however sometimes it takes more. Each match is 1:1 single game.

Why don't you visit Korea and enjoy Bull Fighting? If so, make your own fighting cow first and play the game with your friends!





Put the Battery Case and Motor Frame on the Main Frame and fix with 35mm Supports, bolts and nuts.





A) Fix the bolt as inner side of Motor Frame. B) Leave the hole without fixing any bolts.

창의공학교실4(영문).indd 64





Fix the Servo Motor to Main Frame using the Motor Frames and 15mm Supports.



Refer to above two pictures taken from different angle.
 A) Firstly fix the Servo Motor and 15mm Support to Motor Frame.





5 Fix the DC Motor Drive Boards and Interface Board and then fix the DC Motors to Motor Frames and insert the Wheels.



Refer to above two pictures taken from different angle.
 A) Fix the Servo Motor to the L-2x6 Frame and make a tail then overlap the DC Motor Drive Board and fix it to the Motor Frame with bolts.





Using various frames, Caterpillar Wheel Guide and Tire to the Main Frame to make face of the bull.



- 8 Refer to the both pictures taken from different angle. Pay attention on the position and the length of the Support.
 - A) Tighten the bolts on the Motor Frame.





9 Fix the bull's head to the Servo Motor by the joint structure, and then fix the CPU Board and Remote Control Receiver too.



10 Refer to the both pictures taken from different angle. Pay attention on the position of the Nylon nut to be fixed.





1 Connect the Power Cable of Battery Case to the CPU Board and Power Connector of the Interface Board. Connect the DC Motor cable to the DC Motor Drive Board.



12 Connect the 3Pin Cable to the OUT Port 1, 2, 3, 4 of CPU Board and Interface Board (DC CPU) 1, 2, 3, 4. Connect the 3Pin Cable to 1, 2, 3, 4 of Interface Board (DRIVER) and DC Motor Drive Board 1, 2, 3, 4.



Connect the 3Pin Cable to the OUT Port 5, 6 of CPU Board and 5, 6 of Interface Board (SERVO CPU). Connect the Servo Motor cable to the Interface Board (SERVO MOTOR) 5, 6. Connect the 3Pin Cable to IN Port 7 of CPU Board and Remote Control Receiver.





Try to Decorate!







Set the Starting Point of Servo Motor

- Main Function : Set the starting point and rotation radius of the Servo Motor.
- Application : Set the zero point and then fit the Motor Guide to the starting point. Then, Set the radius of rotation with the Servo Motor Chip.



Set the zero point as 1 on the program of Servo 5 and then insert the Motor Guide. Set the zero point as 214 on the program of Servo 6 and then insert the Motor Guide.






Practice!

Raise the horn high and then make it face toward the opponent to attack.



Shall we make it move?

- Try to make your robot move forward if you press the button [1] on the Remote Control, move backward by the button [2], turn left by the button [3] and turn right by the button [4].
- 2 Raise the horn skyward if you press the button [1], [5] on the Remote Control and lower it downward by the button [2], [5].





•



•

•

•

•

•

3 Make its horn face the opponent if you press the button [3], [5].

Combine all programs to play the game.



Let's Play Game!



How to play

The game is played on a circle arena. This is a game as pushing out the opponent by the freely movable (facing up and down) horn.

2 Game rule

- It is a game that each robot attempts to force another bullbot out of a circular ring.
- Robot should not be armed with any weapon that can hurt other robots except the horn to push out the opponent.
- If the result of the match between the two robots does not easily come to a conclusion until the game is over, a referee should make a decision or rematch.

Game Example







How to play

This is a game of tug of war as that directly pits two bullbots against each other in a test of strength. And there is a line on the divided part. Then, tie the rope on the horn and mark the rope with a "centre line".



- The bullbots start with the rope's centre line directly above a line marked on the ground, and once the contest (the "pull") has commenced, attempt to pull the other robot such that the marking on the rope closest to their opponent crosses the centre line. The robot which leaves longer rope wins.
- > If opponent's wheels go across the center line, game finishes and automatically wins.

Game Example





1. The Picture below shows joint structure of the Bull Bot. If the 8-holes Frame is relocated on the position A, how will the robot's operation be changed?



▶ If it is moved to the position A, power to raise the robot's head is (stronger, weaker).

▶ If it is moved to the position A, a range of moving head is (wider, smaller).

Homework	Teacher 's Check





TrailerBot is a robot that pulls a trailer which is generally an unpowered vehicle used for transport of goods and materials. Let's figure out vehicle's drive system and examine what the differences are. Then, have a race of the trailer truck by changing direction using steering device. Who is the best driver of the trailer truck?

Trailer : A container on wheels which is pulled by a car or other vehicle and which is used for transporting large or heavy items.

75

창의공학교실4(영문).indd 79

2010-12-10 오후 4:32 26



• • Drive System of Vehicles • •

Have you ever heard of the words like Two-Wheel or Four-Wheel Drive? These are about driving system of vehicle, which is about moving method of vehicle.

Drive system is largely divided into two types; Two-wheel Drive and Four-wheel Drive. Two wheel drive or 2WD describes vehicles with a powertrain that allows two wheels to receive power from the engine simultaneously. If the engine drives the front wheels only, it is a front wheel drive car or FF car. If the power is transferred to back wheels, it is called a rear wheel drive car or FR car. The difference is up to the engine and the wheels.



FF (Front engine Front Drive) which is a front wheel drive car has an engine in the front side of a car and that engine transfers the power to the front wheels. The front wheel is relatively close to the engine so that lesson the power loss and the interior space is wider.



FR (Front engine Rear Drive) car typically places the engine in the front of the vehicle and the driven wheels are located at the rear and weight distribution is better so the drive is more stable. However, unlike FF car, the power transmitting device lies below between the engine and rear wheels so it has higher floor.





MR (Mid engine Rear Drive) which is a rear wheel drive car has the engine in middle and transferring the power to the rear wheels so the largest drawback of mid-engine cars is restricted rear passenger space; most mid-engine vehicles are two-seat vehicles. However it has very strong power due to unlimited size of engine. The Mid-engine is usually applied to super cars such as Ferrari Enzo and Toyota MR2 etc.



RR (Rear engine Rear Drive) which is a rear wheel drive car has engine at the back and transferring the power to rear wheels. Placing the engine near the driven rear wheels allows for a physically smaller, lighter, less complex, and more efficient drivetrain.

Four Wheel Drive uses all 4 wheels so power of engine is divided equally to all wheel so it is much powerful, stable and safer. However, the vehicle needs much machinery to move four wheels, it is more complex and fuel consumption is fairly high.

What type of drive vehicle have you ridden? Also, what type do we need for our TrailerBot?

Reference http://en.wikipedia.org/wiki/Four-wheel_drive





Connect the Main Frame and Middle Frame and then fix the Motor Frames, the L 2x6 Frames, Supports and others with bolts and nuts and make the body of truck.



6 6 • 6 6	0	0	•	•	•	0.01-13-400	•	•	•	•	0
		0	•	•	•		•	•	•	•	٢
	-19	•	•	•	•		•	•	•	•	۲
		•	••••	•	•••	:::	:		•	:	•
		•	•	•	•		•	•	•	•	0
	۲		•	•	•		•	•	•	•	۲
0 0 0 0	ŏ	•	•	•	•		•	•	•	9	9

2 Refer to the both pictures taken from different angle.





3 Connect the DC Motors to the Motor Frame and then fix the Wheels. Overlap 2 Battery Cases and fix with 25mm Supports.



4 Refer to above two pictures taken from different angle.





5 Connect and fix the Interface Board to the L-2x6 Frame and Middle Frame. Put the Servo Motor on Supports and fix.



6 Refer to above two pictures taken from different angle.A) Fix the Motor Frame on the Servo Motor and then check the assembling position and fix the 25mm Support to Interface Board.





Use the Option Frames, Small Frames and 40mm Supports and make the trailer connecting device.





Refer to above two pictures taken from different angle.A) Overlap and assemble the 4-Holes Frames under Option Frame and on the opposite side, overlap and fix the 3-Holes Frames under the 5-Holes Frame.





9 Fix the Middle Frame, Option Frames and the L-2x2 Frames with Supports and Nylon Nuts and make steering system.





10 Refer to the both pictures taken from different angle.





11 Connect the Motor Guide and Wheels to the Steering system.





A) Fix the bolts to the Motor Frame. B) Insert the 5mm Supports to the Wheels and then fix the L-2x2 Frame with Nylon Nuts.

창의공학교실4(영문).indd 87





13 Fix the Servo Motor using 40mm Supports and then assemble the CPU Board.





A) Leave it empty without any bolt insertion. B) Set the zero point of Servo Motor and then insert the Motor Guide to the Servo Motor axle.





5 Assemble the Remote Control Receiver and Battery Case with various frames and make the driver's seat of truck.





16 Refer to above two pictures taken from different angle.
A) Assemble the DC Motor Drive to the L-2x1 Frame then fix with the bolts of Motor Frame that is assembled to the CPU Board.

창의공학교실4(영문).indd 89







Connect the Power Cable of Battery Case to the CPU Board and Power Connector of the Interface Board. Connect the DC Motor cable to the DC Motor Drive Board.



Connect the 3Pin Cable to the OUT Port 1, 2, 3, 4 of CPU Board and Interface Board (DC CPU) 1, 2, 3, 4. Connect the 3Pin Cable to 1, 2, 3, 4 of Interface Board (DRIVER) and DC Motor Drive Board 1, 2, 3, 4.



19 Connect the 3Pin Cable to the OUT Port 5, 6 of CPU Board and 5, 6 of Interface Board (SERVO CPU). Connect the Servo Motor cable to the Interface Board (SERVO MOTOR) 5, 6. Connect the 3Pin Cable to IN Port 7 of CPU Board and Remote Control Receiver.





 $\frac{20}{10}$ Connect thetwo Main Frames with the Middle frame and then fix the Wheels and make the trailer.



21 Refer to above two pictures taken form different angle and build the frames careful in the position and lenght of the support.

Completed TrailerBot!





Try to Decorate!







Set the Starting Point of Servo Motor

- Main Function : Set the starting point and radius of rotation of the Servo Motor.
- Application : Set the zero point and then fit the Motor Guide to the Starting Point. Then, Set the Radius of Rotation with the Servo Motor Chip.

[Starting Point Set up Position]

[Radius Rotation]







Set the Starting Point of Servo Motor

- Main Function : Set the starting point and radius of rotation of the Servo Motor that connects the trailer.
- Application : Set the zero point and then fit the Motor Guide to the Starting Point.

Then, Set the Radius of Rotation with the Servo Motor Chip.

[Starting Point Set up Position]

[Radius Rotation]







Shall we make it move?

Make it move forward when pressing the button [1] of the Remote Control, move backward with pressing the button [2], turn left when pressing [1], [3] and turn right with [1], [4]. 2 Make it turn left while moving backwards when pressing the button [2], [3] of the Remote Control, turn right while moving backwards with pressing the button [2], [4]. Also make only front wheels to turn left when pressing [3] and turn right with [4].





•

•

•

•

•

- 3 Make the trailer connecting the device close when pressing button [1], [5] of the Wireless Remote Control and open with [2], [5].
- 4 Combine all programs to play the game.





창의공학교실4(영문).indd 97

Let's Play Game!



How to play

> Set a trailer in certain sized stadium. This game is to drive along the T course and connect the trailer to the robot in the parking lot.



2 Game Rule

- > The robot should arrive after connecting the trailer in time.
- If the robot deviates from the course, it will receive a cut in marks.









How to play

Set a trailer in certain sized stadium. This game is to connect the trailer to the robot in the platform and then put it down in the departing area.



Game Rule

> The robot that moves the trailer to the departing area most rapidly wins.

If the robot deviates from the course, it will receive a cut in marks.

3 Game Example





1. I am trying to park the Trailer Bot. How should I control the steering system (front wheels) to reverse into a parking space?





Front

Back

(2)











FutureBot is your original robot according to a given topic. You can perform robot skills based on what you have learned. Let's your own robot with refreshing and creative idea that can help many people!





• • Household Robot • •



{Guarding Robot Watchdog>

Have you ever seen robots in movies or novels? Like a serving robot or friend-like robot that can talk with us.... Household robot is a robot that helps, protects and gives enjoyments to humans in real life.

And it is a mechanical device for performing a task which might otherwise be done by a human and has many different kinds. As we have learned before such as a cleaning robot, parrot robot and dog robot are all included in criteria of household robot. Let's learn about other various kinds of household robots and make a robot that can help the family in our home.



Wakamaru, that can distinguish ten faces and memorize 10,000 words. Wakamaru recognizes human faces and come closer to talk and it can work not only as a secretary but also housekeeper, security and even can serve the elderly.



Robot Paro looks like a cute doll but it is "Mental Commitment Robots" which has numerous sensors and processors inside artificial fur.

"Mental Commitment Robots" are developed to interact with human beings and to make them feel emotional attachment to the robots. Rather than using objective measures, these robots trigger more subjective evaluations, evoking psychological

impressions such as "cuteness" and comfort.



IfBot, that loves to talk with a funny face. It can define emotions of person who it is talk to in 4 states as anger, happiness, pity and usual. IfBot has conversation ability of 5 year old child that can be the companion to lonely elders.



Nubo, that can stand up by itself even if it falls with its 15 joints.

This robot is a two-legged robot which can dance by the Remote Control or mobile phone or make it detect sound of human. Also, a camera is attached to its both eyes so it can function as security for an empty house and it launched since 2005.



High Grade Course ||

This course helps students to deepen their understanding of robotic assembly and its program.Students also can learn how to use various chips and complex arithmetic operations such as variable chips, function chip etc. Let's solve applied problems through interesting missions.

MissionBot

BarcodeBot

WritingBot



By using an automatic infrared sensor, this robot can follow the black line and move things through the connected gripper and the servo motor.



By using an automatic infrared sensor, this robot can read the barcode and display on the dot matrix board. Students can learn the principle of the barcode scanning.



This robot can write or draw through the fixed pen.



KumdoBot

FutureBot



By using the golf club which is connected to the original servo motor, this robot can swing step-by-step and can roll the ball into the hole.



KumdoBot can swing the sword. Students can learn repeated WHILE chip.

Original Robot

In this course, students will design their own robot according to the given theme and show it to each other. They can improve their creativity and self-confidence through this process.