

UNDERSTANDING INTERACTION DESIGN USING TINY COMPUTER SYSTEM

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ABSTRACT:

Our purpose is to explore the feasibility of an educational technique for students to have a positive relation with a computer from the stage of thinking and to learn “interaction design.” In this practice, the students designed the basic emotion of a robot using a tiny computer named “The Hand cricket.” The Handy Cricket can be easily programmed by using a program “LOGO Blocks.” Although the almost students who study design usually use a computer for drawing and painting, they have not used a computer for machine control. We made the students can understand a machine control to use the Handy Cricket and LOGO Blocks.

Our education program is; (1) observation of the various motions in nature, (2) classification of the motions by some imitative words, (3) construction of robots’ motions, (4) some reflections on designing motions. The students designed some emotions about robots. They had to craft the shape for a robot to be able to move smoothly, and they had to think about computer programming for us to able to have a communication with a robot. We recorded their work process in detail and analyzed how they had the first idea, crafted a shape, thought the programming and avoid some errors.

On the based of the practice, we considered; (1) Observation method from the nature for the motions of robots, (2) Practical use of the computer as a self-expression tool, (3) Embodiment and visualization of the basic emotions about robots.

Our education program can make students understand the design process through a combination of computer programming and crafts. And they can master interaction design in the world of robot design.

Keyword: Windows, design, robot, human – machine interface

1. INTRODUCTION

Recently, various developments in the use of robots have taken place in engineering, medicine, cognitive science, and so on.

We use robots in factory automation systems, rescue operations, space explorations and medical care. And recently, robots are brought into our homes, where they heal us, play with us, clean our rooms and provide security against prowlers. A robot in the home communicates a lot to us humans. We designers should design robots' gestures and behavior. And robots should have better communication with us. To communicate well, robots are designed to behave like humans. Looking at a robot that walks like a human being, we feel a sense of surprise about and friendship towards it. We have a dream: a robot with a near-human form and brain to help us handle various tasks and talk together with us happily.

However, as a robot's appearance and motion become less distinguishable from a human being's, our emotional response to it becomes positive once more and approaches human-human empathy levels.

This area of repulsive response aroused by a robot with its appearance and motion looking like something between a "barely-human" and "fully human" entity is called the Uncanny Valley. [1] The name captures the idea that a robot which is "almost human" will seem overly "strange" to a human being and thus will fail to evoke the empathetic response required for productive human-robot interaction.

We should consider the gesture and behavior of robots again. We need to design robots to move and interact with humans well. And we have to make a design education program about robots' behaviors and motions.

Our purpose is to construct an education method for designing robot motions.

2. EDUCATION PROGRAM

Our education program is constructed in four sections: (1) observation of the various motions in nature, (2) classification of the motions by some imitative words, (3) construction of robots' motions, (4) some reflections on designing motions.

2.1 NATURE OBSERVATION

Observing a natural phenomenon is one of the most important ways of thinking. Designers observe a natural object, simplify some of its curves and patterns, and bring about a new design. We think this is the most important when we design motions.

In our program, we do not make students observe the motions of animals on purpose. We have two reasons. One is the complex motions of animals are too difficult for students to re-produce. Although the motions of the joints and muscles are beautiful, it is difficult for students to express the motions with inorganic materials such as metal, wood, plastics, and so on. The another cause is the motions of animals give students have a fixed idea about the motions of robots. Students who think the behavior of a cat is pretty would think to make a robot pretty is to make it move like a cat

The purpose of this program is for students to discover unique motions, not to reproduce the motions of animals. Students observe a motion such as that of a leaf dropping, water rippling, or balloons dancing in the wind. They observe a simple motion in nature. This observation gives them a chance to re-discover the motion. They observe and analyze the simple motion, and come to have the new idea of reproducing the motion mechanically.

2.2 MOTIONS CLASSIFICATION

Motions in nature are to be classified. The students classify motion samples into some types and plot them on a map named “nature motion map.” The map has two axes, “soft – hard” and “strong – warm.”

They give a keyword to each motion. The keyword is an imitative word[2]. It is subjective to represent a concrete motion with an abstract keyword. They find a keyword in a dictionary to imitate a motion. They discuss about the keyword if necessary. The keyword that the students choose in their discussion is used to describe the motion. And on the basis of this keyword the students reproduce the motion with a machine.

They have to design a new interaction between humans and machines. They have to express a new emotion about a robot. For this purpose, they add the word describing the emotion to the motion.

2.3 CRAFTING AND PROGRAMMING

Based on the nature motion map, they produce some motion objects. The prerequisites of objects are: simple mechanism, repeatable moving and well-proportioned. The objects are plotted on a map named “re-produce motion map” as same axes as the nature motion map.

Comparing the nature motion map with the re-produce motion map, students inspect the objects which they have made. They sometimes remake them when they feel a different emotion about the motion object. They complete the map in trial and errors.

At the final step, based on the motion map, they make a new motion robot with a new concept. The robot arouses in us a new emotion.

2.4 REFLECTION

We record the students’ learning process in photos and movies. Each of them writes down their ideas and errors on a post-it card. They reflect on their learning process after they have made a new robot. It is very important that they themselves can reflect on their learning process. How do they observe nature? How do they discover the keyword? And how do they make the computer program and the mechanics of a motion? Reflecting on the process, they can well understand (1) a view on nature observation, (2) abstraction by words and, (3) computer programming and mechanics.

3. PRACTICE

Our education program started in 2003. In this paper, we introduced the 2006 program. There were twenty-five sophomore students and some senior students. From April to July, they observed and made maps, and from September 2006 to June 2007, they made a motion object.

3.1. OBSERVATION WITH A HIGH VISION CAMERA (HDV)

The students used a HDV1080i camera, SONY HVR-A1J, for the observation[3]. The HDV 1080i images gave them a closer view of motion in nature than SD video cameras.

We gave some information to them: (1) searching in the video finder, (2) recording with wide

lens and zoom lens.

The HDV camera could capture the details of water dropping and splashing on land. Observing the motions they could not see in everyday life, they had a chance to discover simple and beautiful motions in nature.

3.2. EDITING AND MAPPING

The images taken with the HDV camera were edited as follows:

- (1) changed the DV format and saved on PC
- (2) edited the repeat movie
- (3) chose the keyword
- (4) plotted on the nature motion map on FLASH

3.2.1 EDITING THE MOVIE FILE

To keep the HDV quality, we saved the data in DV PRO format on the PC[4]. And to edit the movie data, we used the software “iMovie[5].” The students could edit the movie without using any special technique.

3.2.2 MAPPING ON A FLASH SOFTWARE



Fig.1 Nature Motion Map made on a Flash

To put the movie data on a map, it was translated to FLASH swf data[6]. We set the resolution of the FLASH file to 1920 * 1080 pixels and made a map (Fig.1) . The map data was about 800MB. The map was dynamic. So the students could confirm the motion on the map.

3.3. MAKING A MOTION PROTOTYPE MODEL USING TINY COMPUTER

The students made a motion based on the map in figure 1. The process of production is (1) control by computer programming, (2) design of mechanics, (3) shape production.

3.3.1 CONTROL BY COMPUTER PROGRAMMING

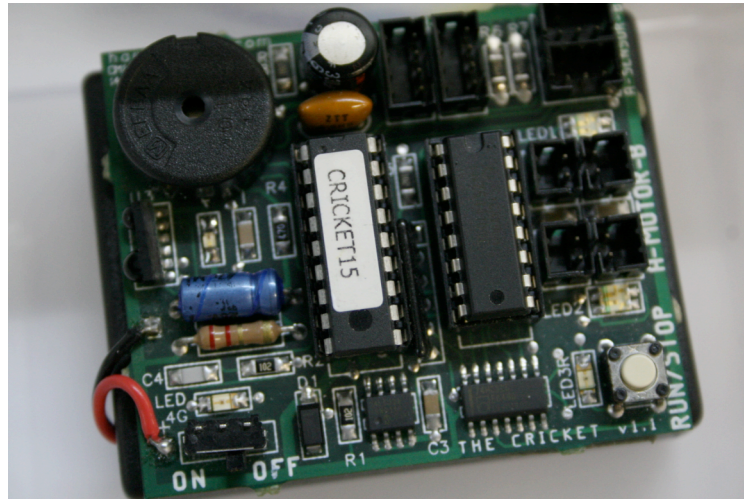


Fig.2 The Handy Cricket

We use tiny computers called "The Handy Cricket [7]" (Fig.2). The Handy Cricket is a low-cost micro-controller ideal for robotics, data collection, electronic art projects, school technology demonstrations, and lots of other applications. The Handy Cricket has the following feature set:

- Microchip PIC® microprocessor with built-in Logo interpreter.

- 4096 bytes of user program and data memory. This memory preserves your program and data even when the Cricket is turned off and batteries are removed.

- Outputs for two DC motors. Two plugs and one bi-color LED on each output.

- Inputs for two sensors. Sensor value may be read as true/false or converted to a number from 0 to 255.

- Two bus ports, which allow the Cricket to interact high a large collection of other devices.

- Built-in infrared transceiver with a raw data rate of 50k baud.

- Power supply provided by four AA cells.

- Piezo beeper, program run/stop button, power LED, and program run LED.

- Board dimensions are 58 mm x 48 mm (2.2" x 1.8"); overall dimensions of battery case are 65 mm x 60 mm (2.5" x 2.3")

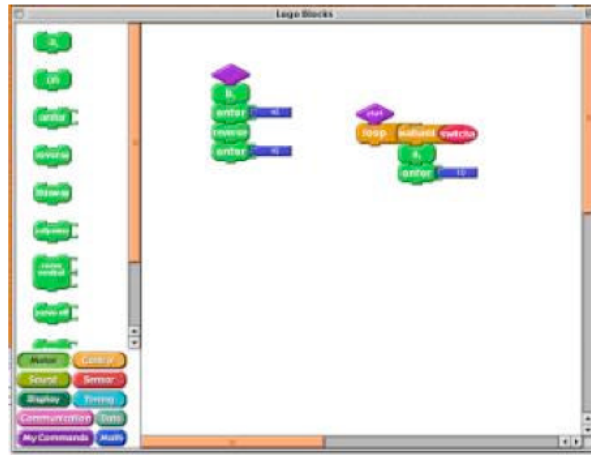


Fig. 3 Cricket Logo Bloks

Almost all the students did not know computer programming. We did not lecture them on it. They wrote programming intuitively by using LOGO BLOCKS (fig.3) [8], a GUI based programming tool.

3.3.2 MECHANICS DESIGN

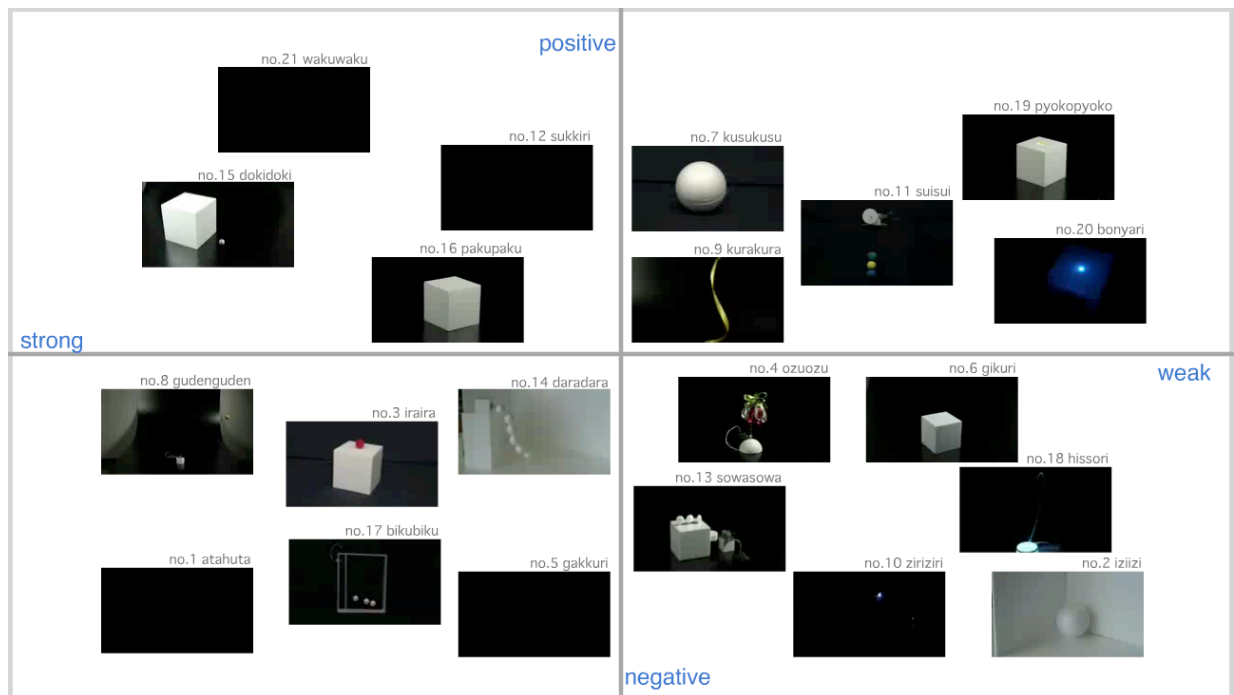


Fig. 4 Re-produce Motion Map

Designing the mechanics is a very high-level skill. Within the specified time, it is difficult for the students to learn the complex skill and apply it. We provide a package of mechanics parts in the education program. The package includes geared motor, clank gear, motor, LED light, photo sensor, switch, and so on. The students made twenty-motion samples using the package.

Figure 4 is a re-produce motion map. Based on this map, the students designed the objects that have emotion-arousing motions.

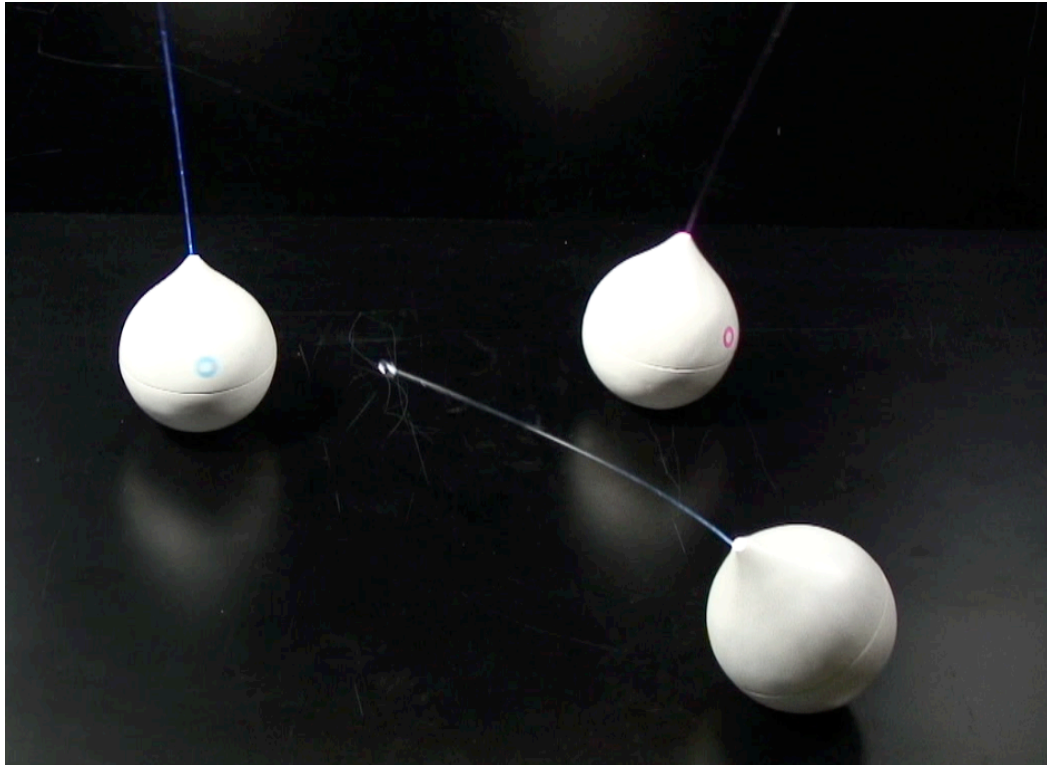


Fig. 5 Sample of the motion object

Figure 5 is one of the sample objects they made. The motion objects made were of three types. They had different characters: one is quiet, another is shy and the other is rough. Their mechanics and motion are very simple. The one made from Styrofoam is a unique style.

3.4 REFLECTION WITH MULTIMEDIA

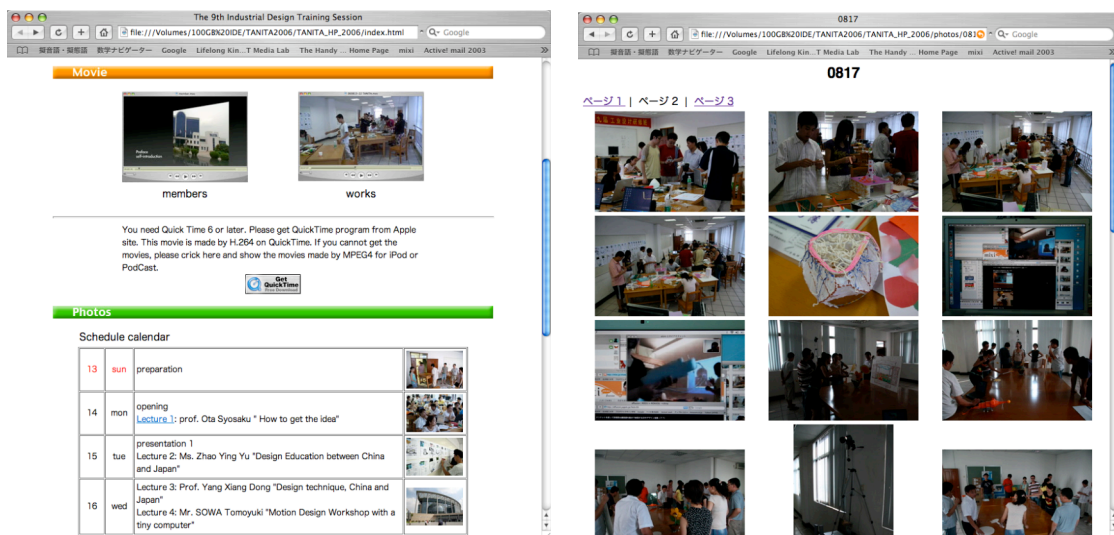


Fig.6 Reflection web site

We provide a reflection web site so that the students can reflect on their work process from their first prototype idea, to building, reconstructing and finally completing the product model (Fig.6).

Looking at the web site, each student can plot programming errors, prototype problems and their solutions on a timeline. When other students came across similar problems, they can look at the website to get new ideas to solve their problem.

4. CONCLUSION

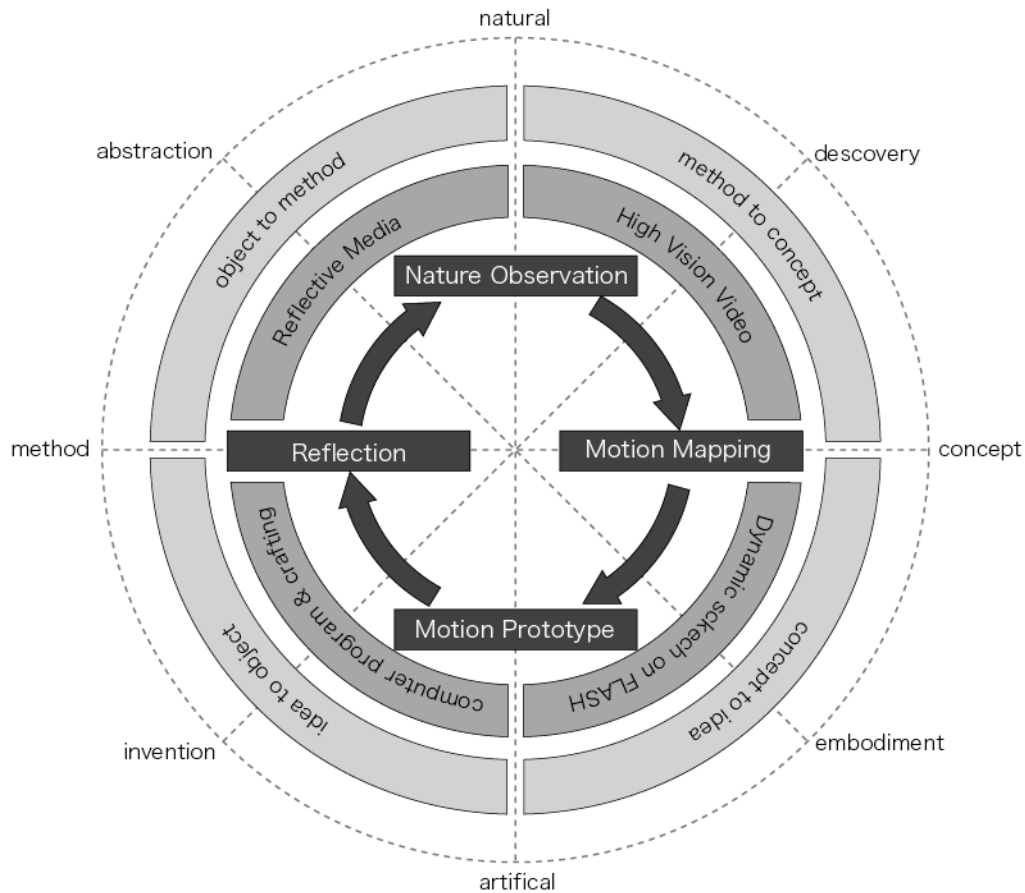


Fig. 7 Education diagram for motion design

Figure 7 is a diagram of our education program. In the program, we have four educational points as follows:

- (1) Students can discover basic motions by observing the motions in nature without animals.
- (2) We are able to make dynamic contents with multimedia such as HDV or flash.
- (3) Using The Handy Cricket computer system, students can understand the control machine without any special training in computer programming. And using the sensors, motors and LED lights, they can think about the interaction between humans and machines.
- (4) Recording their work makes them understand the importance of the design process. Using movie or animation contents is important in learning the process of motion design.

In this program, the motion objects the students make do not have any specific purpose. The purpose of our education program is “to discover new motions for robots.” Design a simple motion gives the students a chance to discover new interactions between humans and machines. We think if we design more simple motions for robots, they will be able to arouse more emotional responses.

PREFERENCE

- [1] Karl F. MacDorman “Androids as an Experimental Apparatus: Why Is There an Uncanny Valley and Can We Exploit It?”
- [2] The National Institute for Japanese Language, e-Japan. “NIHONGO WO TANOSHIMOU” <http://jweb.kokken.go.jp/gitaigo/index.html>

[3] HDV was designed to offer existing video production environments a cost-conscious upgrade path from standard-definition (SD) to high-definition (HD) video. Since HDV operates at the same recorded data rate (25 Mbit/s bitstream rate) as DV, HDV recorders share the same physical (MiniDV) tape transport as existing DV equipment. HDV camcorders open high-definition video acquisition to consumers, amateur videographers, and low-budget TV production. In HDV, the video frame is defined to have an aspect ratio of 16:9. HDV 1080i uses a resolution of 1440×1080 pixels, but is still displayed with an aspect ratio of 16:9 (like SD widescreen formats, it uses a pixel aspect ratio of 1.33 instead of 1.0).

[4] Digital Video (DV) is a digital video format launched in 1994, and, in its smaller tape form factor MiniDV, has since become a standard for home and semiprofessional video production; it is sometimes used for professional purposes as well, such as filmmaking and electronic news gathering. The DV specification (originally known as the Blue Book, current official name IEC 61834) defines both the codec and the tape format. Features include intraframe compression for uncomplicated editing, a standard interface for transfer to non-linear editing systems (FireWire, also known as IEEE 1394), and good video quality, especially compared to earlier consumer analog formats such as 8 mm, Hi8 and VHS-C. DV now enables filmmakers to produce movies inexpensively, and is strongly associated with independent film and citizen journalism.

There have been some variants on the DV standard, most notably Sony's DVCAM and Panasonic's DVCPRO formats targeted at professional use. Sony's consumer Digital8 format is another variant, which is similar to DV but recorded on Hi8 tape. Other formats such as DVCPRO50 utilize DV25 encoders running in parallel.

MiniDV tapes can also be used to record a high-definition format called HDV in cameras designed for this codec, which differs significantly from DV on a technical level as it uses MPEG-2 compression. MPEG-2 is more efficient than the compression used in DV, in large part due to inter-frame/temporal compression.[1] This allows for higher resolution at bitrates similar to DV. On the other hand, the use of inter-frame compression can cause motion artifacts and complications in editing.[2] Nonetheless, HDV is being widely adopted for both consumer and professional purposes and is supported by many editing applications using either the native HDV format or intermediary editing codecs.

[5] iMovie is a video editing software application which allows users to edit their own home movies.

Integrated with FireWire, iMovie takes the raw footage from most digital video cameras (or analog to digital converters) and loads it onto the Mac. From there, iMovie can edit, add titles and add music. Effects cover basic color correction and video enhancement tools, and transitions such as fade-in, fade-out, and slides are included by default. iMovie 5 HD supported HDV.

[6] Adobe Flash, or simply Flash, refers to both the Adobe Flash Player, and to the Adobe Flash Professional multimedia authoring program. Adobe Flash Professional is used to create content

for the Adobe Engagement Platform (such as web applications, games and movies, and content for mobile phones and other embedded devices). The Flash Player, developed and distributed by Adobe Systems (which acquired Macromedia in a merger that was finalized in December 2005), is a client application available in most common web browsers. It features support for vector and raster graphics, a scripting language called ActionScript and bi-directional streaming of audio and video. There are also versions of the Flash Player for mobile phones and other non-PC devices.

Strictly speaking, Adobe Flash Professional is an integrated development environment (IDE) while Flash Player is a virtual machine used to run, or parse, the Flash files. But in contemporary colloquial terms "Flash" can refer to the authoring environment, the player, or the application files.

Since its introduction in 1996, Flash technology has become a popular method for adding animation and interactivity to web pages; several software products, systems, and devices are able to create or display Flash. Flash is commonly used to create animation, advertisements, various web-page components, to integrate video into web pages, and more recently, to develop rich Internet applications.

The Flash files, traditionally called "Flash movies" or "Flash games", have a .swf file extension and may be an object of a web page, strictly "played" in a standalone Flash Player, or incorporated into a Projector, a self-executing Flash movie with the .exe extension in Windows. Flash Video files have a .FLV file extension and are utilized from within .swf files.

- [7] F. Marth, B. Mikhak, and B. Silverman. Meta Cricket: A designer's kit for marking computational devices -Author bios. IBM Systems Journal, volume 39, Number 3 & 4, 2000, MIT Media Laboratory.
- [8] development: MIT. LOGO BLOCKS is based on LOGO language. LOGO is programming language for beginners.

APPENDIX:

1. Behavior Construction Kits. Mitchel Resnick, Epistemology and Learning Group, The Media Laboratory, Massachusetts Institute of Technology. Published in Communications of the ACM, vol. 36, no. 7 (July 1993)
2. 2005 Resnick, M. and Silverman, B. Some Reflections on Designing Construction Kits for Kids. Proceedings of Interaction Design and Children conference, Boulder, CO.