



# Standard League WRO Football Simple Simon EV3 Training Curriculum

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## Simple Simon RCJA Soccer

Simple Simon is intended as an introductory level game of Standard League Soccer and WRO Football. It will give novice students a feel for the RCJA Soccer games and tournament conditions. State Committees will be running Simple Simon competitions if enough interest is shown. Simple Simon will not be offered at a national level.

You will find that RCJA 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.

It is a common misconception that a lot of technical equipment is needed to compete in RCJA Soccer. 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 LEGO Mindstorms EV3 45544Kits  
One or two One or two Hitechnic IRV2 Sensors  
1X RCJV 05 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 Tommabot from <http://www.robocupjunior.org.au/tutorials>

Add an infra red sensor and a bull bar and you are ready to go. Do not add the upper motors until you aim to use a kicker.

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 RCJ or WRO Soccer Tournaments. **It does not necessarily have to use a compass.**

If you have only one infra red sensor, you can build a goalie using an EV3 Colour sensor. This sensor will pick up a pulsed ball from 40 cm. Follow the goalie training notes below and you will have a robot that will prevent yours and the opposition robots from scoring.

Any questions queries or comments, contact: [b.thomas@ccg.vic.edu.au](mailto:b.thomas@ccg.vic.edu.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 EV3 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 Tommabot add a bull bar and a Hitechnic IRV2 Sensor.

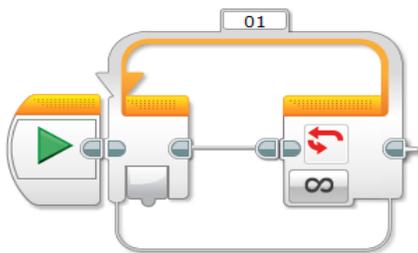
All that you need is motors plugged into outputs B and C and the IR Sensor plugged into Sensor Port 1.

You need to download the IRV2 Sensor block from the <https://www.hitechnic.com/downloads> site and follow the download instructions. It is quite easy!

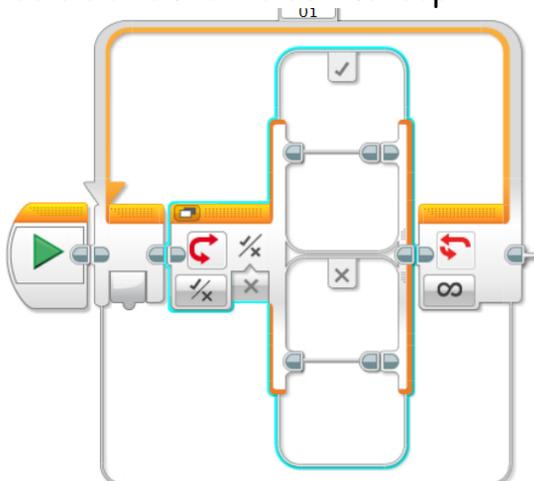
### Programming

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

Create the following simple program that will allow you to see that everything is working OK. Start with a loop. Leave it at the unlimited(loop for ever setting).



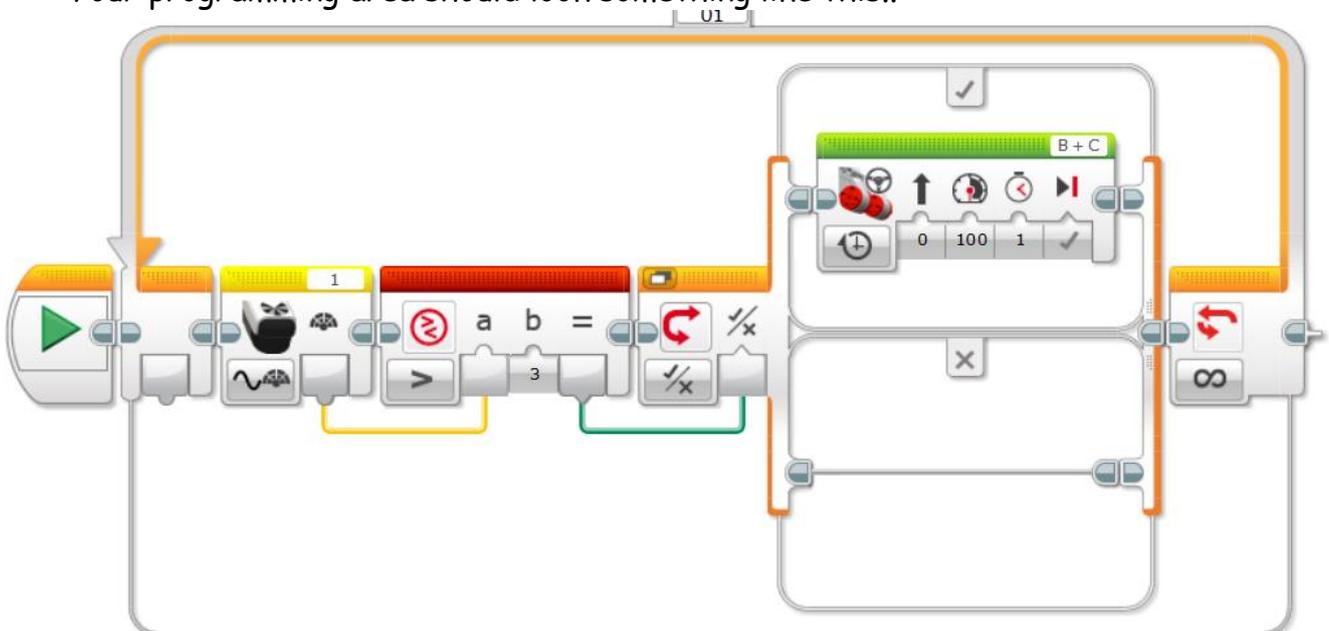
Add a switch to inside the loop



## Programming(cont)

- Now change the switch from Touch Sensor to Logic.
- Add a Compare block
- Select 3 as you threshold Value
- Add a Hitechnic IR Seeker V2 Block
- Select Alternating-Direction
- Wire the blocks up as shown above
- Insert a Move Steering icon into the "True" branch of the switch.
- Select On for Seconds
- 100% Power Forward
- Set time for 1 Second
- Brake at End

Your programming area should look something like this..



The robot will do nothing until the IRV2 gets a reading greater than 3. Then it will take the top path (True) of the switch and move forwards

Save this program on your computer as MW.

Select download and Run  in the right bottom corner of the programming page. This gets you to the correct section of the EV3. I always do this first time I run a program, but always hold onto your robot when you do this, it may get away from you.

The robot should do nothing at this stage

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

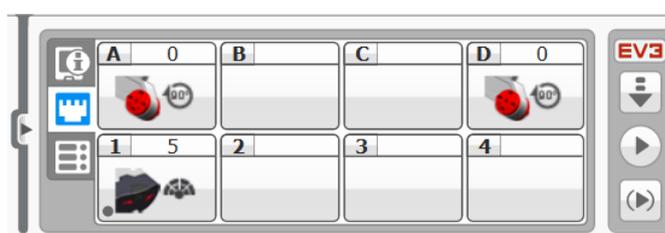
- The teacher will turn the ball on and roll the ball from left to right in front of the robots.
- Did you get a Mexican Wave?
- Try rolling the ball further away from the robots. Which robot has the best range?

## 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.

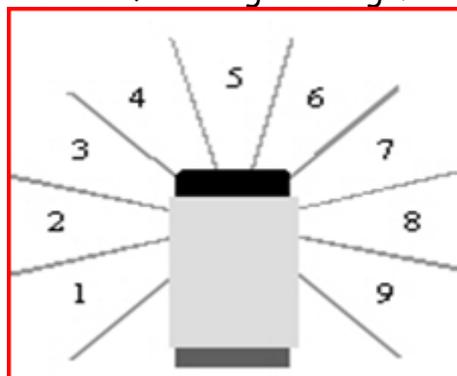
You can now investigate the values of the readings of the Hitechnic IRV2 with the ball in different directions in front of the robot.

- Select Port View from the Brick Information palette at the bottom right of your screen.
- Click on Port 1 and select Hitechnic Infra Red Sensor if it is available. This happens intermittently. If it is not there, select the LEGO Infra Red Sensor and then Beacon Heading.



- Move the ball around the front of the robot and the reading should change.

You will find the IRV2 sensor gives the following readings.



You will be amazed at the sensors ability to "see through" the LEGO.

This should be repeated every time you add other attachments such as dribblers and kickers.

## Simple Simon Soccer Player

### Overview

You will now add another switch to the program from the previous unit. With this, you can now scan for the ball and chase it, no matter where it is on the field.

### Robot Setup

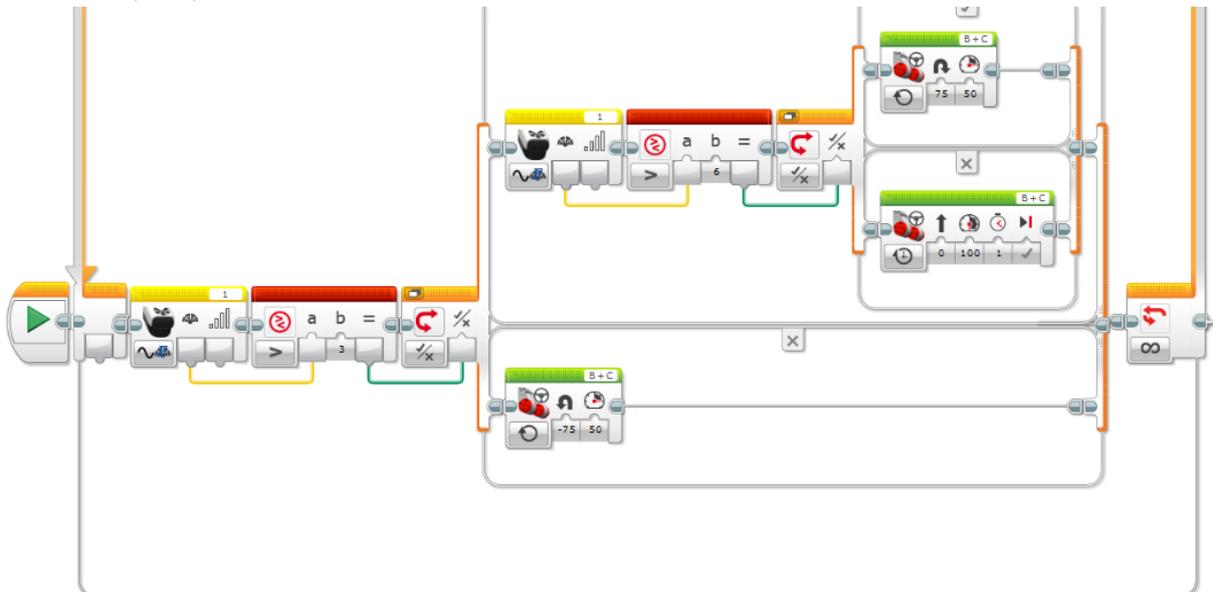
All that you need is motors plugged into outputs B and C and the IRV2 plugged into Sensor Port 1.

### Programming

Place another IRV2, compare and logic switch in the "True" branch of the switch in the Mexican Wave program

- Set the first switch to greater than 3
- Set the second switch to greater than 6

This means that for the lower branch the, sensor readings will be 0,1,2, or 3 meaning that the ball is to the left of the robot.



The middle branch is for sensor reading 4,5 and 6 meaning the ball is straight ahead. The top branch is for readings 7,8 and 9, meaning the ball is to the right of the robot.

- Place a Move Steering in the middle branch.
- Select "On" and 50 % power.
- Add a Move Steering icon to the top and bottom branches.
- Select "On" and 50 % power.
- Adjust the steering slider to turn left for the bottom icon and turn right for the top branch.

If the robot attacks the ball when it is in front and turns away from the ball when it is to the side, it is simply turning in the wrong direction. This can be fixed by changing the programming or even simpler by swapping the motor leads from B to C and C to B on your EV3

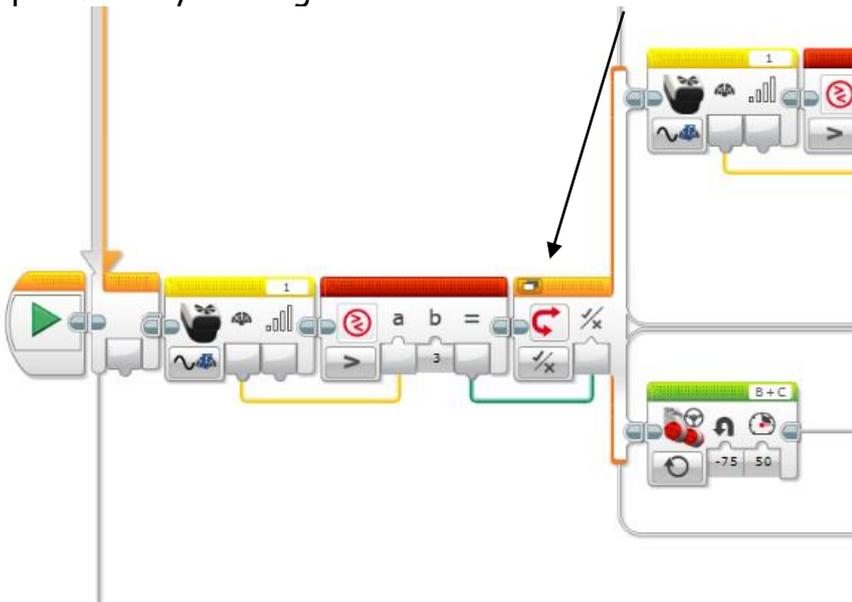
This is the Simple Simon Soccer Player. It will allow you to have fun and play a game of RCJA Soccer. Save it and keep it in case your more complex programs fail.

### 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 when it is straight ahead.

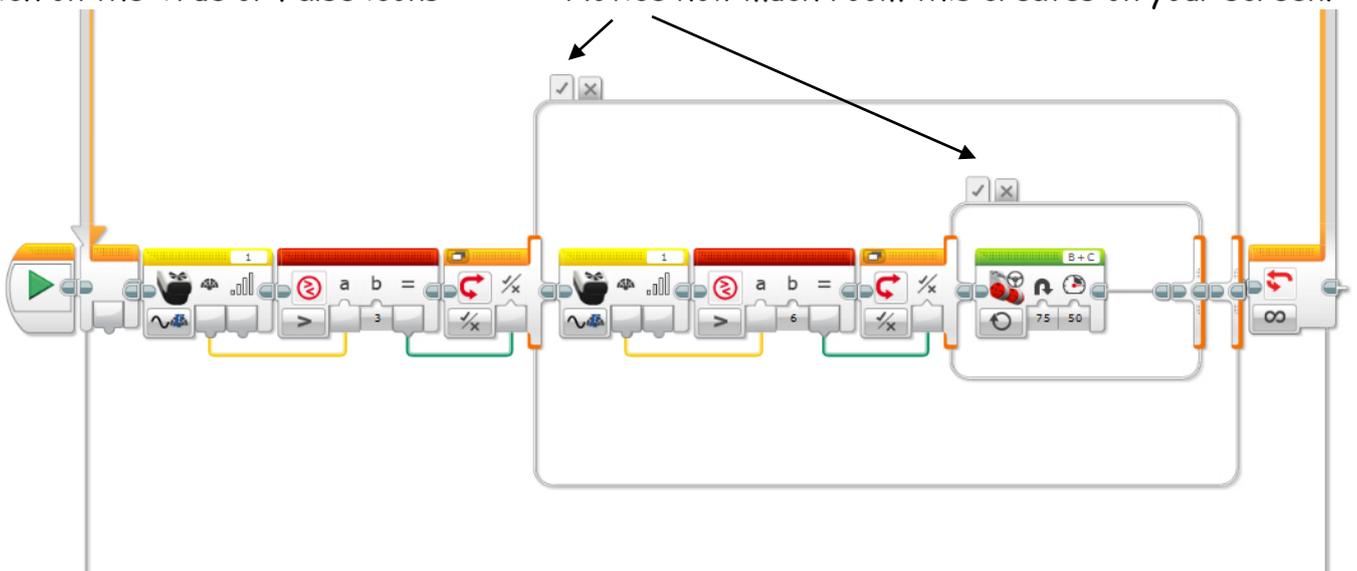
- Increase the speed of the turn until the robot scans past the ball.
- Go back to your previous setting and use this as your optimum scan speed.

Experiment by clicking the "Switch to Tabbed View" icon



You will see that only one of the branches will be displayed. To view the other branch just click on the True or False icons

Notice how much room this creates on your screen?



## Ball Chase

### Overview

You are now ready to use the full facilities offered by the EV3 programming and the IRV2 sensor to keep the ball under control once you have it, and dribble it down the field.

### Robot Setup

You will now need to modify your robot to retain the ball. Read the rules on [www.robocupjunior.org](http://www.robocupjunior.org) regarding robot size and ball capturing zones and build a "bull bar" that will help to control the ball.

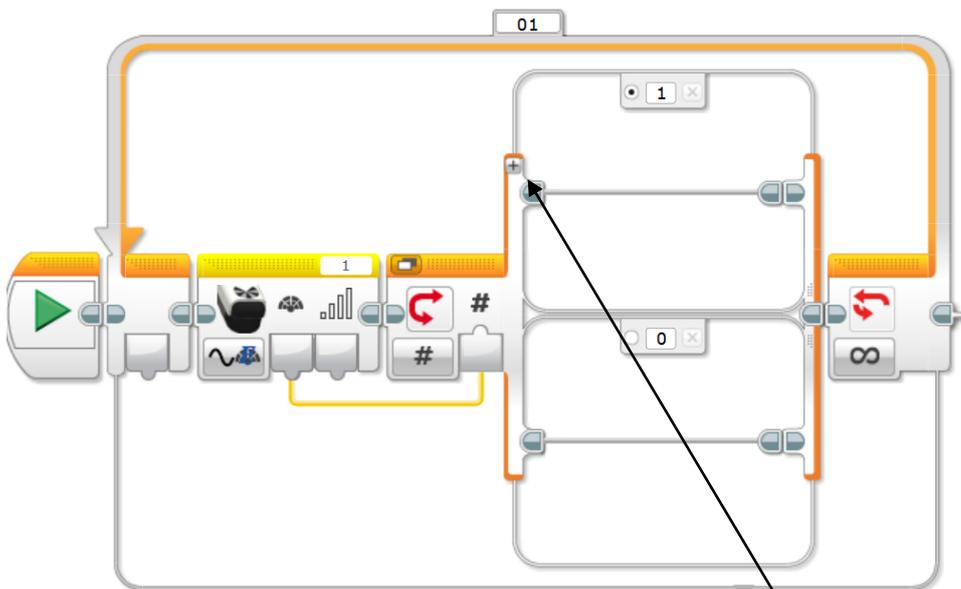
You still only need to have motors plugged into outputs B and C and the IRV2 Sensor plugged into Sensor Port 1.

### Method

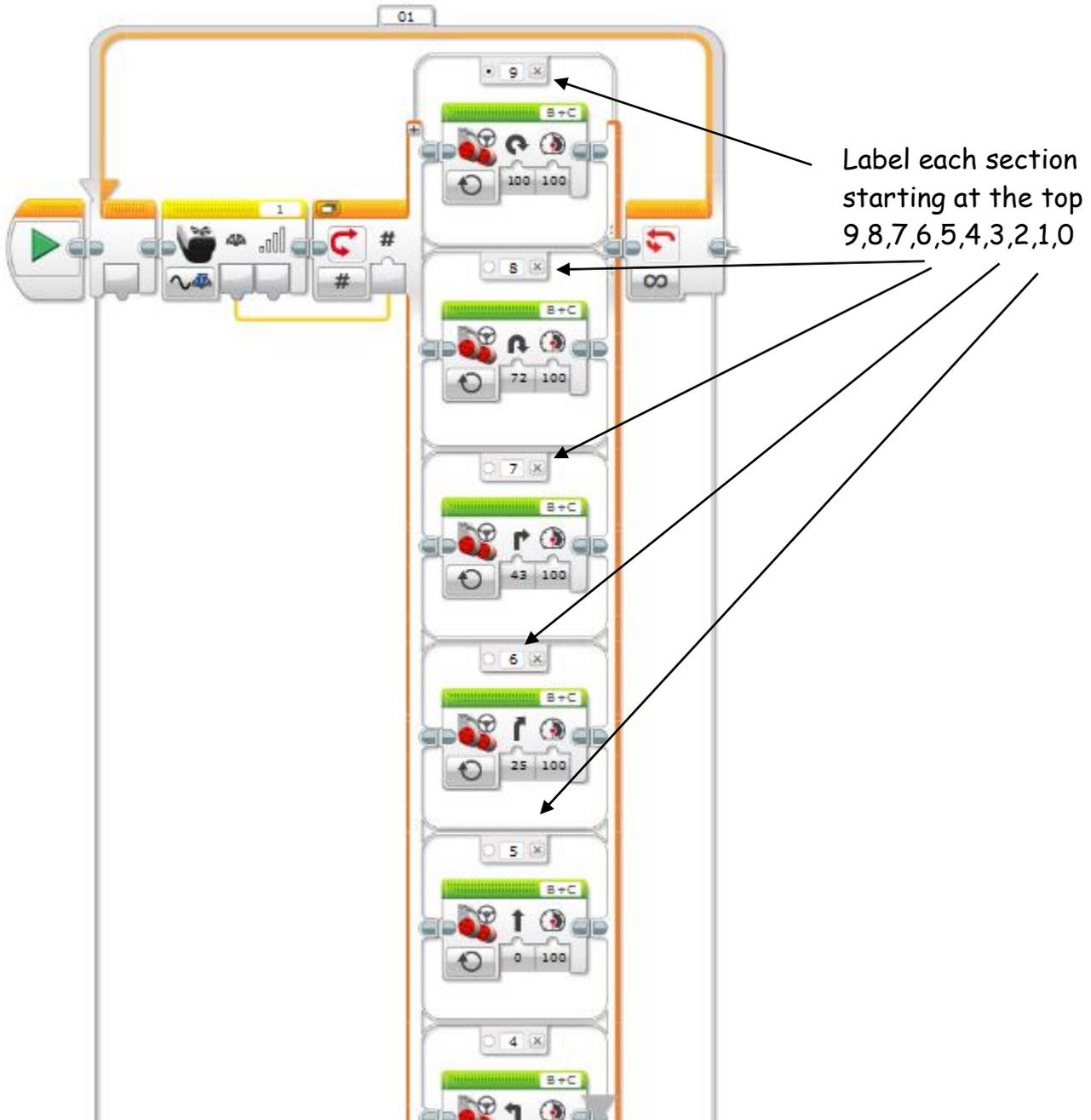
The Simple Simon is not totally smooth. This program utilizes the 10 IR sensor readings allows you to adjust how sharply the robot is turning and gives your robot a command to go directly at the ball.

### Programming

- Start with a new program
- Start with a loop. Leave it at the unlimited(loop for ever setting).
- Place the IRV2 block from the yellow palette inside the loop
- Add a switch and this time select Numeric from the drop down menu
- Wire the IRV2 block to the switch by left clicking and dragging the cm jigsaw block to the # slot.



Now we can use a new feature of the EV3 software, Click on the + symbol on the switch. Repeat this 8 times.



Now, insert the steering motor icon into each of the steps.

Adjust each of these according to how the robot is responding. All robots will work differently to each other, so there are no right or wrong commands

## Reverse Command

### Overview

When competing, it is a huge disadvantage to have your robot getting stuck on walls, goals and other robots. You have to either wait for a "Lack of Progress" or remove your robot as "Damaged" to free your robot. This addition to your program will get you robot to reverse and turn if it hasn't "seen" the ball for three seconds.

It is always better to break your program down into individual tasks, **test them** and then add them to an already saved working program. We will do this here. Try to follow this procedure for any future changes that you make.

### Robot Setup

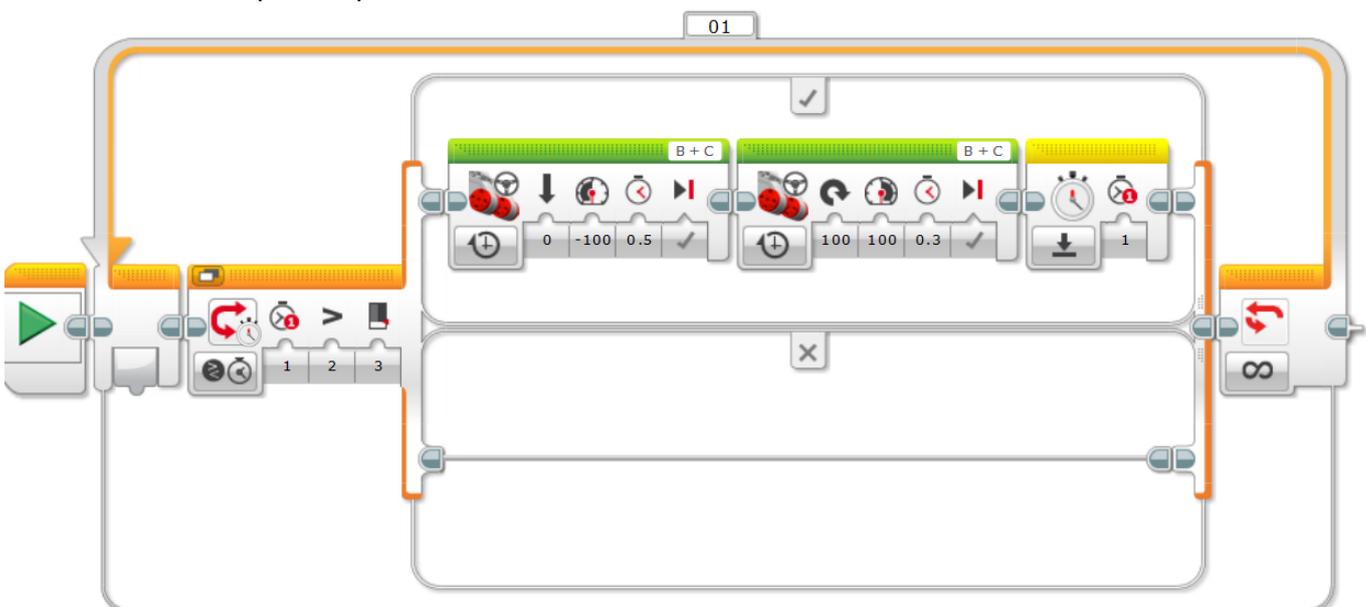
Robot setup is the same as for the Simple Simon Robot

### Method

We will start with a new program and get the robot to reverse and turn after three seconds.

### Programming

- Open the Ball Chase project. Start a new program by clicking the "+" sign.
- Start with a loop. Leave it at the unlimited(loop for ever setting).
- Place a timer switch in the program.
- Set the timer-compare-timer indicator to greater than 3 seconds.
- Add a motor command to reverse the robot for 0.5 seconds
- Add another motor command and set this so that the robot turns 180 degrees after reversing.
- The timer will continue counting and the robot will keep reversing if you don't re zero the timer.
- Go to the yellow palette, select the Timer tile and set this to Reset.



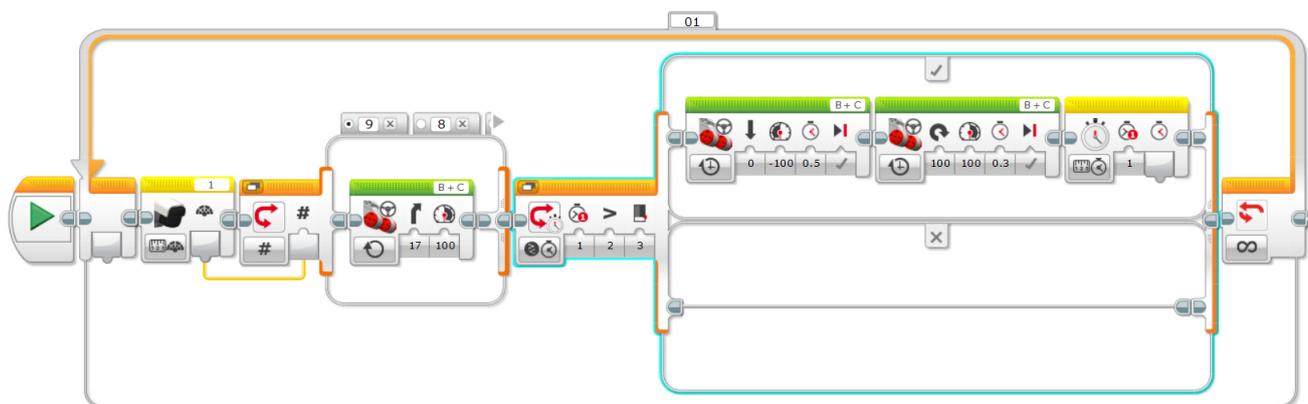
## Method

Download and test your program. The robot should wait 3 seconds and then reverse and turn, wait 3 seconds and do it all again. Adjust the timing of your robots movements until you are happy with them.

Now we will add the reverse to your Ball Chase program.

## Programming

- Select the switch and its contents by clicking on the orange tab of the switch.
- Copy this and paste it into the Ball Chase program after the Ball Chase Tab.

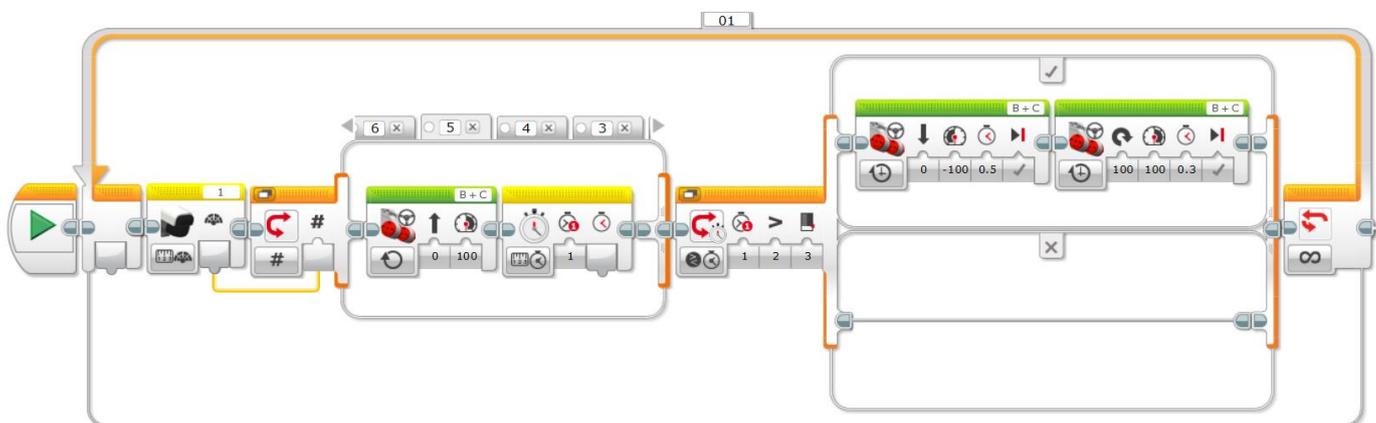


## Method

Download and test your program with the ball present. The robot should chase the ball but after 3 seconds it will reverse and turn, chase for 3 seconds and do it all again. This is not ideal, as the robot will reverse and turn when it has control of the ball. This would be disastrous if the ball was heading for goal. The best way to prevent this from happening is to re-zero the timer when the robot has the ball. That way it will never reverse when you don't want it to.

## Programming

- Select the number 5 tab of the Ball Chase switch.
- Click and drag the Reset Timer Tile to after the motor command in the 5 tab.



## Method

Download and test your program with the ball present. The robot should chase the ball and after 3 seconds it will not reverse and turn. Take the ball away. The robot should spin for 3 seconds and then reverse and turn. This little move is "gold" in the competition situation. Your robot will stay longer on the field without being repeatedly stuck.

## Simple Simon Goalie With Colour Sensor

### 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 possible 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 B and C and an EV3 Colour sensor plugged into Sensor Port 2.

### Colour Selection

The robot will see the infra red ball as black on the colour sensor.

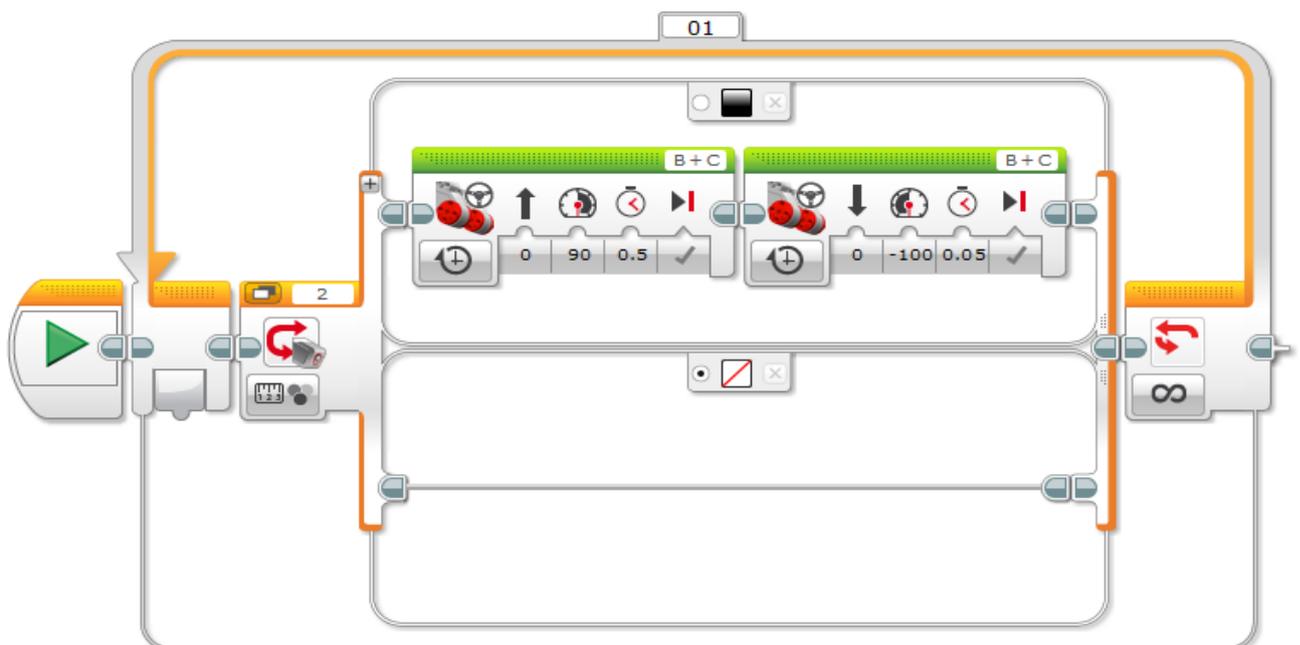
This has a range of over 1 m.

You do not want the robot to chase the ball when it is down the table.

You may need to angle the colour sensor downwards to reduce its detection range.

### 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



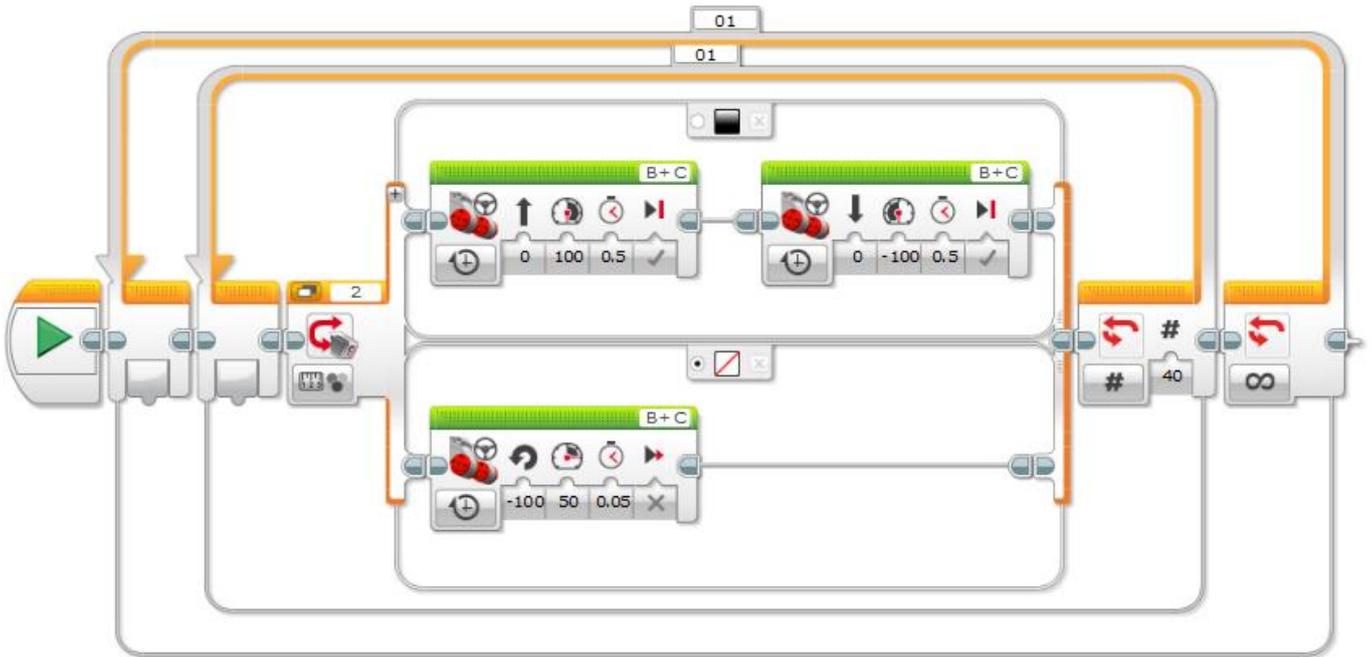
- Set the Switch to Colour Sensor-Measure -Colour
- Set the top branch to black and the bottom branch to no colour and select the default button(important)
- Set Motors to B and C and get them to run forwards 100%, then backwards - 100% for .5 seconds each
- Set the Loop Control to Forever
- Try doing the Mexican Wave with the other robots in the class.
- Adjust the angle of the sensor so that the robot only responds to the ball when it is 50 cm away.

## 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.

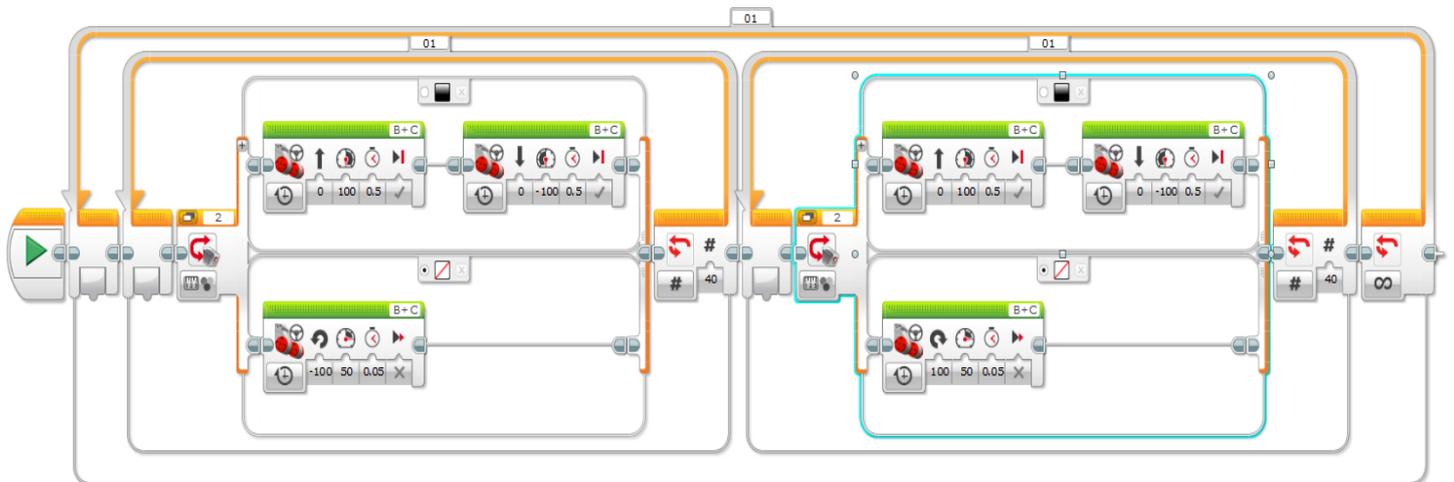
## Programming

- Add another loop at the start of the program.
- Drag the light sensor loops to inside the first loop and place them side by side.
- Add a Move Steering icon to the lower branch of the switch.
- Set the steering to turn full left,
- Motor Power 50,
- Timer to .05 seconds.
- Select Coast to stop (important)
- Set the light sensor loops to count for 40 and the outside loop to loop forever.



Test the program. The robot will scan to the left and attack the ball when it is close.

- Copy and paste the sensor loop to beside the first loop.
- Change the motor icon on the lower branch to turn right.



### 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.
- The robot must not move from its spot in front of the goal after responding to the ball. You must adjust all timings so that the robot remains in position after at least two minutes of play.
- If a robot is scanning quickly it can reduce its ball detection ability.
- Vary the angle of the sensor and the scan speed to get optimum performance.

## Simple Simon Goalie With IRV2

### 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 in "Direction" setting 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.

If this program is properly developed, it will give a team a huge advantage. Consequently, full working examples of programs will not be supplied. You will be given broken down sections of the goalie for you to perfect.

### Robot Setup

The setup is the same as the Simple Simon Soccer Player.

If you are using a Tommabot or similar, it is quite simple to add two more motors to the top of the EV3 as per the building instructions, and the place a kicker below the motors. Be careful to not block the vision of your IRV2.

### Programming

- Open your Ball Chase Project. Save this as "Goalie" before you start.
- Delete the motor commands in the 5 Tab. The robot will do nothing if the ball is straight in front
- For Tabs 0-4 have the robot turn at 100% towards the left
- For Tabs 6-9 have the robot turn at 100% towards the right
- Start with 100% power and gradually reduce these as they get closer to 5.
- For example 20% power for Tabs 4 and 6.

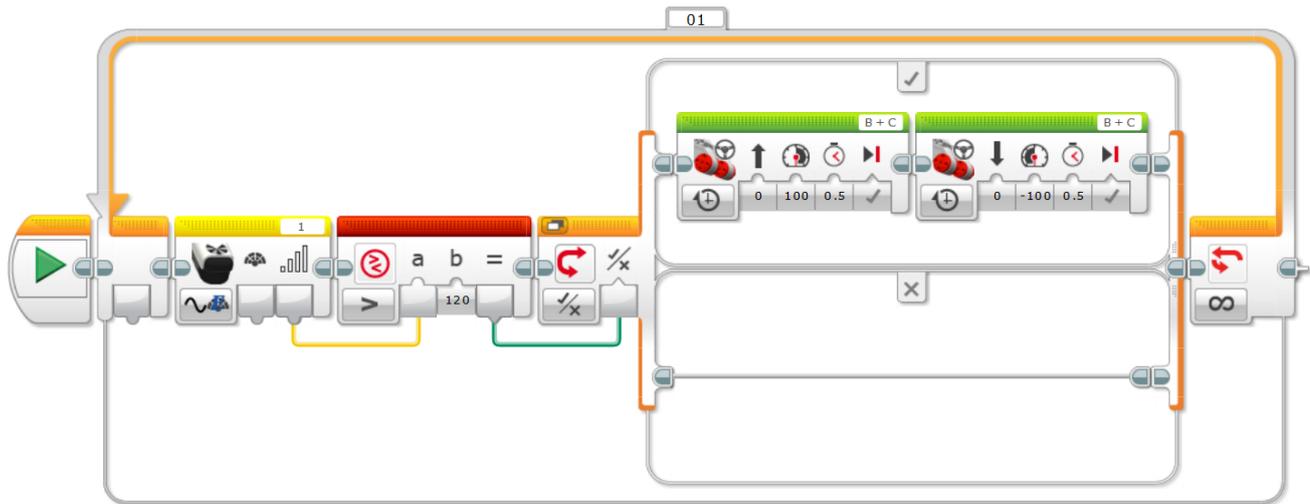
### Method

Download and test your program with the robot in front of goal and the ball present. The robot should turn towards the ball and stop. Wherever the ball is, the robot should turn to face it.

Now we need to have the robot respond to the ball when it gets within striking distance. We will now use the Enhanced Direction setting of the IRV2. This gives an intensity reading of the ball as it gets closer to the robot. The intensity will be about 200 when the ball is next to the sensor and depending on the sensor placement, its reading will be 120 when it is 30 cm away.

## Programming "Ball Range"

- Start a new program by clicking the "+" sign.
- Add an unlimited Loop
- Add the yellow IRV2 Tile
- Select Direction and Enhanced Direction
- Add a red CompareTile.
- Wire the Enhanced Reading block to the a block
- Set b to greater than 80
- Add a switch and set it to Logic.
- Add forward and reverse commands for .5 seconds and full power.



## Method

Download and test your program with the robot in front of goal starting without the ball present. Gradually move the ball closer to the front of the robot. It should respond to the ball by going forwards and backwards when it gets close enough. Adjust the sensitivity of the robot by changing the value in the Compare tile. The robot should respond to the ball by taking some part of it past the black goal square line.

If you have a kicker, you can now add the kick function to between the forward and reverse commands.

## Programming the Kicker

- Start a new program
- Add a quick forward and reverse for Motors A and D.
- Use the blue Unregulated Motor Tiles as they have significantly more power
- Do not set their time to more than 0.2 seconds, the kicker will destroy itself.
- Remember to put a stop (Power 0) for the unregulated motors



## Method

Test this program and try to maximize the kicking range without destroying the kicker. If the kicker stays at the top of the kick, you may need to reverse the motor directions. A good kicker should be able to kick the length of the field with this program. Once you are satisfied with its performance, insert these blocks into the top switch of the previous "Ball Range" program.

Download and test your program with the robot in front of goal starting without the ball present. Gradually move the ball closer to the front of the robot. It should respond when the ball gets close enough by going forwards, kicking, and going backwards.

Maximise the power of your kick by making sure that the robot has possession of the ball and the ball is moving forward before it kicks.

## Programming the Kicker into the Goalie Program

You now have a Goalie Program where the robot will turn and face the ball and a kicker program where the robot will kick the ball when it is close and in front of the robot.

All you need to do is combine these two programs to create a dominant goalie.