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Lego Zip-wire Workbook

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Lego Zip-wire

North Wales is home to Europe's longest Zip-line, taking users across the Penrhyn Quarry at speeds up to 100mph! Zip wires can become worn over time and can be very dangerous for its users if the zip-wire does develop any issues. How can this "wear and tear" be maintained and checked regularly? How can this be maintained without staff doing it manually?

When developing robotics, an important stage after the initial design is to prototype the robot. A prototype is a "trial" version of a product, before the final one is produced. You will be developing your own prototype modelling what you would build if developing a real-life solution. This prototype will be created using LEGO Mindstorm NXT kits.

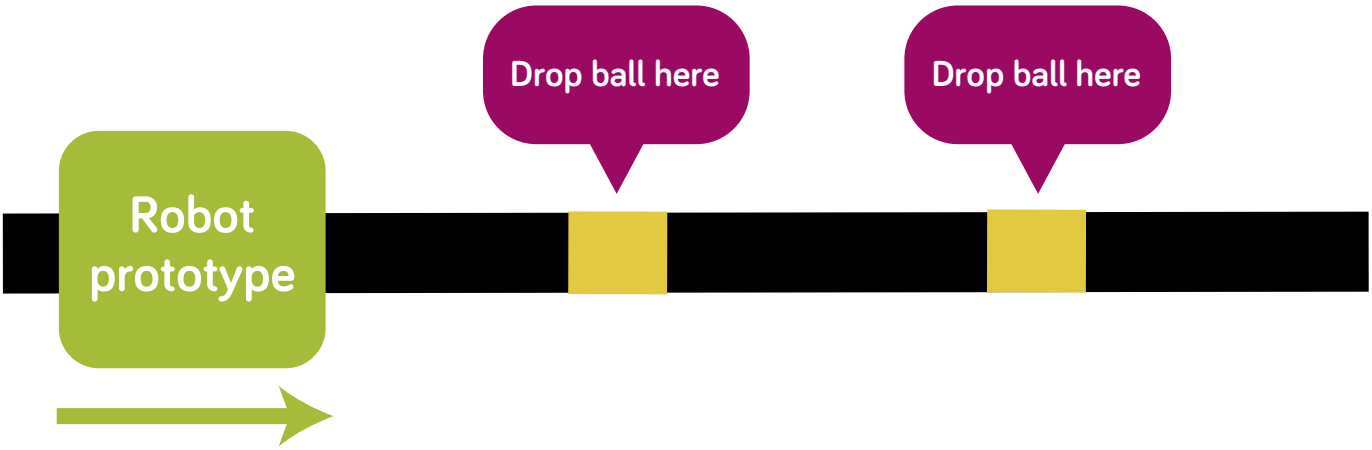
1) Prototyping

What is the importance of prototyping such a robotic solution before developing the final version?

What is the importance of testing the robot after you have implemented the code and finished your design?

Consider these and discuss in groups or teams. Other than functionality, what other ways could you use the prototyping method when developing a product?

Your task will be to develop a prototype that will be tested on a climbing rope with "problem areas" indicated by coloured tape on the climbing rope. Note: the rope will need to be set up on a decline to assist the robots descent. When the robot finds a "problem area" as it crosses the zip-line, it must indicate this to its users. On the final model, this will be done by sending GPS signals, however on the prototype this will not be necessary. The prototype will be required to release a ping-pong ball each time a "problem area" is discovered.



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Building a basic robot will introduce you to the different building parts, the various additional components and how these can be connected to the NXT will help you understand how the robot works and how the kit can be manipulated later on to become a prototype.

2) LEGO Mindstorm NXT kit

Build a basic robot with a motor on either side, using the connection cables to attach it to the NXT brain. How can you get this to move?

There is a programming environment available to code the NXTs and give the robot instructions to follow. See the top tips guide to see how the different blocks can be implemented. Upload the code onto the NXTs and see what happens.

At this stage you should be more familiar with the components and what they do, if you are still a little confused below is a list of the different sensors that can be connected to the NXT. In turn, implement code for each sensor and connect, see how it works, how the blocks' individual options and the controls differ the commands given to the NXT.

Ultrasonic Sensor	Sound Sensor
Motor	RGB Sensor
Line Tracing Sensor	Touch Sensor

3) Zip-line

Set up a zip-line using climbing rope. The line must be on a decline, so gravitational pull can assist any robots moving along it down the zip-line.

The line needs highlighted "problem areas", but these areas need to be sensed by the robot and that the robot should not stop moving but continue down the zip-line. The easiest way of doing this suggests using something similar to coloured tape.

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Now that you are familiar with the NXT kits and have developed a confidence with the drag and drop programming environment lets see how you apply this knowledge.

4) Design

In groups discuss how the NXT kits can be used to solve the problem. Consider the following in your design process:

- How would it move down the wire?
- How would it be attached to the wire without falling off?
- How will it store the ping pong balls?
- How will it know when to release the ping pong balls?
- How will it only release one ping pong ball and not all of them?

Once agreed on a design next you need to start seeing if it can be easily built using the kits and components provided.

5) Build

Build the prototype using the kits provided, extra components can be added.

Note:
Don't forget to correctly connect up the sensors using the provided cables, be careful to note which ports are used to connect to the NXT as this becomes important during coding.

Testing your robot is an essential part of any development process, whether you are making a game an app or designing a brand new mobile phone. By building it bit by bit, together with developing code will enable you to recognise any problems with the code or anything that needs tweaking.

6) Test

Test your prototype. Monitor how it reacts and see how it moves, can any improvements be made?

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7) The real problem

Prototypes may not necessarily resemble a “marketable” product. For instance a solution to the problem is not identifying colours on a climbing rope and releasing ping pong balls using lego kits however it does replicate it. The robot would be required to discover any faults in the line and to send a GPS signal to alert staff of this.

Design a real model of a marketable version of the prototype.

- How will it look?
- What will it look for in the while?
- How will staff receive the GPS signal?
- How will it move down the zip-wire?