



# LittleFellows Inc.

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*September 15, 2002*

*Dr. Andrew Rawicz  
School of Engineering Science  
Simon Fraser University  
Burnaby, B.C., V5A 1S6*

*Re: ENSC340 Project Functional Specification for SmileyBaby Mobile*

*Dear Dr. Rawicz:*

*The following document, Functional Specifications for SmileyBaby Mobile, lists all the desired functional specifications for our ENSC340 project.*

*The purpose of this functional specification is to determine the parameters for our SmileyBaby Mobile before we start the actual implementation process. This document lists not only the specifications that we plan to complete by December this year but also those functions that are desirable and will be development in the future.*

*LittleFellows is comprised of four fun loving but focused energetic 3<sup>rd</sup> year engineering science students: Shona Huang, Marjan Houshmand, Farnam Mohasseb, and Farhood Hashmi. If you have any questions concerning our proposal, please feel free to contact us by email at [ensc340-group@sfu.ca](mailto:ensc340-group@sfu.ca)*

*Sincerely,*

*Farnam Mohasseb  
Chief Executive Officer  
LittleFellows Inc.*

*Enclosure: Functional Specification for SmileyBaby Mobile*



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## Functional Specification for SmileyBaby Mobile

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*School of engineering science*

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## Executive Summary

Functional Specification of SmileyBaby Mobile

LittleFellows Inc.

October 31, 2002

LittleFellows Inc. mission is to create a friendly and comforting atmosphere for babies and to assist their parents with ever increasing challenges of raising a child in today's busy working environment.

LittleFellows Inc. is a new and small company with unlimited potential to lead technological-based and innovative baby products of tomorrow's market. This company has been incorporated by four engineering students from Simon Fraser University in fall 2002. The key element of success of LittleFellows lies in the company's diverse background in both technical and non-technical areas. LittleFellows' ambitious culture distinguishes the company from the other competitors.

Our first product, SmileyBaby Mobile, is entering the market in spring 2003. This smart gadget will distinguish babies crying pattern from all other surrounding sounds, and it will play babies' favorite music to put them back to sleep. In future models, this gadget will be interfaced with other toys and mobiles to create a comforting environment for babies.

Parents like to see their child smiling, and at LittleFellows we do our best to bring comfort, warmth and happiness to both parents and their little fellows. LittleFellows' highest priority is to address baby's needs, and we do realize parents are extremely concerned with their child's safety and well being. LittleFellows Inc. paves the road to success and achieving the highest level of customer satisfaction by paying close attention to customer needs.



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## Introduction

SmileyBaby Mobile is a device that turns on the mobile and plays soft music automatically when the baby cries. Researchers in the field of psychology have discovered that babies use different patterns of crying to show their feelings. Most individuals, especially parents, have a hard time ignoring baby's cry and will attempt to attend to their baby. However, not all the cries require the parents' immediate attendance. SmileyBaby is a tool intended to decrease the amount of work required for parents to complete. In addition, SmileyBaby furnishes the baby with warmth and comfort. In other words, this gadget detects that the baby is crying, perhaps due to boredom, fear or loneliness, and runs a mobile or plays a selection of music. A functional unit of SmileyBaby will be ready by December of 2002. Further developments for commercial purposes will occur following that date.

### *Scope*

The functional specification for SmileyBaby will be outlined as follows: an overview of the system, functional requirements, the physical and theoretical characteristics, practicality and marketability, user preferences, interface requirements, safety issues, legal issues, and regulatory requirements. Please note that this product is developed at the university learning/working environment where proof of concept device will not necessarily be possible to finitely describe. If this product becomes marketable, some confidentiality and secrecy will be necessary to ensure maximum profit and marketability.



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## *Referenced Documents*

- [http://www.ensc.sfu.ca/users/whitmore/public\\_html/courses/305/305.htm](http://www.ensc.sfu.ca/users/whitmore/public_html/courses/305/305.htm), Specifications and Post-Mortems.ppt, Example Functional Spec.pdf, Steve Whitmore, September 14, 2002.
- <http://www.parenthood.com/articles/phw877.htm>, Why Do Babies Cry?, Fiona Marshall, May 30, 2002.
- <http://www.blakehall.demon.co.uk/ExampleIntroLesson.htm>, The Development of Social Behaviour,
- Home Based Study Ltd, May 30, 2002.
- <http://www.todayparent.com/baby/article.jsp?cid=6518>, How Babies Communicate, Teresa Pitman, May 30, 2002.
- <http://www.slumbersounds.com/baby-crying-info.htm>, Crying Out Loud - Deciphering and Soothing Your Baby's Cries, Dr. Charles E. Schaefer, September 25, 2002
- <http://www.fisherprice.com>, Fisher-Price homepage: [www.fisherprice.com](http://www.fisherprice.com), Oct.1, 2002.
- <http://www.cpsc.gov>, U.S. Consumer Product Safety Commission homepage: [www.cpsc.gov](http://www.cpsc.gov), Oct1, 2002.
- [http://www.epinions.com/Tiny\\_Love\\_Maya\\_Symphony\\_in\\_Motion\\_3D\\_Toys](http://www.epinions.com/Tiny_Love_Maya_Symphony_in_Motion_3D_Toys), Oct. 3, 2002.



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- <http://www.fisherprice.com>, Fisher-Price homepage, Oct.1, 2002
- <http://www.cpsc.gov>, U.S. Consumer Product Safety Commission homepage, Oct1, 2002

## *Intended Audience*

The developers of the company will be using this document to reach the goals of the company. The engineering group will use this document as a reference source to develop and implement required stages of the SmileyBaby. The marketing staff will use the document for estimating production and sales promotions. The project manager will determine the progress and quality of the product based on this document.

## System Overview

This section outlines an overview of the SmileyBaby system. As demonstrated in Figure 1, SmileyBaby consists of several sections. Figure 1 shows a microphone receiving sound in the room and converting analog audio into a digital signal. The signal will be stored in a FPGA (a type of memory) from which the signal will be fed to a DSP (Digital Signal Processor) for analyzing. The device will decide if the existing sound contains the baby's cry. Finally, the outcome from the Digital to Analog converter turns on or off the mobile determined by the DSP.



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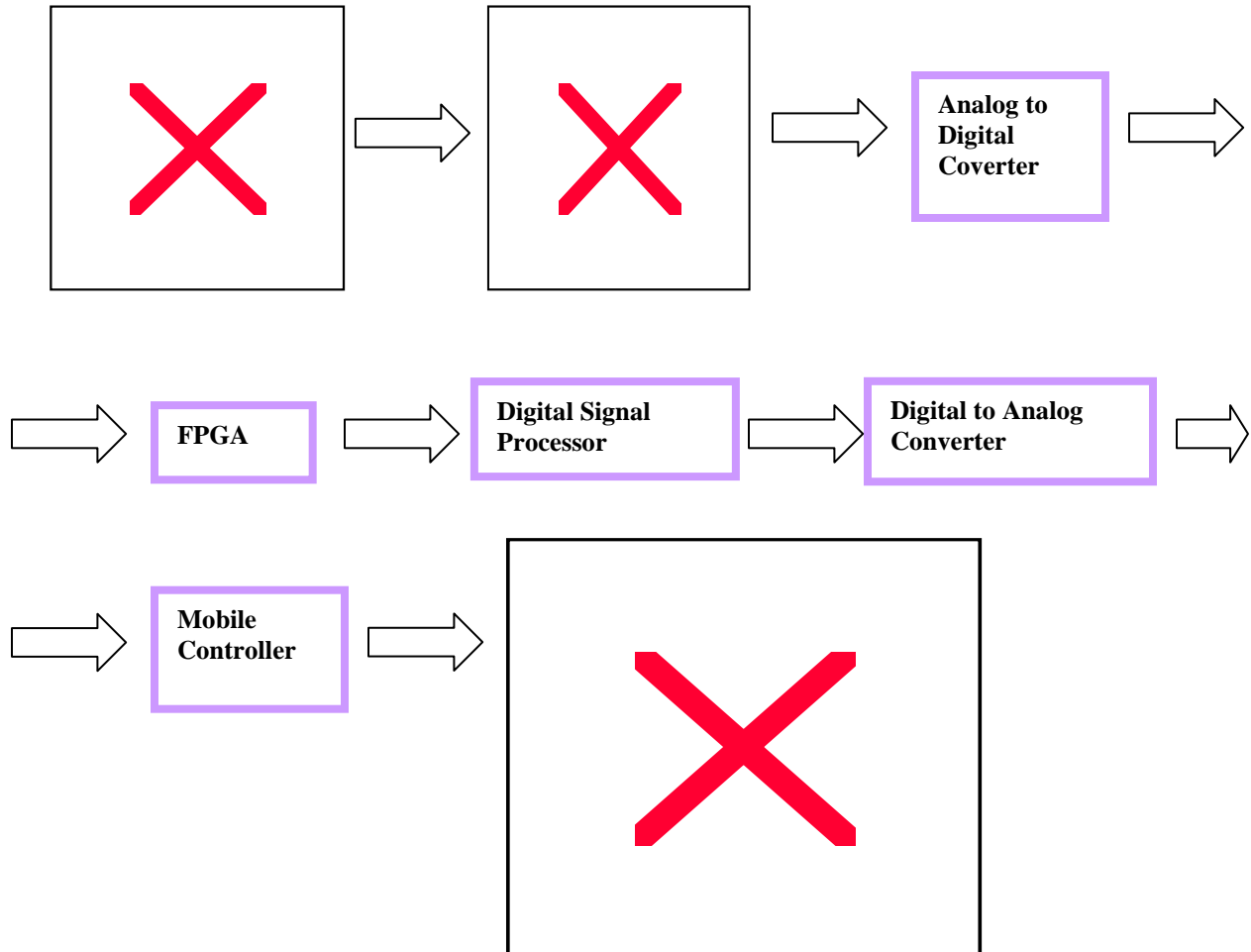


Figure 1, System Overview of SmileyBaby Mobile





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## *Physical requirements:*



SmileyBaby Mobile consists of three individual components: microphone, processing unit and baby mobile. A typical SmileyBaby Mobile system is shown in the above figure. SmileyBaby Mobile is capable of sensing the baby's environment which precludes a rigorous and closely defined response which is described below.

[R1] The microphone is located within 50 cm of the baby which means the baby might be able to touch the microphone. Because of this, SmileyBaby Mobile has to meet the Code of Federal Regulations (CFR). List of all these requirements are provided in the regulatory requirement section of this document. [4]

[R2] The physical size of microphone is 7cm x 2cm x 2cm. The microphone should not have any extruding sharp edges. These requirements are for baby's safety and to prevent baby from mouthing the microphone. [3]



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- [R3] The processing unit which measures 10cm x 10cm x 2cm must be located away from baby in some user friendly location. [3]
- [R4] The product should weight less than 1 Kg for ease of transportation. [3]
- [R5] Because the processing unit must monitor the baby for long periods of time and still consume very little power AA batteries will provide power for the unit. [3]
- [R6] All the connections to the device are accessible from the rear of the unit. [3]
- [R7] The device requires a high efficiency LED to show that the system is off or on. [1]
- [R8] The device requires a secondary high efficiency LED to show the status of microphone. [2]
- [R9] The processing unit is housed inside a high impact plastic enclosure. [4]
- [R10] The unit shall be capable of operating at the normal consumer temperature range of between 10 °C and 30 °C. [3]
- [R11] The unit shall be capable of operating under all household humidity and pressure ranges. [4]

## System Requirements

### *Performance*

- [R12] The device should be capable of sampling at a minimum of 20K Hz, while the optimum sampling rate is 40K Hz. [1]
- [R13] Initialization and set up time should be within 250 ms. [1]



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[R14] The mobile should turn on within three seconds after baby starts crying. [1]

[R15] For power efficiency and to prolong usage of the DSP chip, we will also employ a noise detector to switch the processor to energy-save mode when the environment has been quiet for a certain period of time. [3]

## *Compatibility*

[R16] The DSP chip requires 5 to 12 volt to operate. A voltage adapter will be required if using 117 volts AC. [3]

[R17] This device can be adapted to control many toys/small appliances. [4]

## *Reliability and Serviceability*

The processing unit, including the DSP, is a solid state device attached to the currently marketed mobile; and it should outlast the mechanical parts of the mobile. Since we will be interfacing SmileyBaby with existing OEM(Original Equipment Manufacturer) mobiles, the greatest possibility of failure will be in the controlling unit.

[R18] Once plugged in, the DSP board should be constantly monitoring surrounding sounds. The unit should be capable of continuous operation without failure. [3]

[R19] In event of failure, the unit must be able to reset upon reapplication of power or through the reset switch. [3]

[R20] The unit's buttons should have a duty cycle of at least 1,000,000 cycles. [3]



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[R21] The unit's firmware will be one-time programmable. [1]

[R22] The unit should not be serviceable by the end user. [1]

## *Safety*

[R23] CAUTION: Possible entanglement injury. Keep out of baby's reach. Remove mobile from crib or playpen when baby begins to push up on hands and knees. [4]

[R24] Since children under three tend to put everything in their mouths, all parts used in the mobile must have a diameter of 1.75 inches or more to avoid choking hazard. [4]

[R25] Extra caution should be taken to ensure that the electric parts of the product are correctly wired and difficult to misuse. [4]

[R26] The device should have no pieces that are detachable by children. [4]

[R27] Use electrical cords that have polarized plugs or grounded three-prong plugs. These features reduce the risk of shock. [4]

## Interface Requirements

Requirements for the user interface are the installation of the mobile and powering the DSP and the mobile.

The mobile has a music unit that is attached to the crib. The mobile unit then fits into the top of the music unit. The mobile is suspended from the top of a pole. The pole is candy shaped and holds the mobile well above the crib height. It should attach to most cribs with an easy attachment



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mechanism. This attachment mechanism can easily be swung out of the way to allow easy access to baby. The music unit has an on/off button and three other buttons, one each for Mozart, Bach and Beethoven. There is also a volume control to adjust the volume on the music box.

[R28] Both music box and DSP board should be connected to the power outlet. [3]

[R29] The switch on the music box should be capable of bypassing the DSP output. [1]

[R30] There is also a microphone that fits easily on the music box and connects to the DSP board. (Please note that the microphone should be pointed directly toward the baby for best performance.) [1]

[R31] The processing unit which includes the DSP board has a visible on/off button and an input for the microphone. The microphone will be physically attached to the music box but electrically connected to the DSP board. [1]

[R32] In order to activate SmileyBaby, the user must turn on the DSP board, the music unit, and correctly hook up the microphone. [1]

## Constraints

[R33] There is no LCD for this automatic device and it does not require any inputs from the user. [1]

[R34] The mobile unit and music box come separately and the music can be played without the mobile unit hooked up. [1]

[R35] The DSP board (processing unit) is only compatible with this mobile package and cannot be interfaced with other toys or mobiles. [1]



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[R36] Once the DSP board is turned on, the mobile should be in ON state in order for the SmileyBaby to work. SmileyBaby will do nothing if the DSP is on and mobile is off. [1]

[R37] Once the DSP board is turned off, the mobile can function separately. In other words, it can be easily turned on or off using its own ON/OFF button. [1]

## User Characteristics

SmileyBaby 's potential customers are any individuals who desire to care and raise a child. The majority of these customers are parents, grandparents and babysitters, who would like to create a friendly peaceful environment for both their babies and themselves.

Due to possibility of the baby's cry at any time of the day and night, SmileyBaby's system performs and functions at all time.

## Assumptions and Dependencies

As a result of the algorithm used to distinguish a baby's cry from other surrounding noises, it is very necessary for parent to acknowledge how to install the device. The mobile should be installed above and near the chest of the child. The microphone will be placed within the mobile facing downwards to the baby in order to record the baby's cry which must be determined to be louder than other ambient noise.



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## Regulatory Requirements

As previous stated in the physical requirement section, SmileyBaby Mobile is in direct contact with the baby's environment and it has to be compatible with Code of Federal Regulations (CFR). The following documents are of special interest to LittleFellows Inc.

[R38] Requirements for Nonfull-size Baby: Part 1509, sec 1509.1-13. [4]

[R39] Requirements for electrically operated toys or other electrically operated articles: Part 1505. [4]

[R40] Test methods for simulating use and abuse of toys and other articles intended for use by children 18 months of age or less: Sec 1500.51. [4]

[R41] Technical requirements for determining a sharp metal or glass edge in toys and other articles intended for use by children under 8 years of age: Sec. 1500.49. [4]

[R42] For safety, we will only use electric extension cords with a certification label from an independent testing lab such as UL (Underwriters Laboratories) or ETL (Electrical Testing Laboratories) on the package and on the product. [4]

[R43] We will refer to recommendations set out by the U.S. Consumer Product Safety Commission. [4]

Another set of regulatory requirements are for the processing unit of SmileyBaby Mobile to be compatible with IEEE standards, since this device will in the future be integrated with other toys and mobiles.



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## Conclusion

In our opinion, the requirements stated in this document are the ideal standard for a complete device ready for mass production. However, due to time, funding and other constraints, we only plan to finish the requirements rated (1) and perhaps (2) should time and resources permit by the end of this semester. Requirements rated (3) or (4) are for production and future product improvement.





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## Appendix

### *Glossary*

**A/D converter** Converts analog signal to digital signals

**Bus** A set of signal lines through which the processor of a computer (or a microprocessor) communicates with memory and I/O devices.

**CPU** central processing unit (CPU) The combination of the register file, the control unit, and the ALU.

**Control unit** The part of the processor that decodes and monitors the execution of instructions. It arbitrates the use of computer resources and makes sure that all computer operations are performed in a proper order.

**D/A converter** Converts digital signals to analog signals

**DSP** digital signal processing unit (DSP) A circuit that improves the accuracy and reliability of digital communications. A DSP chip is able to differentiate between human-made signals, which are orderly, and noise, which is inherently chaotic.

**Memory** Storage for software and information

**Microcontroller** A computer system implemented on a single, very large-scale



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**integrated circuit** A microcontroller contains everything that is in a microprocessor and may contain memories, an I/O device interface, a timer circuit, and A/D converter, and so on.

**Microprocessor** A CPU packaged in a single integrated circuit

**Program** A set of instructions that the computer hardware can execute.

**RAM** random-access memory (RAM) allows read and write access to every location inside the memory chip.

**GFCI** Ground fault circuit interrupters are electronic devices that protect people from serious injury due to electric shock. They monitor the electricity flowing in a circuit, and if the amount flowing into the circuit differs from the amount returning, the GFCI will shut off the current. Although they prevent electrocution, there is still a risk of electric shock.

**Three Prong Plug** This plug on a three-wire cord set provides a path to ground for electricity that is straying or leaking from a product. It helps to protect the equipment and can prevent electric shock.

**Polarized Plug** A plug with one large or wide prong and one narrow one, it ensures that the plug is inserted correctly in a socket and reduces the risk of injury by electric shock.