Junkbots

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ABSTRACT

The School of Science and Technology at the University of Northampton have been working with local schools to create robots made from junk and also to use robots programmed by the students to perform simple rubbish clearing exercises. This is an initiative by the University to introduce environmental sustainability, engineering and computing to students in schools. This paper focuses on the programming part of the project, providing reflections on the activities.

INTRODUCTION

The project sets out to engage pupils with a set of activities over four three-hour sessions that provides an insight into STEM subjects. The workshops will be structured in the following way:

a) Introduction to waste management, its impact, recycling and reuse, followed by an introduction to the idea of making robots from rubbish.

b) Involves some problem-solving exercises (approx. ½ hour); then in groups investigate adding 'junk' with a new electrical components such as batteries and motors to use vibrations to move the robots.

c) Applying some of the ideas on problem solving and use of materials developed previously to build a little junk-clearing robot. These are based on Lego based robots are provided with two light sensors using Java. The facilitators (which are either university staff or students) provide guidance and help programming the robots and the instructions to be used.

d) The final session will involve the students, with the help of the facilitators, demonstrating and presenting their group's solutions.

The robot programming activities are, for many of the school students, the first time they have done any programming, so the facilitators are central to the success of this activity. They provide guidance to the students but also fixing problems as they arise. These facilitators are usually computing undergraduate students who have being using the robots for at least three months before – the aim being they can gain some useful experience. An example worksheet produced by one of the facilitators is shown in figure 1.

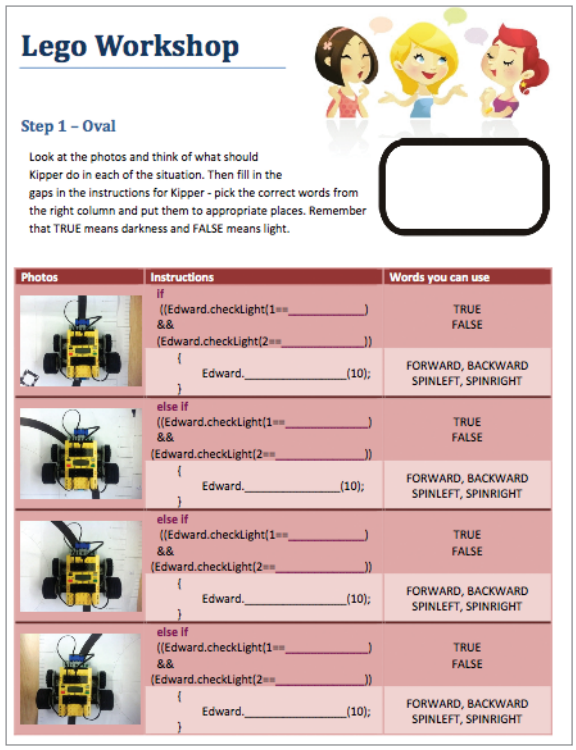

Figure 1. *An example worksheet*

SUMMARY

Three schools have taken part of the project (62 students in all), so time to reflect on and summarise the project so far.

Programming

The programming of the robots caused a differences in opinion which seemed to come down to two main factors, that there was only one robot per group and having to learn a challenging new skill (programming):

"Didn't get much of a go on this one" (Students D, E)

"this was good however I didn't get to do a lot" (Student F)

"Really enjoyed it" (Student G)

"It was really good and the amount I have learnt about Java is incredible" (Student J)

"It was cool because we could program them" (Student Q)

"It was good being the programmer" (student R)

"it was exciting and interesting but I didn't get to do much" (student C)

"I didn't really understand it !!!" (student E)

"I enjoyed this the most because it involved problem solving" (student G) 5/5

"I did not really enjoy this...I found it confused" (student K)

Saying all that those that did it generally performed very well completing the tasks set.

- Most groups programmed a robot to push a can into a containment area (a black square);
- Some groups managed to get a robot to push a can to a black line reverse leaving the can in the square;
- The previous task was developed by some groups to including stopping at second black line after reversing away from the first black line;
- One group used an ultrasonic sensor and the robot didn't move until an object was placed in front of it;
- A second group moved towards an object, detected it using a light sensor and went around the object.

Team Working

The language the students used in feedback suggests the students did see the team work element to it. Each reply was an individual reply, but in many cases 'we' and 'us' was used. This could be indicative that these students did see it as a group activity (which it was intended to be). A couple of quotes from one of the students on this point

"We liked this activity because it help us work as a team."

"We really enjoyed ourselves over the last 4 days. We found it very useful."

FUTURE RESEARCH DIRECTIONS

One of the criticisms of the robot programming part of the Junkbots project is not everyone necessarily gets a go at the programming. To address this a new feature has been added to the project. There are now two parallel activities as well as programming a robot; there is a separate programming exercise carried out at the same time which replicates some of the same actions of the robot but this time on screen.

These exercises are based around the increasingly popular Greenfoot software (http://www.greenfoot.org/download/) which is free to download and use. This can be put on as many machines as are need enabling more people to have a go at programming.

The exercises initially get participants to set-up the world, place a robot within it and get the robot to move across the screen. Building on the each previous exercise, the complexity increases and includes challenges (such as in the figure) where the robot pushes a piece of rubbish (in this case a barrel) off the screen.

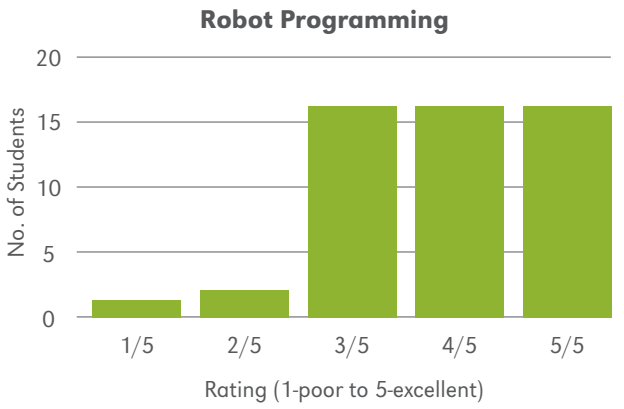

Figure 2. *Student feedback on programming the robots.*

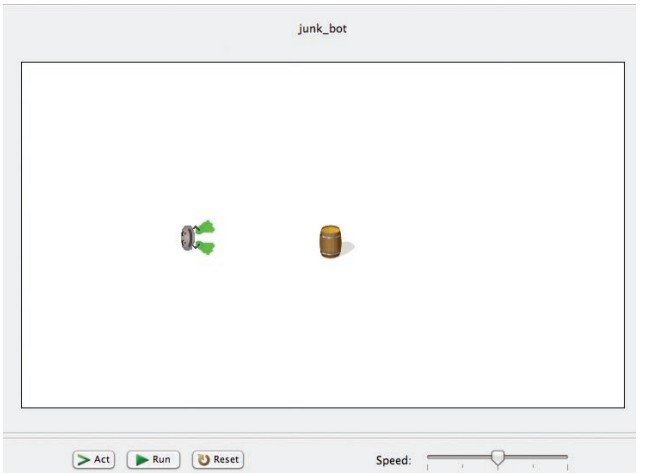

Figure 3. *Using Greenfoot*