



Simple Simon GEN II Robot Soccer NXT-G Training Curriculum (for pulsed ball)

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Get Started in GEN II Soccer

You will find that GEN II Soccer is no harder than any other robot competitions. **It is actually easier for beginners to enter and compete successfully in Soccer!** They can then raise their expectations and skill levels as they compete. The GEN II field is not a compulsory item for beginners to purchase or master, it just adds a further dimension of control for the robots and programmers when they get to that stage. The GEN II colours are rarely used by teams until they have a year or two of experience.

It is a common misconception that a lot of technical equipment is needed to compete in in GEN II. Teams starting out have the most fun if they build and program a Simple Simon Soccer Player or two and just compete!

Equipment needed for a Simple Simon Soccer Player Team:

2X 9797 LEGO Mindstorms Kits

1X Hitechnic Infrared Seeker V2 or Tris10 Findball IR Sensor

1X Hitechnic Pulsed Soccer Ball

Have a look at <http://www.teaching.com.au/catalogue?catalogue=MTA&category=MTA-ROBOCUP-ROBOTICS-COMPETITIONS> . There is a great deal where you can get started in Simple Simon for little more than the price of two NXT Kits! There are also great sensor deals for beginners if you look at the MTA catalogue.

The Simple Simon Approach

Build a Domabot soccer robot or two from

<http://www.damienkee.com/home/2011/8/20/domabot-classroom-robot-design.html> .

Program a Simple Soccer Robot(or two) from the notes below. A Simple Soccer Player that can find the ball and kick it will be competitive in most GEN II League Tournaments. **It does not necessarily have to use a compass.**

Build a goalie using an NXT light sensor. These sensors will pick up a pulsed ball from 40 cm if they are calibrated correctly. Follow the goalie instructions below to just move forwards and back when it sees the ball. That way it will remain in front of the goals. Simple mathematics can tell you that a 22cm goalie in front of 45 cm goals will cut the chances of the opposition scoring a goal by close to 50%.

To make a very good goalie, just add and program more light sensors at 45 degree angles in front of the robot. This way the robot will not have to scan for the ball just detect when it is nearby. If your goalie is good enough, it will prevent your striker from kicking own goals. You do not need a GEN II field to practise on at this stage. Just mark out the field dimensions and goals on a mat, or the carpet of the classroom floor and develop your soccer team on this.

Simple Simon GEN II Soccer

Simple Simon is intended as an introductory level game of GEN II Soccer. It will give novice students a feel for the GEN II games and tournament conditions. State Committees will be running Simple Simon competitions as unofficial leagues. Simple Simon will not be offered at a national level.

Aims

To make GEN II Robot Soccer accessible to all students.

Limit the need to purchase specialised equipment in order to compete in GEN II

Maximise participation of students.

Minimise the infrastructure needed for GEN II Soccer games.

Rule Modifications

The following modifications can be made to the RCJA GEN II Rules.

1. Teams will have a maximum of two Hitechnic IRV2 sensors.
2. All other sensors must come from Mindstorms RCX or NXT kits.
3. Only Mindstorms NXT-G software can be used.
4. Games will be 5 minute halves with no half time break and 4 minutes break between games.
5. All programming should be done prior to the tournament.
6. If the ball hits the side wall, play will continue.
7. If "lack of progress" is called, the ball will be replaced to the nearest neutral spot.
8. "Damaged" robots can only be removed with the referee's permission.
9. If a robot is in a situation where it is about to kick an own goal, it should not be removed.
10. A damaged robot remains off the field for 30 seconds or until a goal is scored.
11. **The teams completing in a game must referee the next game.**
12. Any team that is not ready to start a game will lose a goal per minute for being late. The game clock will start at the scheduled time and the game will run according to the tournament schedule. Forfeits result in a 5-0 score line
13. Teams may not be given setup areas if accommodation is limited. They will use the area around the allocated field to program robots (if required)
14. Only one laptop and two robots will be brought to the field area. No spares or tools are to be used. One chair and one powerpoint will be made available to teams.
15. Robots and laptops are to remain in the field area once the tournament has begun.

Follow the training notes below and you will be playing GEN II in less than 2 hours.



Any questions queries or comments, contact: b.thomas@ccg.vic.edu.au
<mailto:thomas.brian.d@edumail.vic.gov.au>

Finding the Ball: The Mexican Wave

Overview

The first part of playing any ball game is to find and chase the ball. This unit allows your robot to chase the ball when it is in front of the robot.

If you get all of the robots in the class, you can create a Mexican wave of robots.

It is assumed that you have a minimal knowledge Mindstorms NXT-G programming.

It is recommended that you go through this exercise as it ensures that all sensors and motors are plugged in their correct position and working.

Robot Setup

Build a Domabot.

All that you need is motors plugged into outputs A and C and the IR V2 Sensor plugged into Sensor Port 1.

You may also need to download the IR V2 tile. Just go to

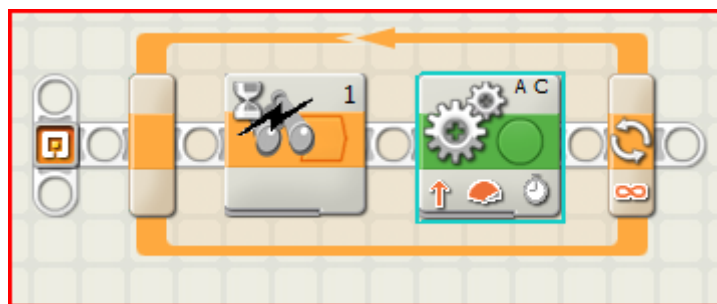
<http://www.hitechnic.com/downloadnew.php?category=13> and follow the instructions.

The more recent tile has AC DC written on it. Both the tile shown on these notes and the newer tile have almost identical properties.

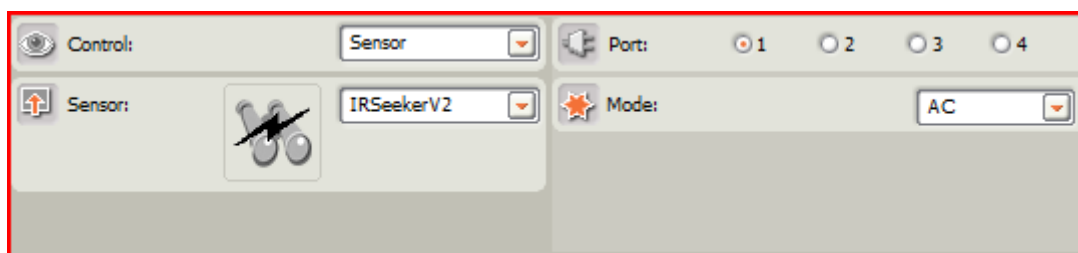
Programming

Create the following simple program that will allow you to check that everything is working OK.

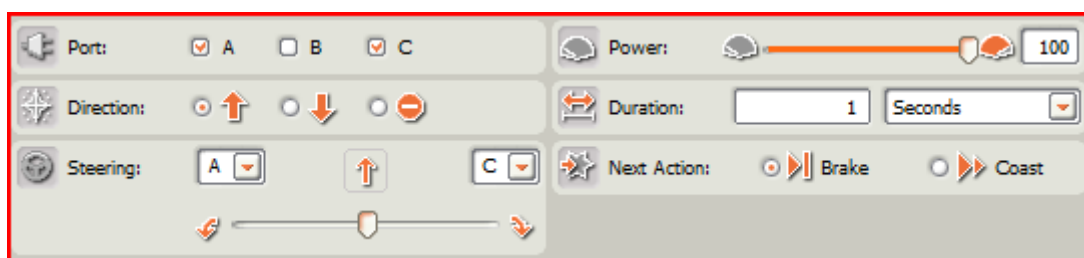
In this program the IR Seeker is just waiting for a reading from the ball and then the robot will be told to move forward



The Wait(egg timer) icon should be set to IR Seeker V2 Sensor plugged into Port1. The Mode should be set to AC(pulsed)



The motor icon is set to Inputs A and C, Power level 100% and Duration 1 second.



Save this program on your computer as MW. Download this to your robot. Push the orange button on the NXT 3 times until the MW Run file appears.

Place all of the class robots with their backs to the classroom wall

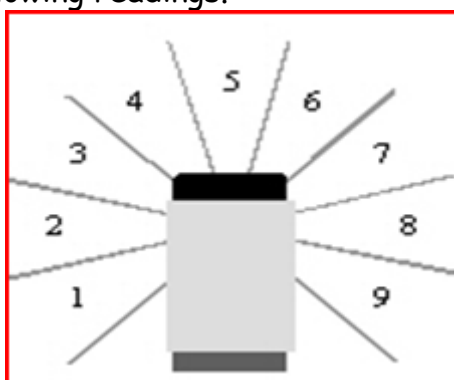
- Push **The Orange Button** on the robots.
- The program should be running but nothing should happen.
- The teacher will turn the ball on and roll the ball across the classroom.
- Did you get a Mexican Wave?
- Try rolling the ball further away from the robots. Which robot has the best range?

Notes

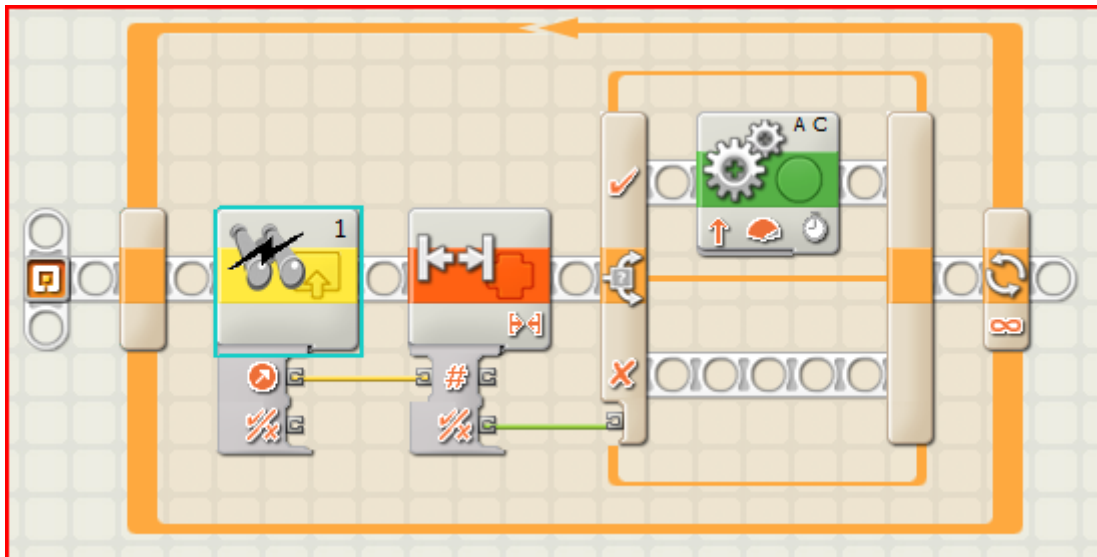
The pulsed ball has an incredible range and also can be sensed by reflection off walls. Experiment with the location of your IR V2 sensor and maybe shield it with black tape to reduce the influence of reflections and still maintain the excellent range.

Extension

The IR V2 sensor gives the following readings.

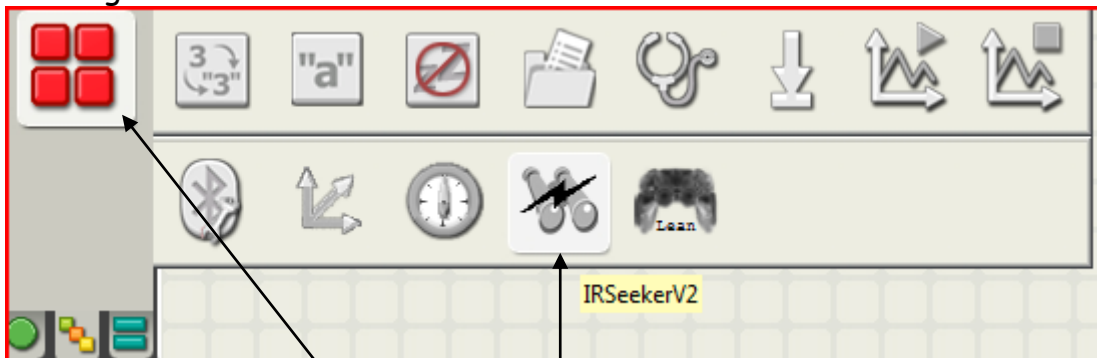


Introduce a Switch into your program to perform the same task, but with a little more control.



Start by inserting a loop. It will already be set to Unlimited.

To get the other tiles, you will need to start with a Complete Palette and then go to the Advanced Settings to find the IR V2 Sensor Tile



Complete Palette

Advanced Settings

IR V2 Tile

Then go to Data and Select the Range Tile

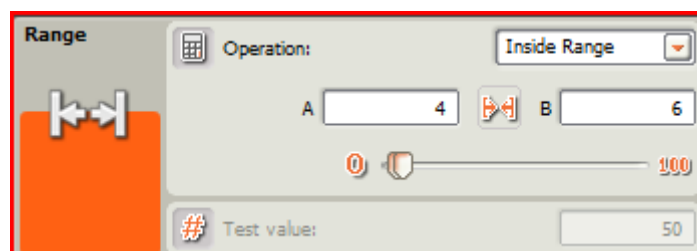


Data

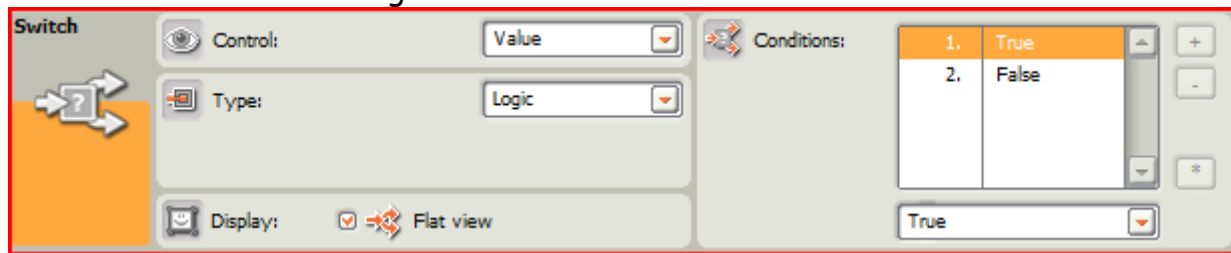
Range

Select the same settings for the IR V2 as above

Select a range of 4-6 for the Range tile.



Now insert the Switch Tile which can be found next to the Loop Tile in the Flow Palette
Set the Switch to Value and Logic



Use the same Motor Controls as before.

Wire up the Tiles as shown. The drop down controls can be obtained by hovering over the bottom left hand corner of a tile and then clicking when the drop down tool appears.

Repeat your Mexican Wave. The robots should now only start moving when the ball is directly in front of them (Range 4-6).

Simple Simon Soccer Player

Overview

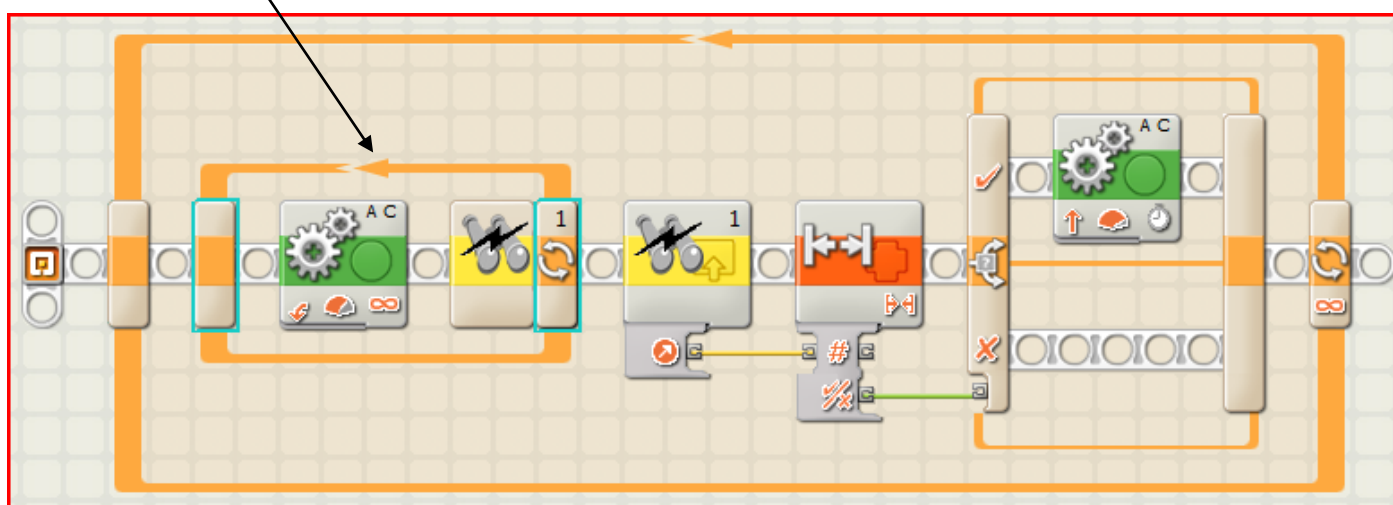
You will now combine ball detection and the switch program from the previous unit to make an efficient soccer playing program.

Robot Setup

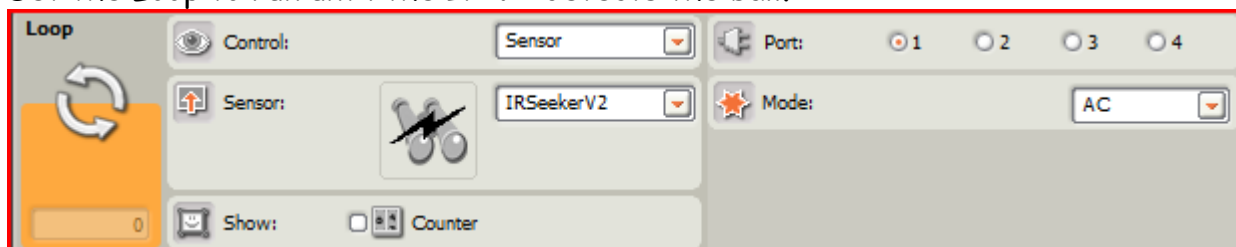
All that you need is motors plugged into outputs A and C and the IR V2 Sensor plugged into Sensor Port 1.

Method

Insert a Loop and Motor Control into the program from the previous unit.



Set the Loop to run until the IR V2 detects the ball.



Set the Motors A and C so that the robot turns to the right at 75% power.

Adjustments for Improvement

A fast robot will beat other robots to the ball. However if a robot is scanning too quickly it may scan past the ball and miss it.

- Increase the speed of the turn until the robot scans past the ball.
- Go back to your previous setting and use this as your optimum scan speed.

This is the Simple Simon Soccer Player. It will allow you to have fun and play a game of GEN II Soccer. Save it and keep it in case your more complex programs fail.

Ball Chase

Overview

You are now ready to use the full facilities offered by the IR V2 to keep the ball under control once you have it, and dribble it down the field.

There are two possible programming options and they both work.

Robot Setup

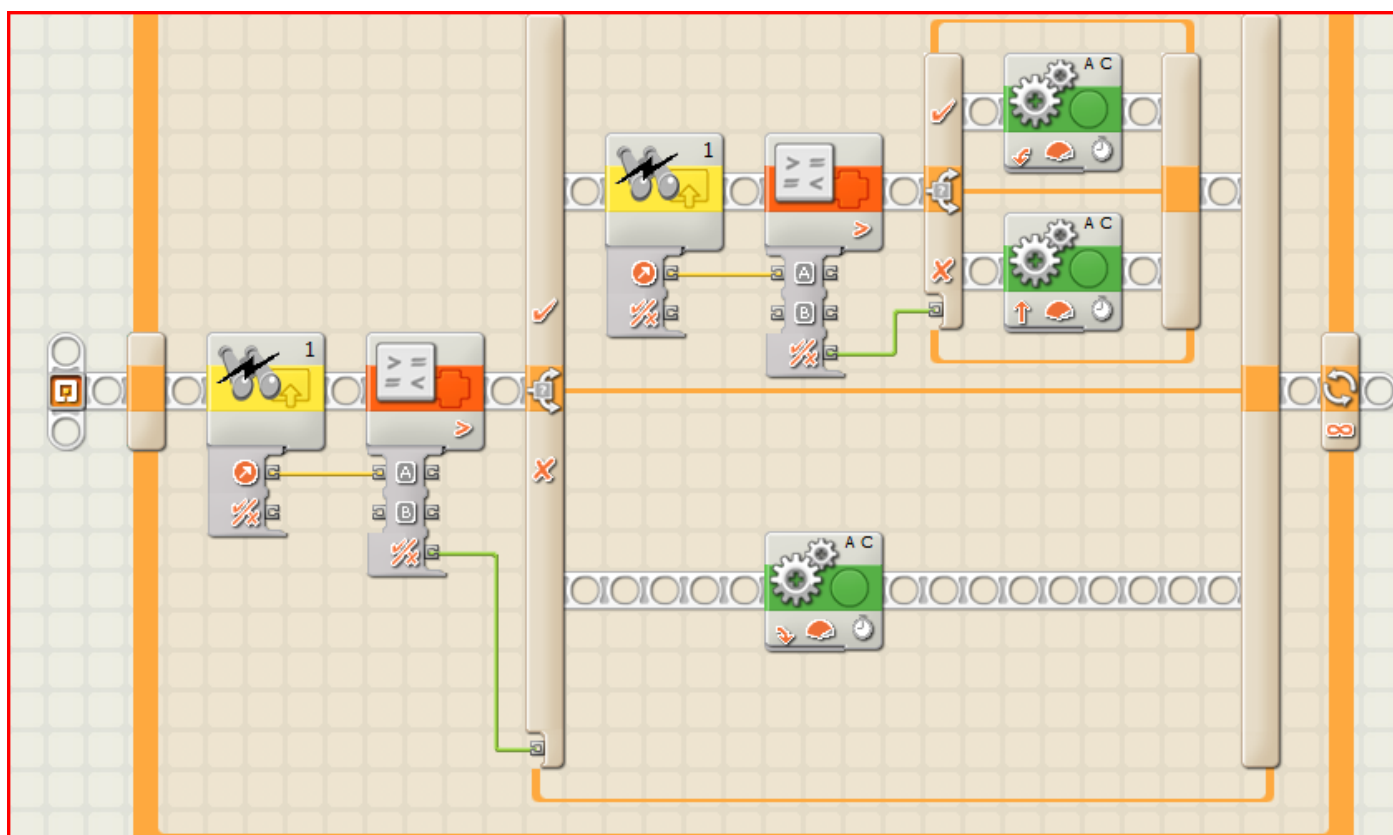
You will now need to modify your robot to retain the ball. Read the rules regarding robot size and ball capturing zones and build a "bull bar" that will help to control the ball.

You still only need to have motors plugged into outputs A and C and the IR V2 Sensor plugged into Sensor Port 1.

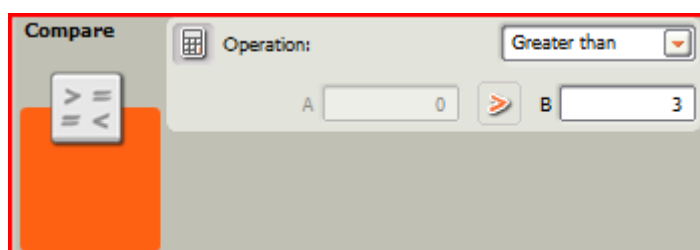
Method

Option 1: Switch Method

Insert two Switches together inside of an Unlimited Loop



- Insert the IR V2 Sensor Tile and set as in the previous unit.
- This time select the Compare Tile from the Data Palette
- For the First Icon select Greater than 3



- For the second Icon select Greater than 6
- Wire up the data ports as shown
- Set the bottom Motor Tile, so that the robot turns left for .2 Seconds and Coast
- Set the top Motor Tile, so that the robot turns right for .2 Seconds and Coast
- Set the middle Motor Tile to forward for 1 Second and Brake.

The robot will now respond to IR V2 readings in the following way.

- 0-3 Turn Left
- 4-6 Straight Ahead
- 7-9 Turn Right

The robot should now scan for the ball if it cannot see it. As soon as it sees the ball it will chase it down the field.

Option 2: Data Method

This method may take a little more to get your head around, but it works really well.

It involves the manipulation of data coming from the IR V2 to control the steering of the motors.

The steering control operates on readings of +100 to turn full right and -100 to turn full left. Data input of 0 will have the robot running straight ahead.

To convert the IR V2 data to this, you must subtract 5 from the reading.

This will now give a result of:

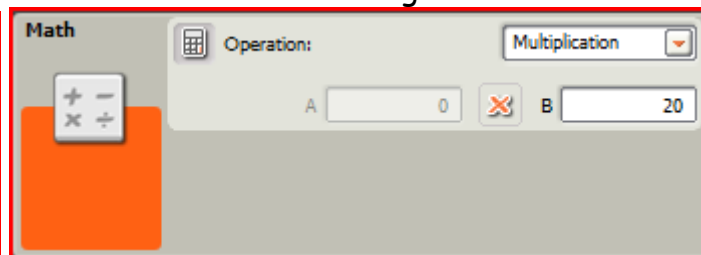
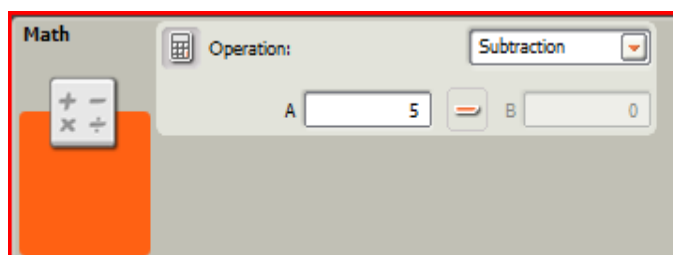
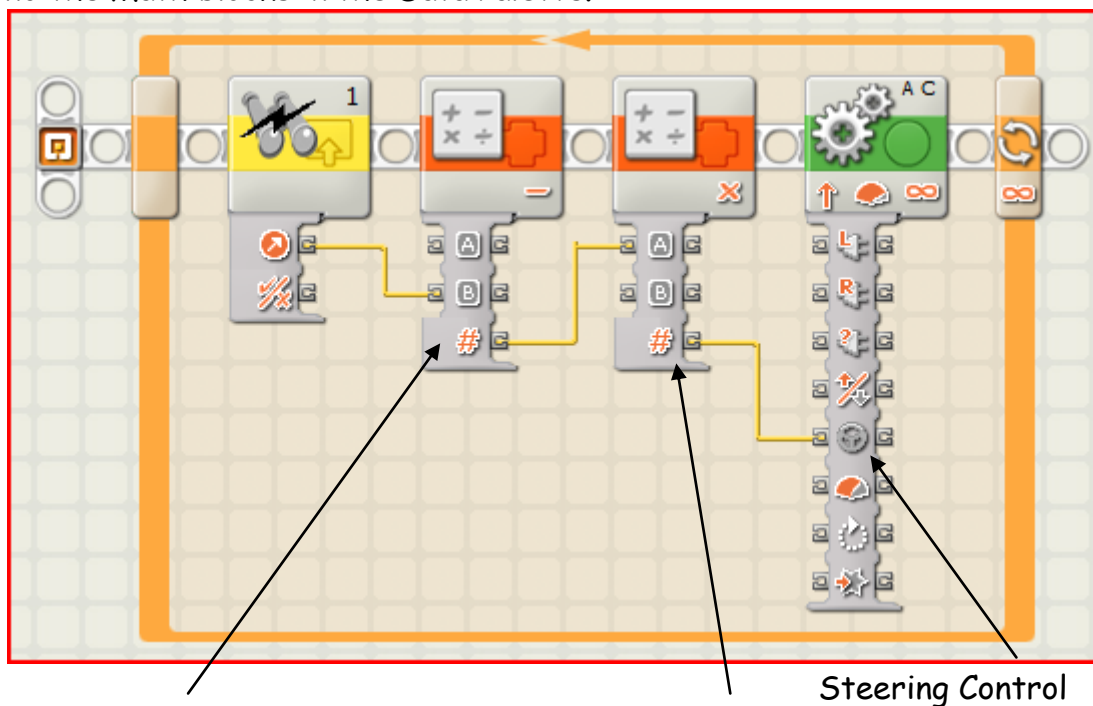
0 if the ball is straight ahead.

0 to -5 if it is to the left

0 to -5 if it is to the right.

To convert these figures to the 0-100 range required for the steering, you must multiply them by 20.

You will find the Math blocks in the Data Palette.



Wire it up to the correct data points and run it

How good is that!!!

Smooth Simon Soccer Player

Overview

Have you noticed that your Soccer robot doesn't dribble the ball smoothly and tends to weave backwards and forwards. If you try to build a program for every one of the IRV2 sensor directions using the greater than "filter" your program will take up most of your programming space. The following "Tab" method allows you to fit all of the IRV2 directions in one switch.

Robot Setup

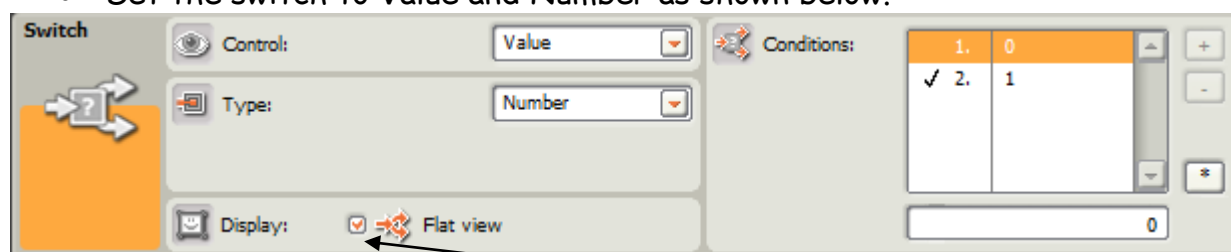
You will now need to modify your robot to retain the ball. Read the rules regarding robot size and ball capturing zones and build a "bull bar" that will help to control the ball. You still to have motors plugged into outputs A and C and the IR V2 Sensor plugged into Sensor Port 1.

Method

Option 1: Tab Method

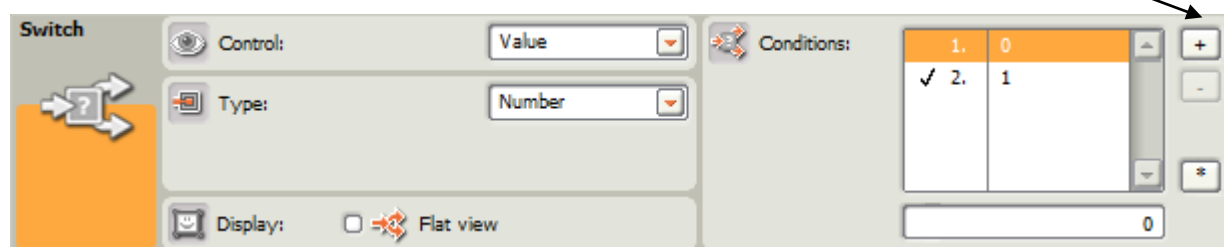
First you need to set up your Tab box. You need to allocate a tab for each of the 0-9 IRV2 readings.

- Start a new program and insert a loop.
- Add an IRV2 tile inside the loop
- Add a switch
- Set the switch to Value and Number as shown below.



Now deselect the flat view option by clicking on the tick.

You can now add more tabs by clicking on the "Add a new condition" button



You will need to add a total of 10 conditions. The left hand column is the condition number and the right hand column shows the IRV2 reading number

- Wire the sensor to the switch.

Click on the first tab and this corresponds to an Irv2 reading of 0. This indicates that your robot can't see the ball. This rarely happens in a game and usually only occurs when a robot is facing a wall. It is always a good idea to have a reverse command in a program for exactly this situation.

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- Now add a "Move" tile to the rest of the remaining conditions
- Start off with each at 75% power and unlimited duration.
- Now you can adjust the steering on each depending on the direction that the ball is in.

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Reading 1:
Full Turn Left



Reading 2:
1 click in from full turn



Reading 3:
3 Clicks in from Full Turn



Reading 4:
2 clicks left from
Straight ahead



Reading 5:
Straight ahead
Full Power



Reading 6:
2 clicks right from
Straight ahead



Reading 7:
3 Clicks from Full Turn



Reading 8:
1 click from Full Turn



Reading 9:
Full Turn right



Reading 9 is a bit more difficult to select as its tab is not shown on the switch

- Select the switch
- Scroll down your tabs menu
- Select the tab for Reading 9
- Don't forget to wire the sensor to the switch.

You will need to test and adjust these readings to best suit your robot.

Simple Simon Goalie

Overview

It is always an advantage to have a robot that will remain in front of the goals. Simple mathematics can tell you that a 22cm goalie in front of 45 cm goals will cut the chances of the opposition scoring a goal by close to 50%. Of course the rules state that this robot must react to the ball in a forward direction.

The IRV2 will detect the ball for the full length of the field. This is not ideal as the goalie should only react to the ball when it is within "kicking" range. It is actually an advantage to build a goalie using an NXT light sensor. These sensors will pick up a pulsed ball from 40 cm if they are calibrated correctly. You just need to program the goalie to just move forwards and back (and kick) when it sees the ball.

Many thanks to the Grade 4 students of Scotch Oakburn College in Launceston for testing and refining this program.

Robot Setup

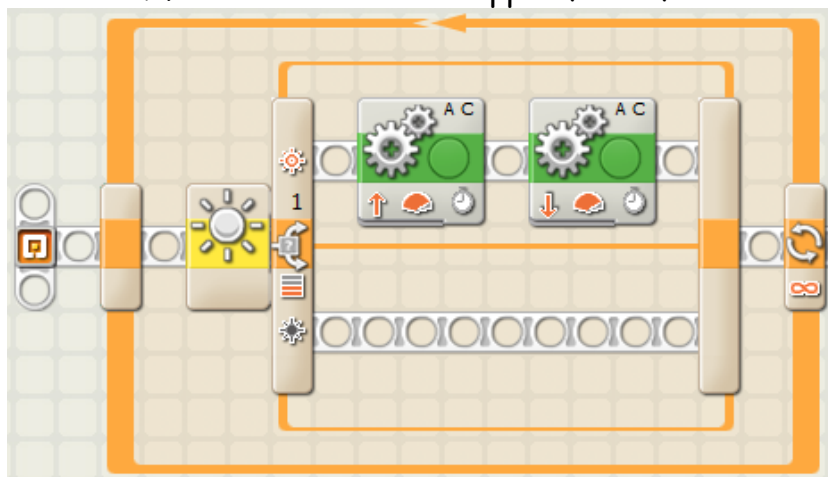
You will need to have motors plugged into outputs A and C and an NXT light sensor plugged into Sensor Port 1.

Calibration

- Do a check of room light levels by using the **View** facility on the NXT.
- Place the robot on the Soccer Field.
- On the NXT, Select View from the first scroll across menu, then Ambient Light followed by Port 1.
- Rotate the robot 360 degrees and check for the maximum light reading of the room.
- If you are using blue tooth, or have the USB cable connected to your computer, you can check the reading by clicking on the light sensor icon in the program and using the view pane on the bottom left hand corner of your screen.
- Program the following program.

Programming

- Start with the loop function
- Then place the switch inside the loop
- Following this, place two Motor controls in the upper fork of the switch



- Set the Switch to Light Sensor and to Port 1.
- Set the compare value to 2% above the calibration reading from above.
- Deselect the Generate Light box.



- Set Motors to A and C and get them to run forwards, then backwards at 100% for .5 seconds each
- Set the Loop Control to Forever
- Try doing the Mexican Wave with the other robots in the class.

Adjustments for Improvement

Adjust the light reading to refine your ball detection.

Turning the Light Switch reading down will make the robot more sensitive and allow it to detect the ball over a larger distance, but this increases the chance of the robot detecting other Infra Red sources.

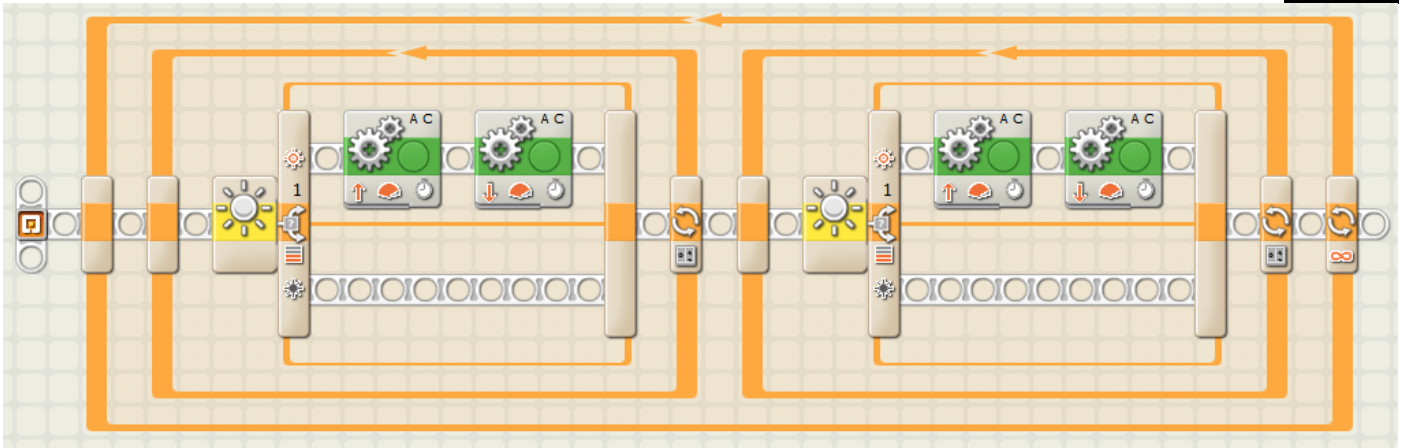
- If the robot is detecting the ball by less than 20cm, turn the Light Switch down by 2%.
- If the robot is chasing light sources other than the ball, then turn the light switch up by 2%.

Scanning For the Ball

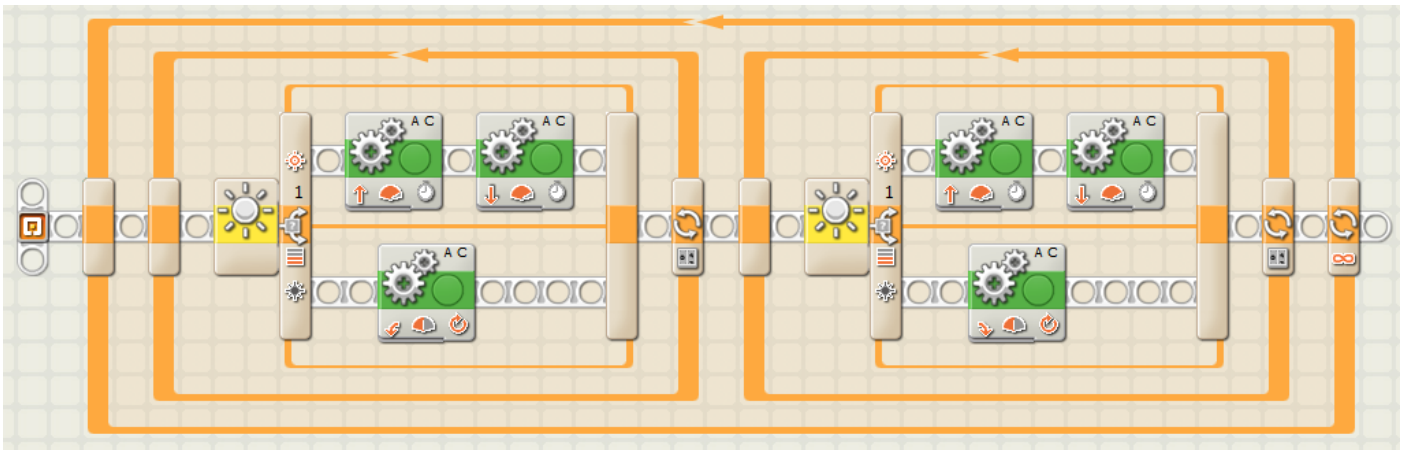
It is desirable that the robot scans only the 180 degrees forward of the goal it is protecting. Consequently if it goes out to kick the ball, it will need to continue its scan from where it left off. This is achieved by scanning in small increments and by counting the number of times it does this. That way after the robot responds to the ball, it can return to its position in front of the goal and continue scanning from that count.

Programming

- Copy and paste the Loop from above with the light sensor switch inside of it.
- Add another loop at the start of the program.
- Drag both light sensor loops to inside the first loop and place them side by side.
- Set both light sensor loops to count for 20 and the outside loop to loop forever.



- Add a Move tile to the lower branches of the two switches.
- Set one motor to turn full left and the other to turn full right.



- Set their power at 50%.
- Set them to turn for 0.05 seconds.
- Change the setting from brake to coast.



Adjustments for Improvement

Change the count of both light sensor loops so that the robot is scanning exactly the same amount and close to 180 degrees.

If a robot is scanning too quickly it will reduce its ball detection ability.

- Increase the speed of the turn until the robot's ball detection range is slightly reduced.
- Go back to your previous setting and use this as your optimum scan speed.

