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App Inventor meets NXT Workshop Session Plan

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Workshop Schedule

"By failing to prepare, you are preparing to fail."

Event Set Up	30 minutes	

Introduction

Welcome/Pre-day Forms	5 minutes	(Slide 1)
Introduction	5 minutes	(Slides 3-5)

What are Robots?

Task	20 minutes	(Slides 6-8)
Robots	15 minutes	(Slides 9-15)

App Inventor & NXT Robots

App Inventor	5 minutes	(Slides 16-18)
Buttons	10 minutes	(Slides 19-20)
Events	25 minutes	(Slides 21-22)
Better Driving	25 minutes	(Slides 23-26)
Moving	35 minutes	(Slides 27-38)

Q&A/Post-day Forms	5 minutes	(Slide 39)
Event Clean Up	30 minutes	

Total: 2 hours 10 minutes for attendees
Total: 3 hours 10 minutes for staff

Hardware and Software Requirements

1. Laptops with appropriate software installed (Oracle Java 7, App Inventor and any drivers for tablets).

2. Google account per laptop.

3. Android tablet for each machine with bluetooth connection.

4. Lego NXT for each laptop, base built with no Sensors attached.

5. Internet Access.

Attendee Prerequisites

1. No programming experience required.

2. No previous App Development experience required.

3. Completed consent forms.

4. If under 16, parental permission to upload photos is required if photos are desired

Learning Outcomes

1. Explain Android, App Inventor and Graphical Programming

2. Create an Application incorporating a variety of input and output components.

3. Understand the terms event driven and flow control.

4. Develop logical thinking skills and problem solving analysis.

Event Set Up and Clean Up

Event Set Up

1. Prepare any pre and post-day questionnaire forms as required. Remember spare pens / pencils.

2. Ensure tables and chairs are arranged to naturally encourage people to sit in groups; ensure no one is sitting with their back to the podium.

3. Test display equipment (e.g. projector) and ensure that presentation and internet connection are working and ready for use.

4. Prepare Top Tips for App Inventor, one each.

5. Distribute blank paper.

Event Clean Up

1. Ensure all pre-day and post-day questionnaire forms have been collected if required.

2. Clear up litter and refuse. Remember to recycle where facilities exist. Remember to switch off lights, computers, and projectors!

Introduction

Welcome and Pre-day Forms

The first 5 minutes is very much about welcoming and encouraging people to complete any pre-day forms before the workshop begins. Also ensure you read through the pre-day forms with the participants to confirm they have been filled in correctly.

Ensure that you welcome the attendees as they enter the room; this helps to create a positive connection.

Introduction

The introduction gives you time to introduce everyone involved with hosting the workshop.

It is not necessary at this point to give an elaborate history of every person involved; try to keep to simple facts.

The main aim is to have everyone settled, focused, and filling required forms, e.g. pre- and post-day questionnaires.

(Slides 1-4: Title)

"Good XXX, I'm XXX and I work for a pan-Wales organization called Technocamps.

Has anybody heard of Technocamps before or been to one of our workshops?

We are a £6 million government funded organization getting young adults and children aged between 11 and 19 to become excited about Computer Science and what it has to offer, in both their education and future careers".

(Slide 3: Pre-day Questionnaires)

Allow time for all students to fill in forms required. Talk through each question and ensure that all questions are filled in.

(Slide 5: STEM)

Ask about the group's views on Science, Technology, Engineering and Maths. Find out what pupils believe these terms mean. Explain briefly what each term means and talk about the link between them all and how Computer Science is also linked with all of them.

App Inventor meets NXT

(Slides 6 - 15: Robots)

To begin, discuss with the group what they think Robots are. The task on slide 7 will enable the group to get creative and design their very own robot: What will it look like? What will it do? How will you interact with it? Discuss with the participants the comparisons in the variety of robot designs and functionalities. Do some of the robots have similar features?

On slides 9 to 14 there are examples of uses for robots within education or even industry, below is a description for each of these:

- Slide 9 - The iCub is a robot used in research to simulate infant learning and to try and mimic that in robotic systems. It has many sensors including cameras, microphones and touch sensors. This is probably similar to many of the robots the students will have drawn but remember to discuss with the group that not all robots will look like humans.
- Slide 10 - An example is an industrial manipulator, used to either work in dangerous places or in a repetitive manner like on assembly lines. They tend to always do the same thing over and over again, which saves us having to do it ourselves.
- Slide 11 - This is Kit from the 80s American TV program. The car would drive itself, talk, think like a human etc. This was science-fiction but nowadays some cars can do things like drive on their own, park themselves and to automatically brake when too close to a detected obstacle.
- Slide 12 - Idris is a research robot used in many projects that have to do with autonomous navigation (driving on its own) in complex environment.
- Slide 13 - BeagleB is the equivalent of Idris but on the sea. Autonomous sailing with instruments used to, for example, measure water quality of listen to dolphins communicate with one-another.
- Slide 14 - Is a washing machine a robot? What does the group think? Why? Why not? Many believe they are robots, as they can be programmed to do different things (different settings for different fabrics) and they sense their environment (temperature, water level, amount of detergent etc).

Once you have gone through this with the group, discuss what actually makes them robots. Is it their appearance or the embedded computers? Robots are devices that sense the environment they are in and what it is doing to them and in particular how the robot can react accordingly to how they are programmed.

(Slides 16 & 17: App Inventor)

To begin introducing App Inventor, describe the different elements of the interface. In red on the left on slide 17 is the palette where components can be dragged from onto the screen. In the blue is your application, where components are dragged to and where the appearance of the application can be monitored. In the brown box are the list of components that have been dragged onto your screen, this makes it easier to delete or re-name a component. Below the components

list is the media box. Here any images, videos or sounds are stored, similar to a library ready to be used within your application. Lastly is the orange box on the right named "properties", where you can edit components according to the variety of options available such as content and appearance.

This is where you develop your first project.

(Slide 18: Blocks Editor Interface)

This interface has been broken down into 3 main sections: Menu of code segments, main area for the code to be built upon and the options for the emulator or connection to device. As you click through the different categories on the menu different code segments will appear that look like jigsaw puzzle pieces. These can be dragged onto the development space where the code can be pieced together depending on desired functionality. Highlighted within the brown box are the options for testing the application. For instance, you could open an emulator which is a window designed like a typical Android device to display how the application will look. For a more realistic testing experience, a connection can be made with a plugged in USB device.

The blocks are used to give your Application behaviour, so the Blocks Editor is where all the clever stuff goes.

(Slides 19 & 20: Buttons)

To begin, import the example project by clicking "more actions" and "import source". The get the group to choose the NXT_Move_Start project that can also be downloaded as part of this workshop's resources. This basic application has the ability to connect to Bluetooth devices, which we will use to connect to NXT's. Encourage the group to add 5 buttons to a new blank application, labelled: "Forward", "Backward", "Left", "Right" and "Stop". Screen arrangements can be implemented to structure the layout of the application.

(Slides 21: Events)

Once the Blocks Editor is open, you will see that there are some blocks already being used. These are there to allow us to connect the tablets to the NXTs. Explain the ".click" event block and explain that these run when a certain event such as "button is clicked" occurs. Where can the students find the relevant NXT drive command block, to put inside this event block making the NXT move? Once one button is demonstrated, encourage the group to complete the other 4.

(Slides 22: Experiment)

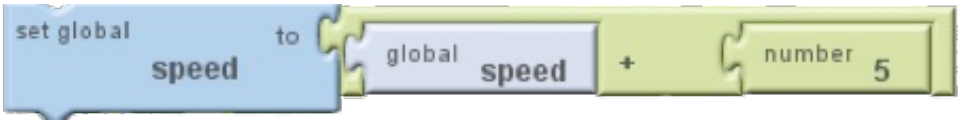
Edit the code according to the mini-challenges on the slide, ask the group what are their thoughts on the experiment with the code and what were the results?

(Slides 23: Better Driving)

Ask the pupils how they believe we could make the NXTs move better and see what suggestions they have. Can the students recognise the need to accelerate and to turn better? What is differential drive? Differential Drive is when you drive with both your motors at different speeds, allowing for your robot to move in any given direction.

App Inventor meets NXT

How can this be applied? Add another NXT drive component, to control each motor individually. Using new variables for "speed", "turn" and "minimum speed", you can control acceleration and deceleration. When clicked, each button will need to increase/decrease the variables just created. Producing something similar to below:



(Slide 26: Clock)

The clock allows us to keep on checking the values of the variables "speed" and "turn" to adjust the speed of the motors every few milliseconds. To do this, you need to add the Clock.timer event block and use this to edit the motors.

(Slides 27 - 37: Moving)

Now we will work through making the robot respond to the variables set using the buttons on our application. To do this we are going to use conditionals to test what our variables decide to do with our motors. Conditionals are also referred to as "IF" statements, they test if something is true and if it is then it does another instruction, but only if it is true.

First, test if the speed and turn are both 0. This means we are not moving, so need to stop the left and right motors.

Next, test if we are moving forward, meaning the speed is greater than 0, then the left and right motors should move forward at the set speed. You may also need to take into account the turn. Try out the numbers on slide 31 before progressing through the answers.

After you have completed moving forward, next is moving backward. This can be slightly more complicated as speed will be negative. You either need to convert speed to a positive or move forward at a negative speed. On slide 37 try out a negative speed.

(Slide 38: Finished?)

If the pupils have finished, allow the pupils to use sensors to enable their robot to drive on its own interacting and sensing its surrounding environment.

Q&A Session & Closure

(Take several questions from the attendees)
(If no questions are asked by attendees, begin summarising topics covered)

Once an appropriate number of questions has been taken, you can then begin to close the workshop. Be sure to have any post-day questionnaire forms filled in by attendees as required. Some audiences may require more prompting to fill in such forms.

Closure and Post-day Forms

The last 5 minutes of closure must be used to, if required, ensure that post-day questionnaires are filled in by the attendees and talk them through the information they have filled in. Ensure that you collect all of the post-day form in before attendees depart, and be sure to thank each person for taking the time to fill in the forms.