A Mobile Visual Programming System for Android Smartphones and Tablets

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***Abstract*— Catroid is a free and open source visual programming system that allows casual and first-time users starting from age eight to develop their own animations and games solely using their Android phones or tablets. Catroid also allows wireless control of external hardware such as Lego Mindstorms robots via Bluetooth, Bluetooth Arduino boards, as well as Parrot's popular AR.Drone quadcopters via Wi-Fi. The project is inspired by Scratch, supported by Google, so far has 170 active developers, is composed of more than 30 subprojects (e.g., a subproject dealing with music composition using audio input sung by users into the microphone), and is growing rapidly. The visual language itself has been renamed to "Catrobat" as non-Android specific versions are under development. Current state (6/2012) of the Catroid system is open beta.**

***Index Terms*— visual programming language; mobile; smart phone; tablet; programming; animations; educational; games; music; kids; children; teenagers; pedagogical; end user development; Android**

INTRODUCTION

Why programming for children? There is a worldwide shortage of software developers. This is due to rapidly increasing demand together with stagnating or even declining number of computer science students. At the same time our society increasingly relies on software which is less and less understood by the general population. Moreover, software development skills are of interest also for philosophical reasons: Developing software is helps understanding the mechanisms and limitations underlying rational thinking.

Why mobile devices? High-quality low-cost smartphones are increasingly becoming available. In June 2012 300 million Android devices were in use. Moreover, one's smartphone nowadays is always in one's pocket and can easily be used everywhere without preparation, e.g., when commuting to one's school using public transportation or at the backseat of the family car. Being able to program mobile devices also has become an important job qualification.

FEATURES OF CATROID

Catroid[1] runs on smartphones and tablets, is intended for the use by children, and has been strongly inspired by MIT's Scratch programming system[2]. As known from Scratch or Google/MIT's App Inventor[3], Catroid programs are written in a visual Lego-style, where individual commands are stuck together by arranging them visually with one's fingers.

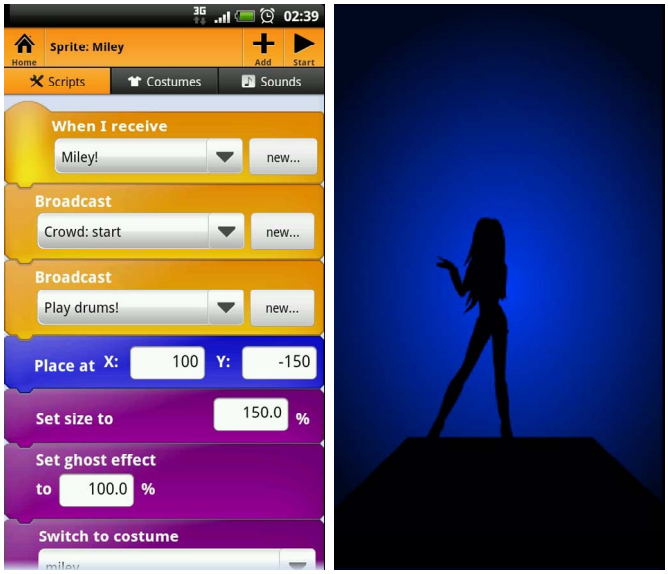

Figure 1. Interactive music video animation.

Figure 1 on the right shows the screen one sees when executing a Hannah Montana interactive music video animation programmed with Catroid which was originally created by a young girl (it is a remix from a Scratch project that can be found at http://scratch.mit.edu/projects/tyster/443306). On the left of Figure 1, a part of the visual program controlling the movements of the dancer is shown. Creating interactive music video animations is tremendously motivating both for boys and girls even though a lot of programming is required and kids can spend days on their creations. Being able to upload such animations as videos to YouTube is an additional strong motivator as kids in general love to show off their creations to their friends regardless of what mobile phone or PC their friends are using. A YouTube recorder for Catroid programs is available, and kids will soon be able to upload their animations to YouTube in high quality (the video encoding is

[1] http://catroid.org/ – I thank the team members and supporters of the Catrobat umbrella project (http://developer.catrobat.org/credits).

[2] http://scratch.mit.edu/ and http://stats.scratch.mit.edu/ (2012-06)

[3] http://appinventor.mit.edu/

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Figure 2. Catroid program for Lego Mindstorm robots.

done on Catroid's servers for performance and bandwidth reasons).

Catroid also differs in important aspects from Scratch and App Inventor. Compared to both, with Catroid there is no need for a PC – the apps can be written by solely using smartphones or tablets. Scratch is intended for PC use with a keyboard, mouse, and comparatively large screen size whereas Catroid focuses on small devices with multi-touch sensitive screens and thereby very different user interaction and usability challenges.

Figure 2 shows parts of a Catroid program that allows controlling a Lego Mindstorm robot. On the left a list of objects is shown, each possessing scripts and images. On the right scripts are shown that are associated with object "turn left" which is the one at the bottom on the screenshot on the left.

Figure 3 shows how Parrot's popular AR.Drone quadcopter can be controlled from Catroid via Wi-Fi. A video showing how it follows the moving helipad is available at http://goo.gl/1CcBK. Being able to quickly use such powerful but very simple to use features is a tremendous motivator to acquire the necessary programming skills for users of all age.

The Catroid system includes a community website allowing users to upload and share their projects with others. It is an important and integral part of our Catroid system. All projects uploaded to the community website are open source and published under a free software license. Everyone can download and edit every project from the website, add new functionality or change the current behavior of the project, and upload the new version again. This is called "remixing" and was a core idea behind the Scratch online community. See Figure 4 for some images of the community website on a smartphone. On the left a list of projects on Catroid's community website is shown. On the right the details page of a project is shown. From there the project can be downloaded directly into Catroid or reported as inappropriate, as not all inappropriate content can automatically be detected. Regarding the latter, names of projects, descriptions, comments, and user names are compared to an extensive multilingual set of cuss

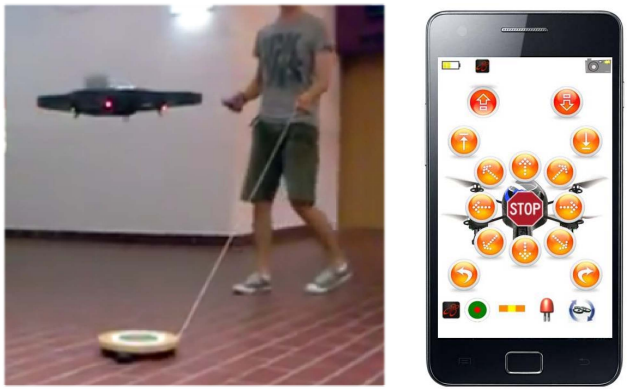

Figure 3. Parrot's AR.Drone quadcopter programmed and controlled via Wi-Fi by a user's program written using Catroid.

words as well as their creative spelling variations and, when recognized, automatically rejected.

The current version of Catrobat as of June 2012 is not yet a full programming language as, e.g., variables and formulas are not yet supported at this time, though we are working hard to extend it in that direction. The project started in April 2010 with a small team. Our aim was to produce a working partial solution with the most important features implemented first,

Figure 4. Catroid's online community website.

and continue from there on. We started to implement some minimal functionality that is sufficient to emulate the highly popular creativity tool Flipnote that is preinstalled on many Nintendo DSi game consoles: Only a background image which can change according to a prespecified timeline while an audio file is playing. We then went on to implement the bricks most used in Scratch programs around the world, based on statistics published on the Scratch website. All of those are now implemented in the first public beta that became available in April 2012. A lot more are currently being implemented to eventually make Catroid a general visual programming system.

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