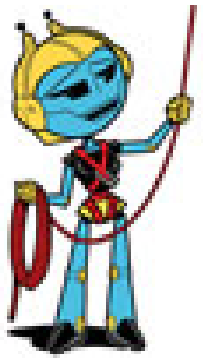
RoboCup Junior Australia

MAZE SPRINT RESCUE FOR EV3 AND SPIKE PRIME

RoboCup Junior AUSTRALIA

Overview of Competition



- "Real world" robot challenge
- Modular, flexible game design
- Accessible to a wide range of robot platforms
- Many possible solutions
- Easy for beginners but with a high ceiling
- Simple scoring
- Engaging and fun.

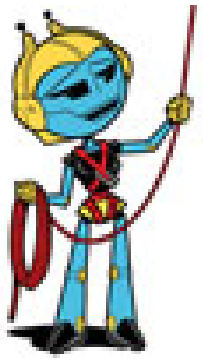
Now even easier for beginners!

CAN BE COMPETITIVE WITH AN EV3

CAN USE THE EV3 CLASSROOM SCATCH PROGRAMMING

PATHWAY TO MORE ADVANCED SOLUTIONS

LOTS OF DESIGN FLEXIBILITY



Scenario

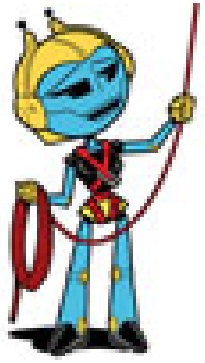
- There has been a disaster in a factory building.

- Several workers are trapped inside but it is not safe to send in rescue teams. Tokens have been placed to represent trapped (green) and seriously injured (red) victims

- The role of your sprint robot is to enter the building, identify the number and classification of victims, and exit the building as quickly as possible.

- Your robot will then report on the victims found.

The Competition



You have 2 minutes to calibrate your robot, find the victims and exit the maze.

There is a minimum of 5 victims in the maze. You get points for each one you find. The red victims are worth more points then the red

Bonus points for exiting the maze before the time has elapsed and for accurately reporting the type of victims

The robot must avoid black holes

The robot can be return to last found victim if stuck without penalty but program cannot be restarted

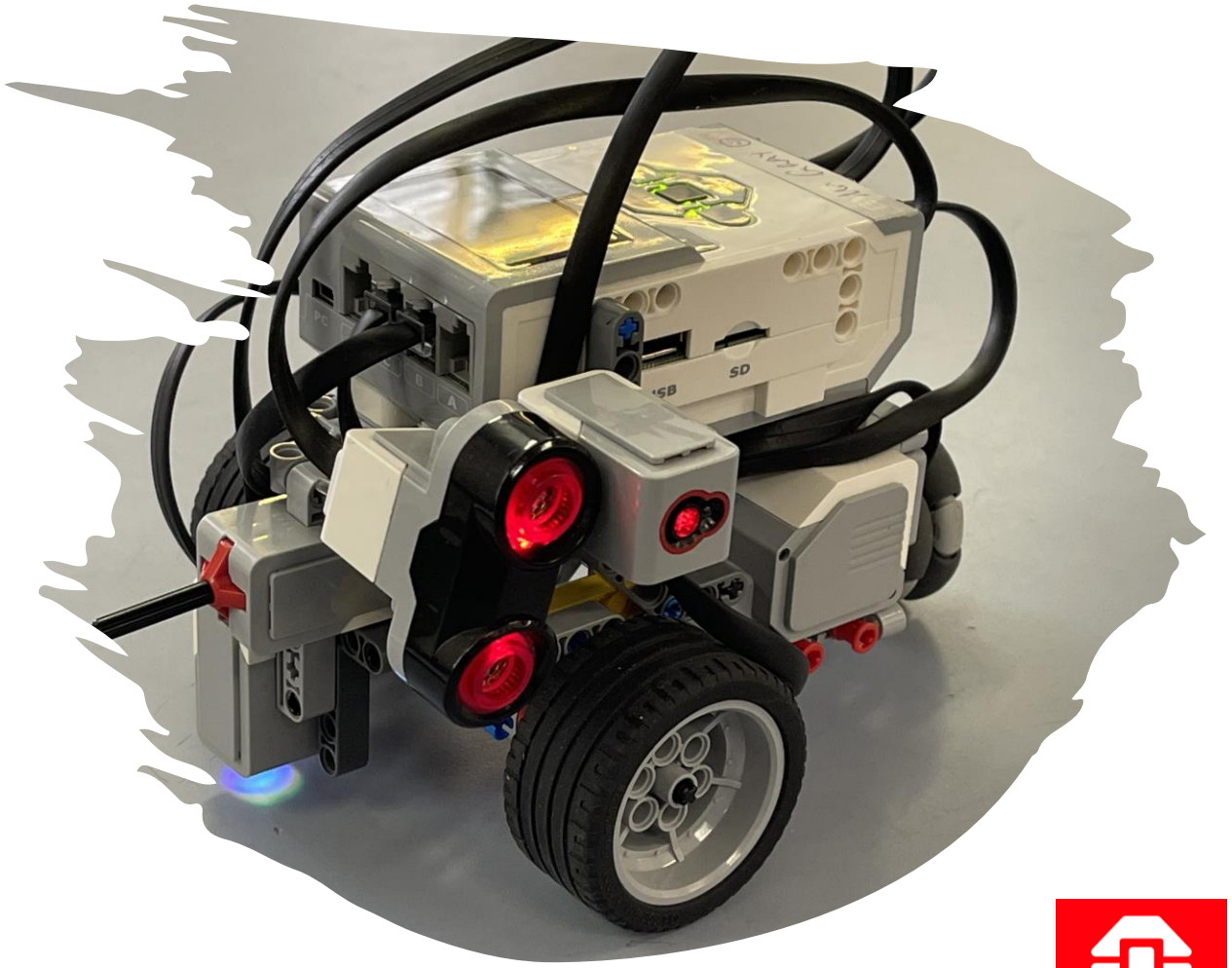
Robot run can be restarted with loss of points at any time

Two divisions

- Standard for EV3 and Spike - with or without a robot!
- Virtual for any robot design running through set mazes.

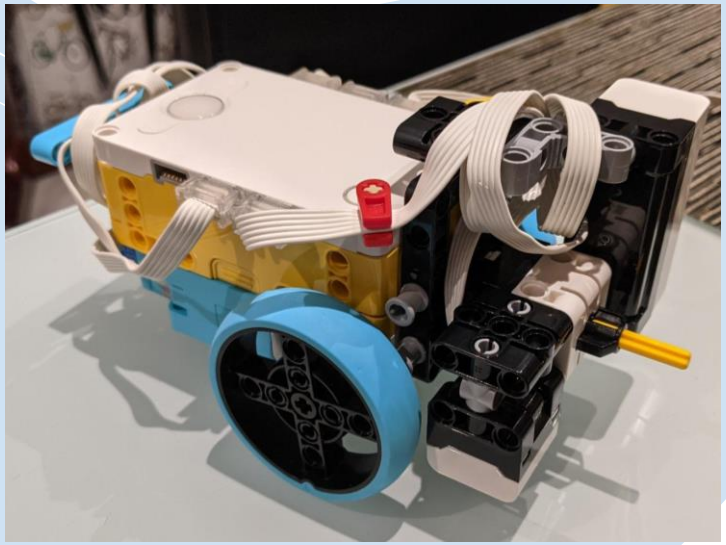
The Robot – what you need

- Basic EV3 robot
- 1 X Colour sensors (pointing down). You can just start with the one facing the wall first
- 1 X Ultrasonic (facing wall)
- 1 X Touch sensor on front of



The Robot – what you need

- Basic Spike Prime robot
- 1 X Colour sensors (pointing down)
- 1 X Ultrasonic (facing side)
- 1 X Touch sensor on front of robot

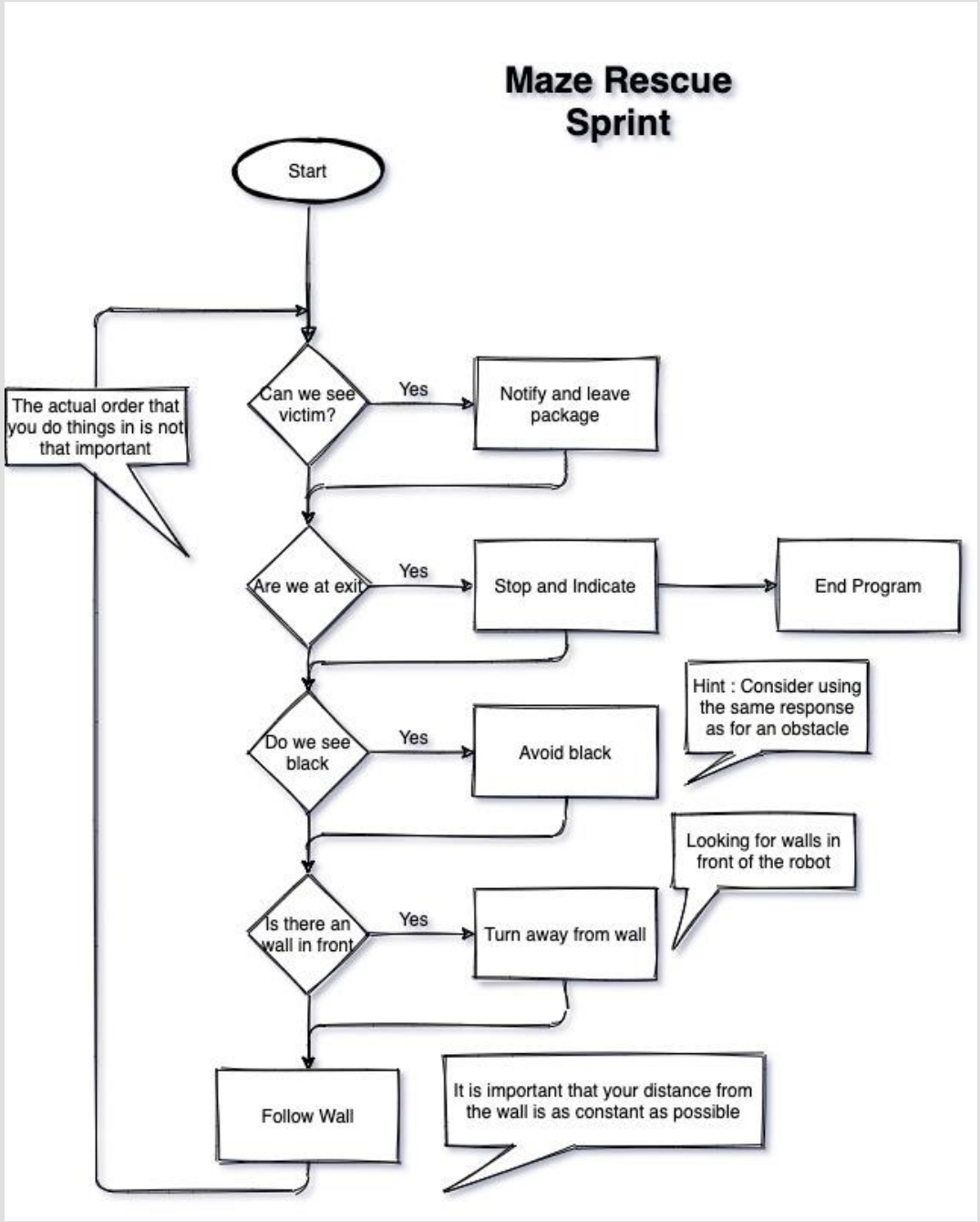


Maze Algorithm

- Keep it simple and work on one element at a time.
- Make your wall follower as smooth as possible. You want to stay at a constant distance from the wall.
- The rate at which the robot turns is important for reliable performance
- A good development strategy is

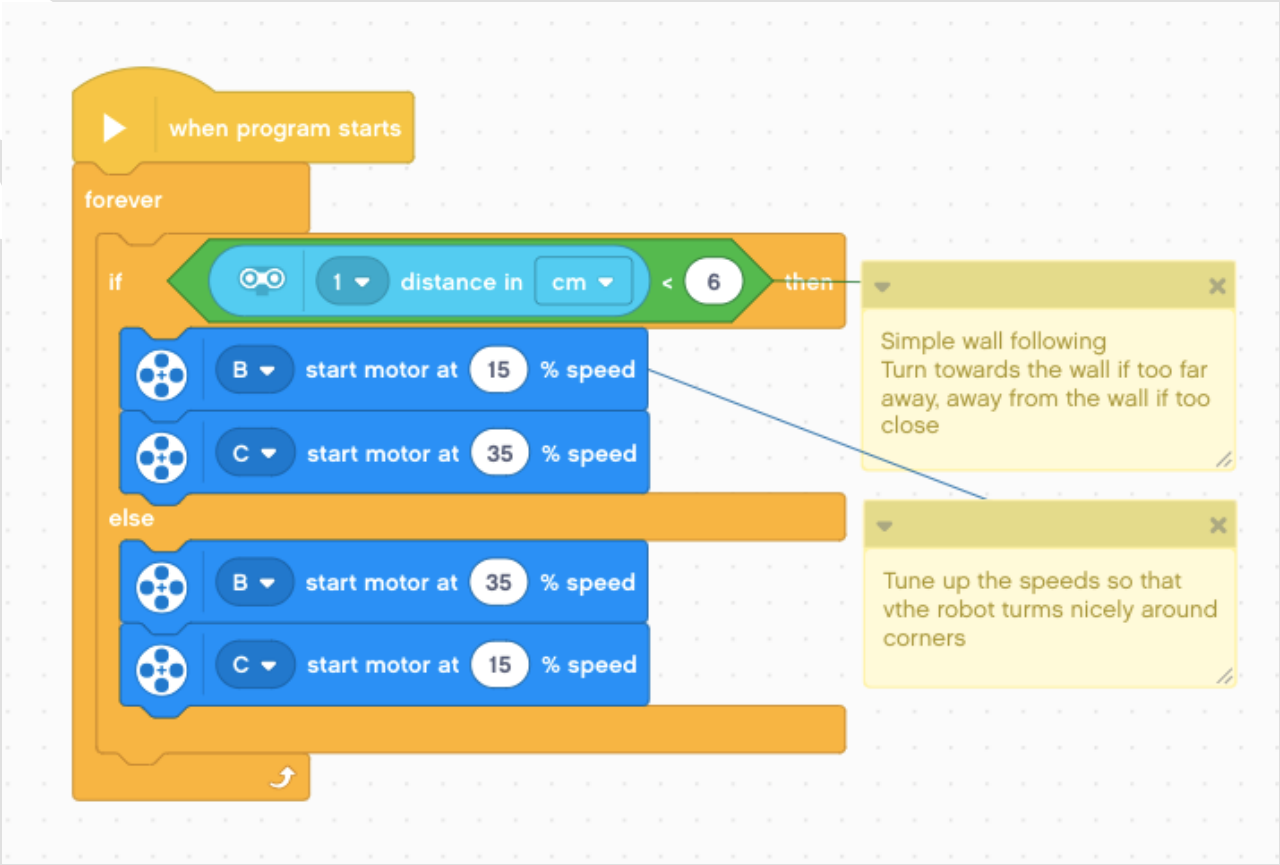
✓ Follow a wall
✓ Detect an obstacle in front
✓ Detect a black hole
✓ Find a victim
✓ Find exit and report

We "nest" a series of if … else statements <u>one at a time</u> to get the robot behavior that we are after.



Simple Wall Following

- Wall following is simple. The robot either steers towards the wall if too far away or away from the wall if too close.
- The key issue is carefully calibrating your robot turn rates. The robot should follow a constant arc around a wall divider.
- Individual motor speed control works better than steering



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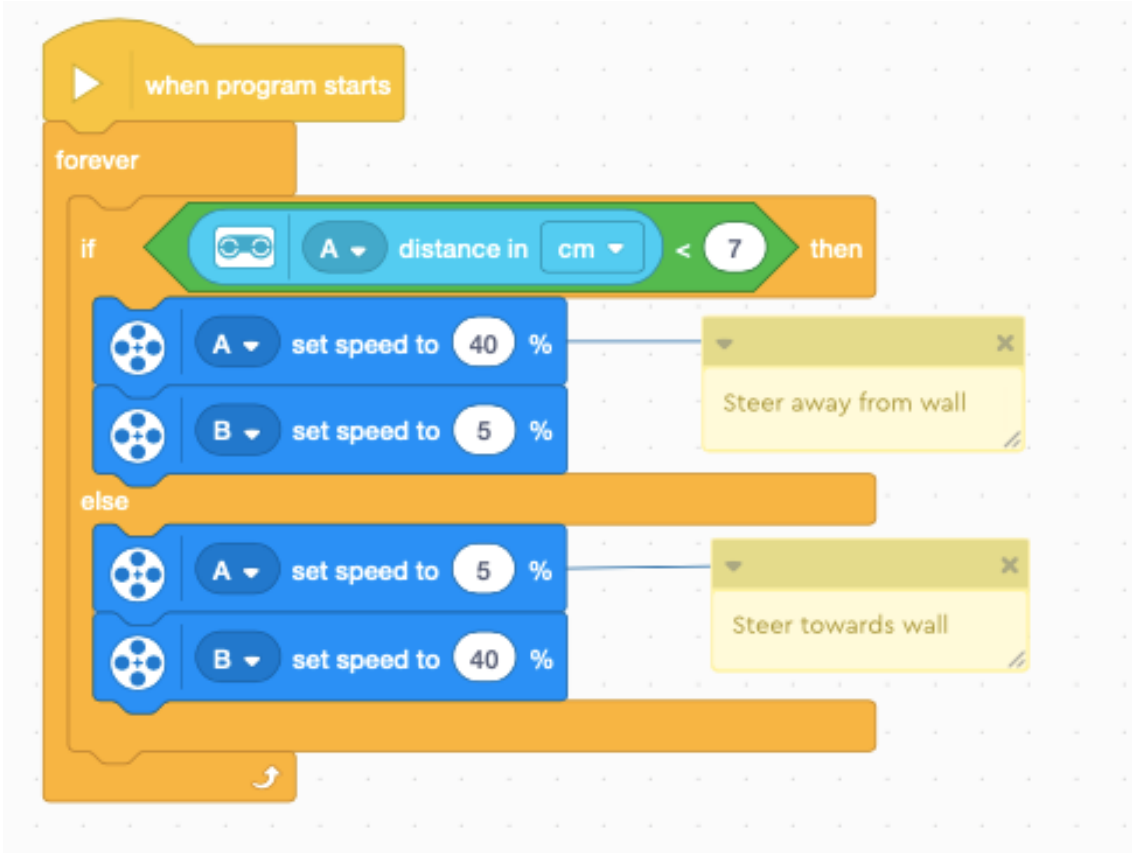


SPIKE™ Prime

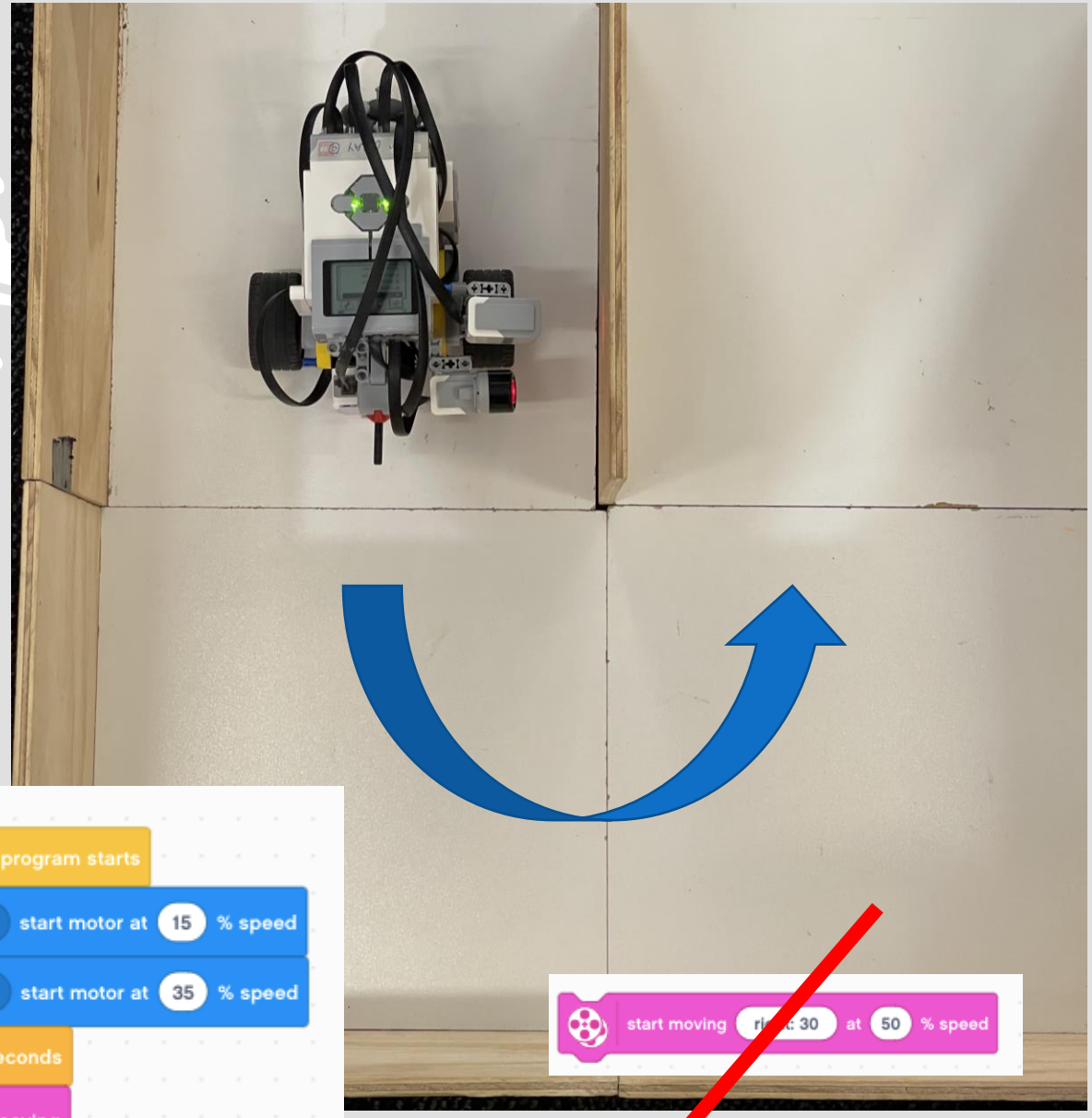

ON/OFF


PROPORTIONAL


FAST
PROPORTIONAL

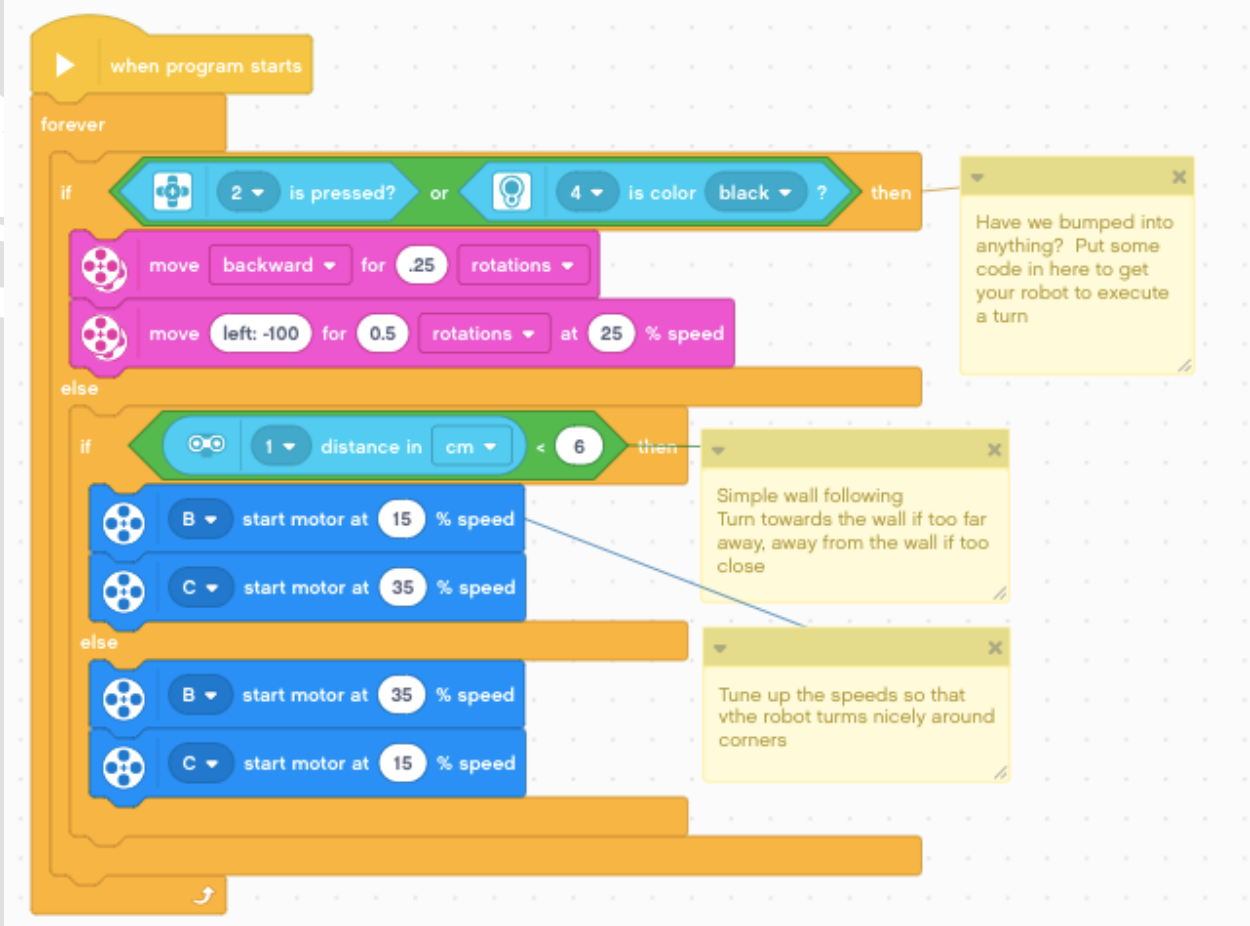
Setting the Turning radius

- When your robot comes to the end of a wall it will try to turn towards where it thinks the wall is.
- Setup your motor speeds so that your robot will do a smooth arc around the wall.
- There is a relationship between speed and turning plus every robot has different characteristics. Play around until you get it right.
- Individual motor speed works much better than using “steering”.



Obstacle Avoidance

- When you see an obstacle in front of the robot you need to react in some way.
- This can be a wall or an obstruction. Even a black hole can be treated as an obstacle as seen in the example on the right.
- If you see a wall in front of you for example you could reverse a little and then turn away from the wall.
- Keep the movements small – it is not unusual to take a few attempts at getting around the obstacle.
- With this simple program you have a robot that can solve a basic maze!



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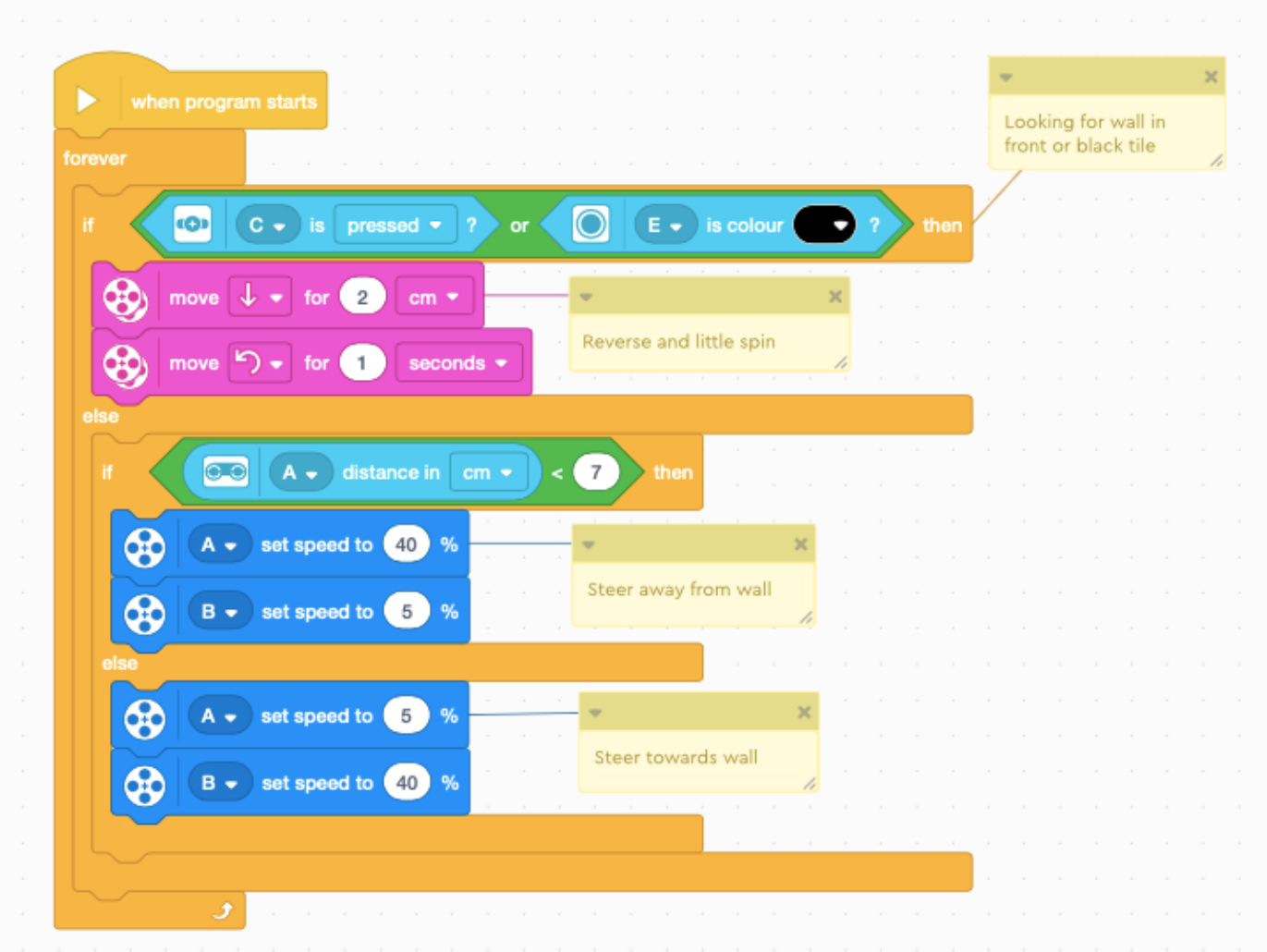
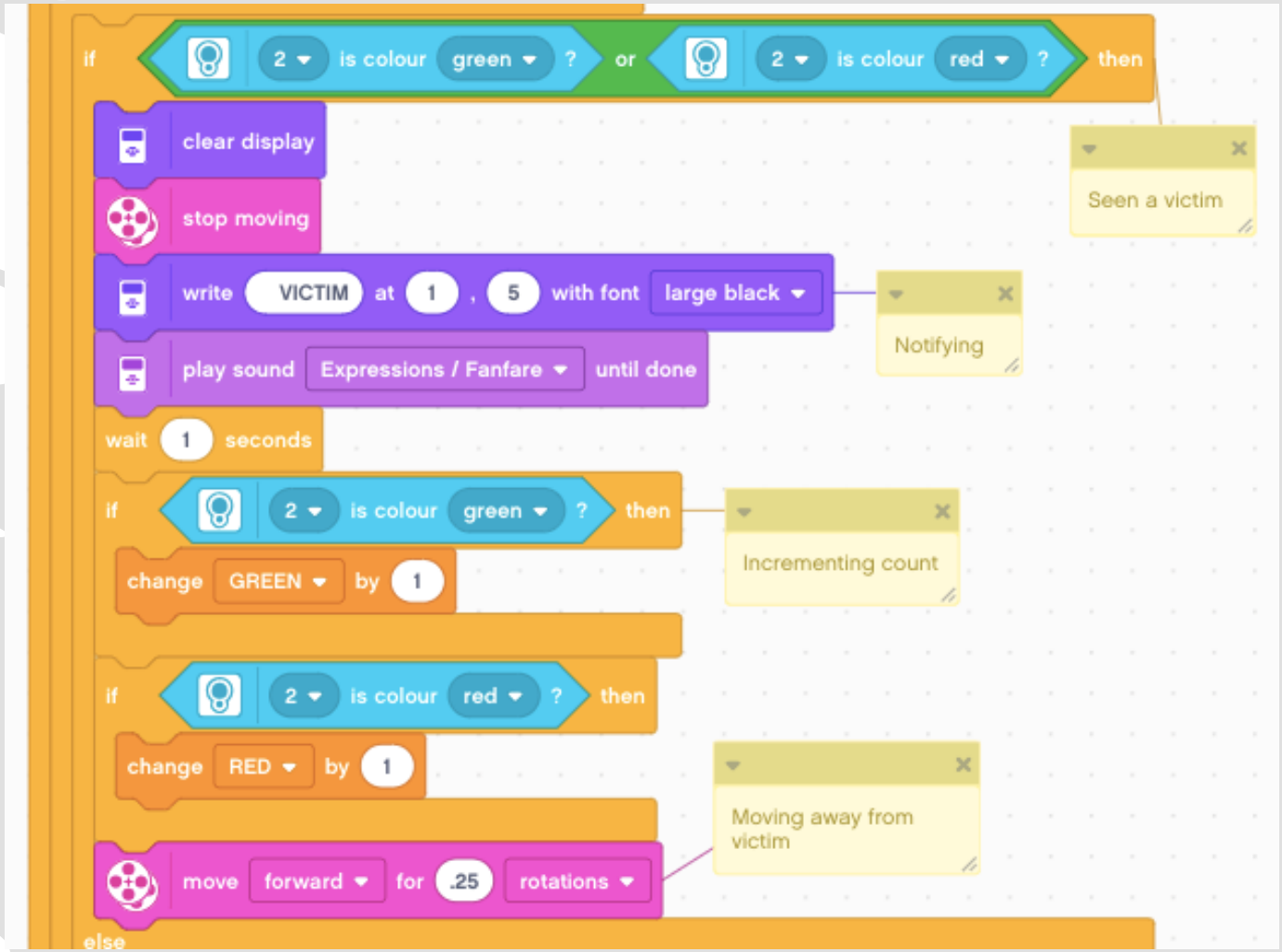


SPIKE™ Prime

Finding the Victim

- The victims are represented by 50mm square markers in the middle of each passage through the maze. They are coloured red or green to indicate if they are in critical condition or just need to be located.
- This means we can use the Colour Sensor to identify the victim.
- When you find a victim you need to stop for 1 second and indicate in some clear way.
- It may be a good idea to move off the victim before continuing – why?
- A constant wall following distance is critical



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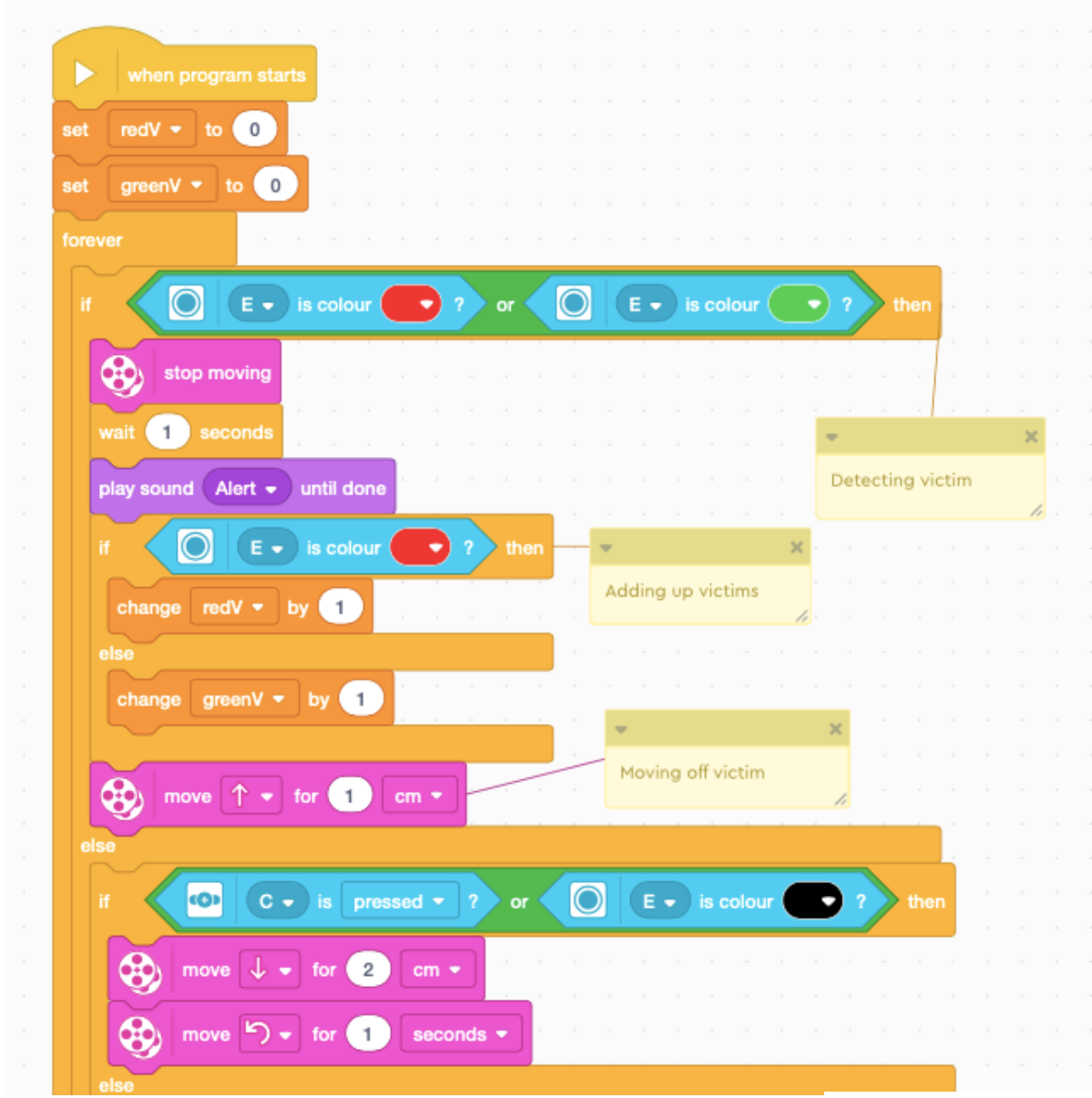


Spike™ Prime

Finding the Exit tile

The exit tile is shiny and highly reflective

See if you can work out some way to sense it

Hint ….. put in another nested if … then based on reflected light to notify your success and turn the robot off.

Now it is time to display how many and what type of victims you have found.

spike™ Prime

LEGO education

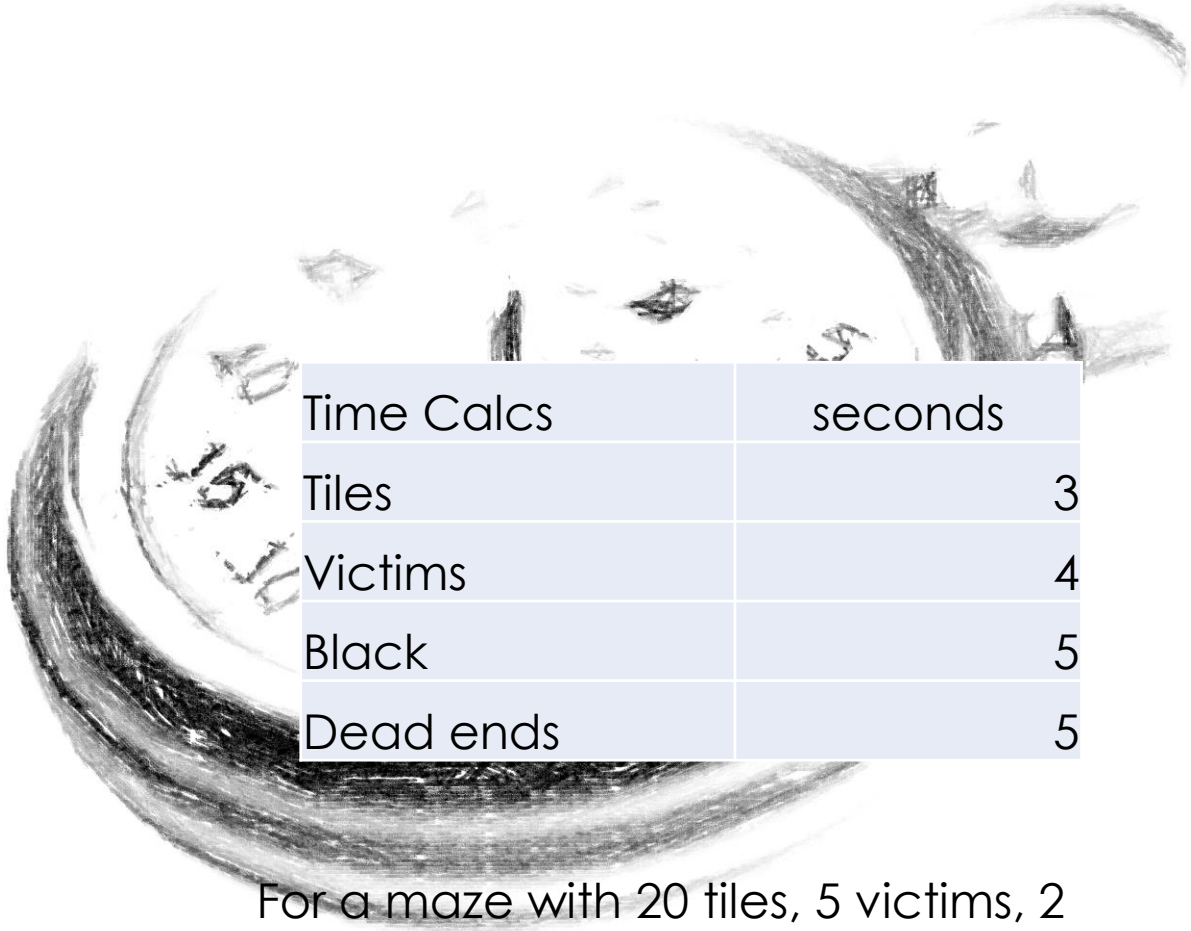
SCORING

ACTION	POINTS	COMMENTS
Found green victim	10	Robot must stop and clearly signal
Found red victim	20	Robot must stop and clearly signal
Time Bonus	2 points for each second less than Target Time	Robot must stop on exit within the Total Time (Target Time plus 60 seconds)
Reporting Bonus green victims	25 Points	Robot must stop on exit and display the correct number of green victims
Reporting Bonus red victims	50 points	Robot must stop on exit and display the correct number of red victims

The champion teams is decided by the cumulative total over several rounds

Target Time

- The Target Time is calculated by an algorithm that considers the following
  - Number of 30cm X 30cm “tiles” X time calc
  - Number of victims X time calc
  - Number of Black tiles X time calc
  - Number of Dead Ends on shortest route X time calc
  - A Challenge Factor (0.8-1.2) for each round.
  - Add up the times and divide by the Challenge Factor
  - 0.8 or early rounds rising ads we proceed.

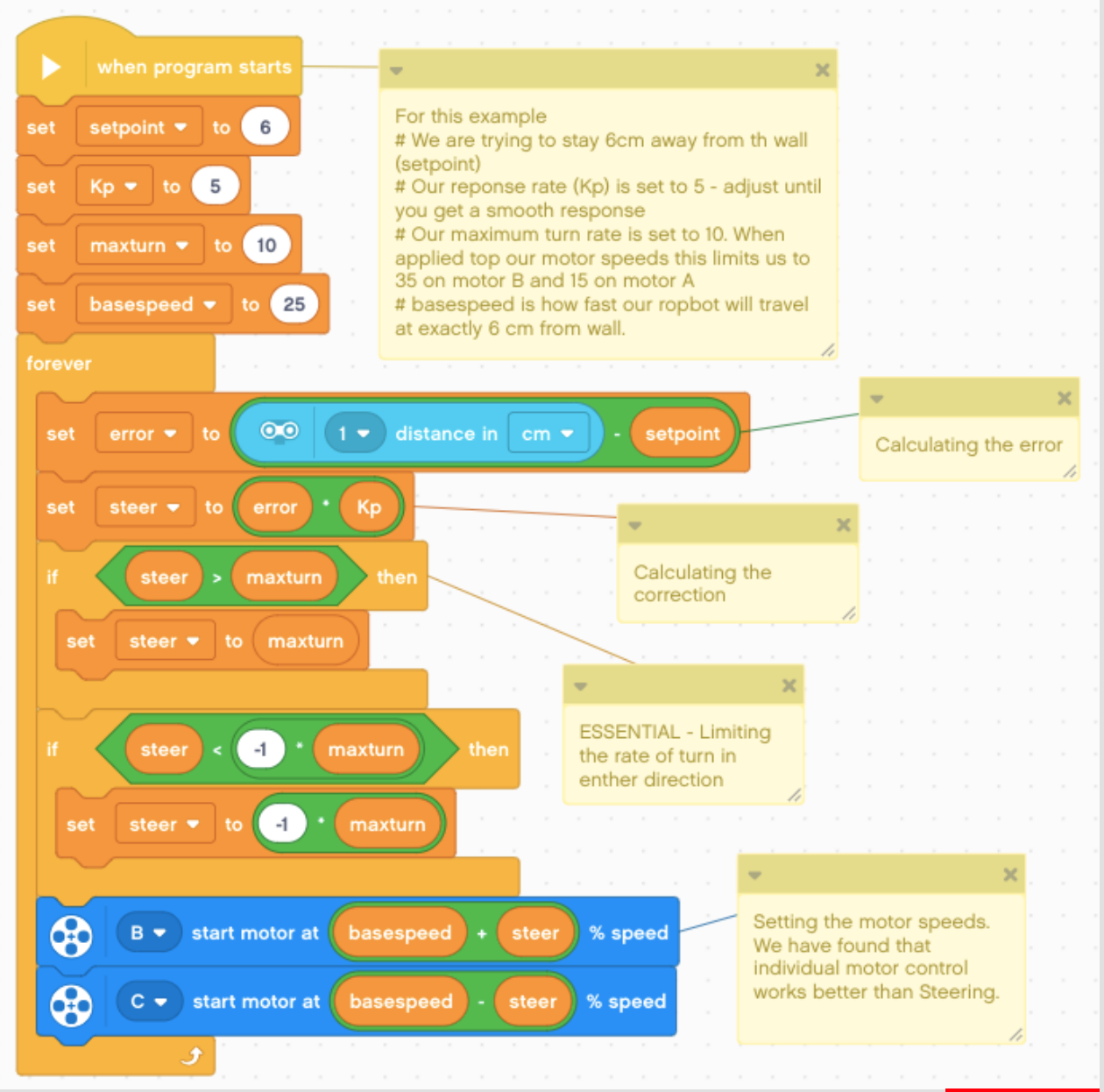


Time Calcs	seconds
Tiles	3
Victims	4
Black	5
Dead ends	5

For a maze with 20 tiles, 5 victims, 2 Black tiles and 3 Dead ends would be calculated as 110 seconds.
This is then divided by the Challenge Factor to give the Target Time

A better Wall Follower

- As already noted an accurate wall follower is essential to increasing the reliability of your victim detection.
- The best way to do this is to use a proportional control algorithm.
- Seems tricky at first but pretty easy once you get the hang of it.
- Essentially you speed up the wall side motor and reduce the speed to the other to move away from the wall.
- You do the opposite if you get too far away.
- **Hints : Make sure you put in something to limit the rate at which the robot turns**
- **Play with the Kp and basespeed until you get the response that you want.**



Important Links

Everything you need will be accessible through the RoboCup junior Australia web site.

I can be contacted at neil.gray@robocupjunior.org.au

- https://www.robocupjunior.org.au/
- https://www.robocupjunior.org.au/rescue-maze/
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