

**Cubetrix: An instrument-like, portable, cube-shaped device**  
(Technical Paper)

**Evolution of toys and its effect on child development**  
(STS Paper)

**A Thesis Prospectus Submitted to the**

Faculty of the School of Engineering and Applied Science  
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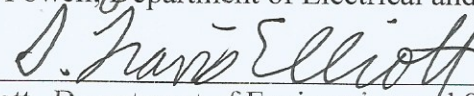
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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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## Introduction

Many people identify technology as a source of innovation and problem-solving, but ignore its contributions to creativity and artistry. The technical project that I am a part of aims to design and create an interactive device that incorporates visual and audial outputs as an artistic and enjoyable product. The device will be cube-shaped and will take in human touch as an input – when a particular side is pressed, the device will react. The output will be an LED pattern on the side that was pressed and an audio signal at a specific tone or frequency. In order to expand beyond just six sounds, the device will react differently depending on the orientation of the device.

Our device resembles a mixture between an electrically-defined instrument and a children's toy. Therefore, my STS research topic is to study child development through the investigation of children's toys as a technology. With the change in technological capabilities, the realm of children's toys has evolved as well. Even in my lifetime I have seen the variety and growth of toys from puzzles and dolls, to game consoles, to online and mobile device applications. Each of these now serve as a valid platform for children to interact with and has no doubt affected the toy industry as well as the way children develop. Child development is also a growing science and has established its importance as a way to understand human behavior and psychology. There is substantial evidence for how certain toys can help children in different areas of their development: social, emotional, mental, etc. My STS research will focus on how specifically flat-screened devices have emerged as an alternative "toy" for a child's play time and how it is affecting their development, as well as identifying social factors for the acceptance of this technology by different relevant social groups.

## Technical Topic

The goal of this technical project is to develop an interactive, musical device that is portable, self-contained, and visually appealing. The device will be in the shape of a cube, 6”x6”x6”, battery-powered, and controlled by a MSP430 microcontroller. The microcontroller will control two input and two outputs. One input, the inertial motion unit (IMU), will determine the orientation of the device which determines what set of sounds the device will play. The other input, the force sensors, determines which side is being pressed. We will have six force sensors – one for each side. One output is the LEDs which will light up a particular side if a “press” is detected. We intend to place 16 LEDs on each face of the cube, and each of these LEDs should display the same color on the same side, but different colors for different sides. The other output is the speaker which will be placed on the inside of the device, but play different tones depending on the orientation of the device and the side being pressed.

The MSP430 will be programmed through a software called Code Composer Studio with C code. The program reads the values of the inputs, defines the parameters like whether the side is pressed or not, then produces the output to the LEDs and speaker. The tones played to the speaker are also generated by the software. The design of the hardware connections was done through Multisim and placed on a PCB board design through Ultiboard, then sent to be custom printed. This PCB board is used to centralize all electronic parts including the MSP430, connections to the inputs and outputs, battery, and other necessary circuit parts. Finally, Autodesk Inventor was used to design a 3D part needed to structure the physical device. An Ultimaker 3D printer was used to print the part in plastic. The cube itself is a clear display case which we intend to spray paint in order to get a translucent effect so that the light will shine through, but the insides of the device will not be fully transparent.

Components of our device have technical areas that our team members are somewhat familiar with, but overall the project is designed to be technically challenging as well as scalable. With this basic device platform, we have many areas of growth where we can redefine the LED patterns as well as the speaker outputs. With the IMU sensor, we can detect more than just the orientation but other movements of the device as well. If given more time and opportunity to expand on this project, our team could look into getting user feedback in order to improve upon our current design and determine what is the best way to interact with the device as well as improve the reaction and aesthetics of the device.

Cubetrix is unique from other similar devices because of its flexibility and capability. There are other devices that are visually appealing with LEDs, but no sound. There are devices with sound but limited visual reaction. There are also devices that will play mp3 music, but not raw tones that are software generated. Finally, there are devices with defined color and sound based on the side, but the ability to change these definitions based on orientation is a new aspect that is not seen in other devices.

## **STS Prospectus**

### ***Introduction***

The primary goal of this study is to analyze the technical development of children's toys and its impacts on child development and utilize the concepts of the social construction of technology theory to understand its acceptance in society through various stakeholders. Where shelves were once filled with rattles, dolls, trucks, and blocks, now are musical devices, singing dolls, and high-tech toys that are all equipped with batteries and microchips (Levin, 2001). More than that, children are now finding entertainment in online games and applications rather than these

physical toys. Research now shows that toddlers can purposefully interact with touch-screen devices at ages as young as 2 (Ahearne, 2016). These devices are growing to be more accessible in the average home and young children can meaningfully interact with them. This begs the question of how this phenomenon influences the development of children.

Child development is a large and well-established area of study. It mainly gained interest in the early 20<sup>th</sup> century, focusing on abnormalities. The focus transitioned its attention to normal development and theories began to form. These theories touch on the factors that affect a child's development – why they might grow to have certain behaviors, what factors are most important in that growth, and how childhood can affect a person's mental state into adulthood (Cherry, 2019). Many studies categorize areas of development by age groups or by skills – social, physical, and cognitive. Focus on these studies can be quite insightful into understanding human behavior as a whole.

The focus of this study will be narrowed to specifically young children in grade school (6<sup>th</sup> grade and under) and how the change in technology from physical 3D toys to flat-screened devices affects their development during play time. Other relevant stakeholders will be analyzed to determine why society as a whole accepts the technology itself and the consequences it bears.

### ***Methodology***

As previously mentioned, child development is a large area of interest and there is significant research in all aspects of it. In order to narrow the focus of this study, the main technology that will be researched is flat-screen devices in the scope of children's play. Most of this study will be conducted through relevant research papers. The first area of research will be the documentation of change in technology and how it has affected the realm of children's toys. How did the shift towards flat-screened devices come about? The second piece is to identify how

these devices are affecting children and their physical and social development. Are their skills and general behavior different when they interact with physical toys compared to these new devices? Next, the relevant stakeholders must be identified. Who cares about this issue and what do they think? After the relevant social groups are formed, the final piece of research will involve understanding what brings this technology into acceptance. What factors are allowing these social groups to influence the technology and vice versa? Each of these questions will aim to be answered through various research papers and online articles.

### ***STS Framework***

The theory of social construction of technology is a framework that will be used by this study in order to conduct a constructed analysis on the issue at hand. Social construction of technology (SCOT) is a theory that claims the advancement of technology is due to various social groups and their interpretation and acceptance of new technologies. The three core concepts of SCOT are: interpretive flexibility, relevant social groups, and stabilization.

Interpretive flexibility is the idea that different stakeholders may have a different understanding of the problem as well as the solution. In some ways the same technology can be the solution to many different stakeholders' various problems. Relevant social groups are groups of stakeholders who have similar purposes or meaning of the technology. And stabilization is the prevailing of one social group in the midst of competing groups.

First, relevant social groups and stakeholders of these new flat-screened devices as a replacement for children's toys will be identified along with their individual interpretations and perceived problems. Next, through interpretive flexibility the different conflicting ideas of the new technology and its purpose will be identified. Finally, an understanding of the stabilization

and acceptance of this new technology will be determined based on which stakeholder prevails and what social factors lead it to general acceptance from society.

## **Conclusion**

The main purpose of this study is to investigate the development of children's toys, specifically looking at the shift towards flat-screened devices as an alternative for "toys". The study will conduct a two-fold analysis: (1) investigating the phenomena of new technology transforming the children's play industry and how it affects their development and (2) using the social construction of technology framework to identify relevant social groups and why this new technology is being accepted. After careful analysis of these social and technical factors in play, we hope to have a better understanding of this specific area of technology and the impacts (positive or negative) it has on society.

## References

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