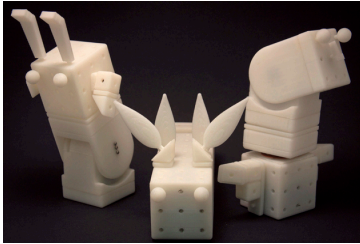# GIFFI: A Gift For Future Inventors

Giffi, a programmable kinetic construction kit, enables children to build dynamic forms with a variety of movements and behaviors.

Kuan-Ju Wu
Tellart, Inc
Providence, RI 02909 USA
kuanju@tellart.com

Mark Baskinger
Carnegie Mellon University
Pittsburgh, PA 15213 USA
baskinger@cmu.edu

Mark D. Gross
Carnegie Mellon University
Pittsburgh, PA 15213 USA
mdgross@cmu.edu

Abstract

Giffi is a computationally enhanced construction kit that enables children to build kinetic forms through purposeful play and discovery.

Keywords

Kinetic Construction Kit, Tangible Interface, Play, Educational Robotics

ACM Classification Keywords

H.5.2 User Interface: Haptic I/O. K.3.1: Computers and Education: Computer Uses in Education.

General Terms

Design, Experimentation, Human Factors

Introduction

Play is important in a child's development and affects how children interact with the world throughout life. German educator Friedrich Froebel designed a collection of twenty types of physical objects (called

Adding a rotational block makes the squiggly snake robot turn its head.

"gifts") including balls, blocks, and other age-appropriate toys to give the child "from time to time new universal aspects of the external world, suited to a child's development" [1]. A century and a half later, Norman Brosterman [2] ascribed the success of Froebel's gifts to using "something tangible to enhance the understanding of something conceptual". Inspired by Froebel, and by Amanda Parkes [6]'s vision of "future interaction for kinetic and transformable structures", we have designed a construction kit for 21st century young inventors: Giffi, a kinetic construction kit to encourage children to investigate kinematic systems through purposeful play.

Interaction

Giffi comprises three basic components: movement blocks, building blocks, and a programming board. With these components children can build animatronics animals or kinetic sculptures.

- Movement blocks

Giffi offers three types of movement blocks: axial/rotational, hinge/swinging, and extension/telescoping. By snapping together these primitive kinetic components, children can compose complex movements. For example, combining two hinge/swinging blocks makes a snake-like robot. Adding a rotational block makes the squiggly snake robot turn its head.

- Programming board

Every movement block contains a servomotor with an ATmega168 microcontroller that stores data and controls the motor. By placing a movement block on
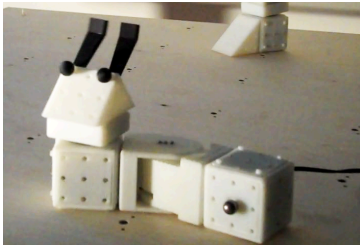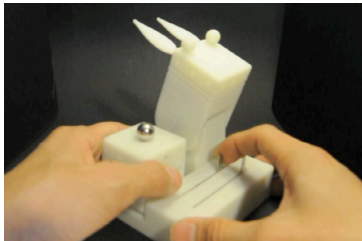
User can set the block's speed and range of movement with programming board.
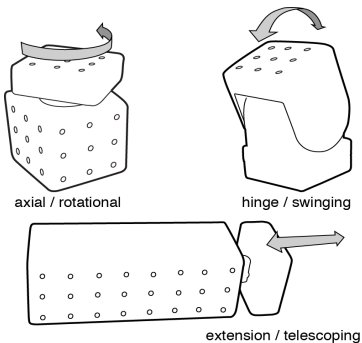
axial / rotational   hinge / swinging

extension / telescoping

Giffi offers three types of movement blocks: axial/rotational, hinge/swinging, and extension/telescoping.

Children play with Giffi at the 2011 Bay Area MakerFaire

the programming board and sliding an adjustable bar on the board, the user sets the block's speed and range of movement. After adjustment, the user removes the block from the board.

- Building blocks

Building blocks are different sized cubes and tetrahedra allowing for a variety of geometrical assemblies. Electrical connectors built into each block double as structural support, so only one power supply is needed for all the movement blocks. Additional parts (e.g., eyes, ears, etc) included in the basic kit add character.

Primitive Motions

Froebel created his gifts for a child to "sooner master the material world about him by becoming familiar with the fundamental properties of the matter …"[3] through "discerning the organized nature of form, to feel that underneath all forms lay one form" [3]. In the spirit of Froebel's gifts Giffi conveys the idea that complex motions are composed of primitive movements. Moving around a central axis, Axial/rotational movement can be found everywhere, from a spinning toy top to the daily rotation of our planet. Hinge/swinging movement is another circular motion. We find it in a bird's wing's flapping, a wagging finger, and an undulating snake. Extension/telescoping movement is linear motion along a straight path, for example, an aerial ladder. To build a dynamic form a child must think which primitive motions are needed and how to combine them. Becoming familiar with the process, a child could sculpt an imagined kinetic structure.

Related Work

Others have designed educational products to offer students technological (i.e., "STEM") skills in an immediate and user-friendly way. LEGO has

successfully developed LEGO Mindstorms and LEGO WEDO [4] allowing children to use visual dataflow programming language on computers to interact and program a robot made of blocks. Topobo [5] provides immediate and physical feedback by using a kinetic memory to record and playback a dynamic mechanization of gestural movement. Kinetic Sketchup [6] consists of different mechanical, material, and behavioral modules. It is a motion prototyping system for architecture and product design. Cubelets [7] offers children an entrée to modular and distributed robotics. The "Kinematics" kit [8] with preprogrammed movement is an excellent and easy way to build simpler kinetic construction kits. By introducing the primitives of motion, Giffi promotes purposeful play and discovery through constructing movement with the aim of sparking imagination, inquiry and exploration.

Reference

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