Scratch Introduction and Programming Education

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***Abstract*— Scratch is a free visual programming language and online community for students between ages of 8 and 16, designed to help them learn and practice computer programming while working on personally meaningful projects such as animated stories and games. The goal of this article is to introduce the Scratch software program for children and demonstrate how it can be used for educators.**

Keywords- Scratch, programming language education, K-12.

I. WHAT IS SCRATCH?

Scratch is a free software program developed by the MIT Media Lab [1]. It is designed to help students between ages of 8 and 16 practice computer programming. Scratch has been accepted by many students, educators and parents to training children to create interactive stories, animations, games, apps etc. [2]. Scratch can help students to develop creative thinking and computational thinking skills for future math and science learning and projects, including simulations and visualizations of experiments, recording lectures with animated presentations, to social sciences animated stories, and interactive art [2].

II. HOW DOES SCRATCH WORK?

There are two main work screens from left to right on the home page of Scratch. The left screen is referred to as the Stage area, where images, such as animations, turtle graphics, etc. are displayed. This Stage area uses X and Y coordinates. Users can choose many ways to create sprites and stage background on the Stage area. For example, users can upload any figures or images from their computers or they can choose a sprite from the Scratch library. Users can also draw their own sprite manually using the Paint Editor, provided by Scratch. All sprites thumbnails are listed at the bottom of the Stage area (See Figure 1) [2].

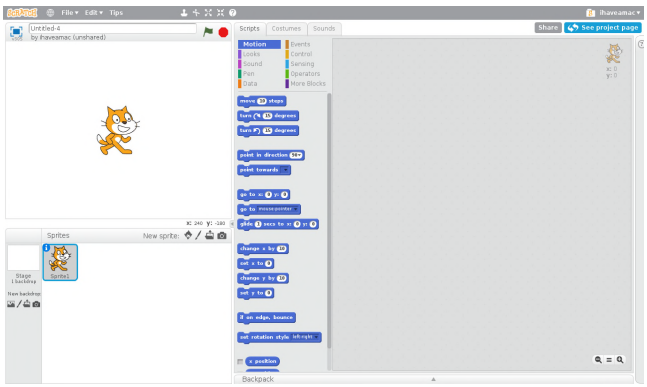

Figure 1. Main page of Scratch

Next, we address the area on the right in Figure 1, which is called Blocks area. Under the *Scripts* tab, all available scripts are listed and categorized in groups such as *Motion, Looks, Sound, Pen, Data, Events, Control, Sensing, and Operators* (see Figure 2). Those scripts can be applied by dragging them onto the Blocks Palette. Each script can also be tested individually by double-clicking the mouse (see Figure 3).

Category	Notes	Category	Notes
Motion	Moves sprites and changes angles and change X and Y values	Events	Contains event handlers placed on the top of each group of blocks
Looks	Controls the visuals of the sprite; attach speech or thought bubble, change of background, enlarge or shrink, transparency, shade	Control	Conditional if-else statement, "forever", "repeat", and "stop"
Sound	Plays audio files and programmable sequences	Sensing	Sprites can interact with the surroundings the user has created
Pen	Draw on the portrait by controlling pen width, color, and shade. Allows for turtle graphics.	Operators	Mathematical operators, random number generator, and-or statement that compares sprite positions
Data	Variable and List usage and assignment	More Blocks	Custom procedures (blocks) and external devices control and can import from PicoBoard or Lego WeDo 1.0/2.0

Figure 2. Introduction of Blocks 1 [4]

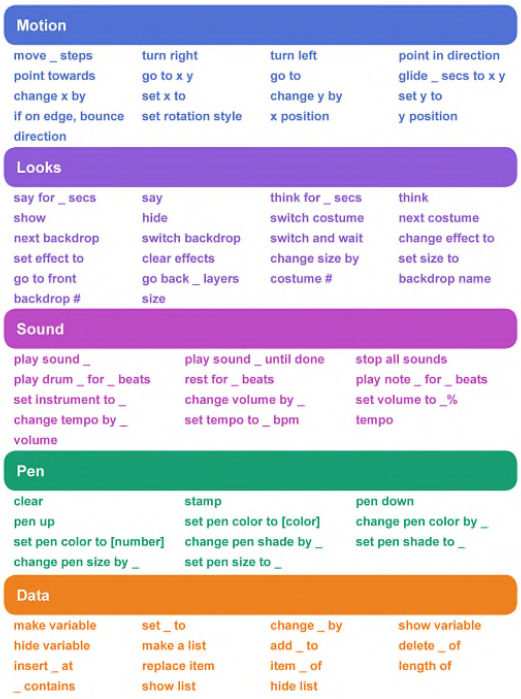

Figure 3. Introduction of Blocks 2 [5]

There are two additional tabs next to the *Scripts* tab, which are *Costumes* tab and *Sounds* tab (see Figure 4). The *Costumes* tab allows users to change the look of the sprite to create various effects, including animation. The *Sounds* tab

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(see Figure 5) allows users to insert/edit sounds and music to a *Sprite*.

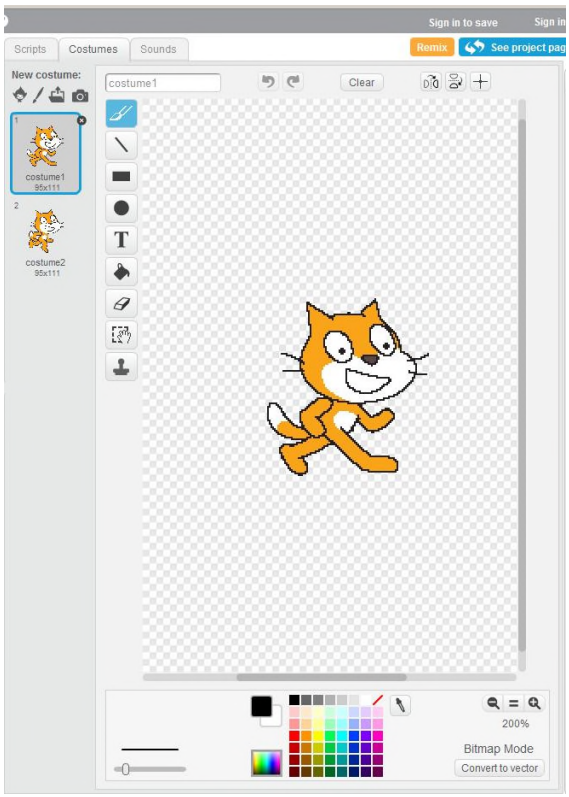

Figure 4. *Costumes* tab [5]

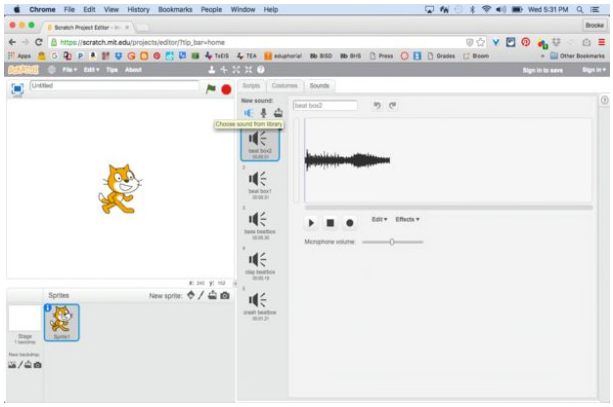

Figure 5. *Sounds* tab. [7]

III. SCRATCH IN EDUCATION

The Scratch programming environment is a computer programming language for children from 8 to 16 years old. Scratch can be integrated into the computer and technology curriculum so that students learn how to program and create multimedia applications and games with ease. Next, we discuss the use of Scratch in the educational curriculum.

Scratch has been widely introduced in after-school centers and other informal educational settings, and has broadened opportunities for children from under-represented groups who may eventually become designers and inventors [8]. Scratch allows students to create their own applications using their own creativity and imagination to create complex programming projects, even connecting with a simple robot used for a couple of sessions. The experience will help their own understanding of geometry, which will help reinforce learning as they are introduced more formally to the subject during mathematics lessons [8].

Creating a finished application involves many skills like the ones used by professional computer programmers, games designers, and multimedia producers, and the children learn the process of moving from the requirements of a desired application, though a design phase, to the engineering and testing of the finished application. Completed Scratch applications can be uploaded to a Web server to create a showcase for parents and other children to view [8].

It should be pointed out that introducing Scratch into classrooms will require teachers to spend additional effort preparing lesson plans for the technology sessions and ensuring that they had the programming knowledge to keep up with some of the more advanced young programmers who were working on projects at home and downloading projects from the Internet. Teachers and school districts need access to the resources and training required to give teachers the experience and confidence to incorporate Scratch into their lesson plans for computer/technology as well as other topics of the curriculum.

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