Coca-Cola Light Up Interactive Packaging

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CREATING THE NEXT®

Background

$$$

NFC

Introduction

- A package for Coca-Cola beverages that interacts with users by lighting up in different patterns when activated
- Total prototyping cost: $795
- Approximate production cost @10000: $9.192/unit

Motivation

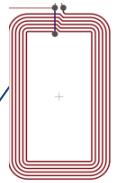
- New concept
- Customer connection
- Brand image

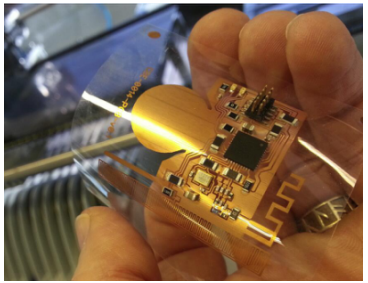
Designs Explored

- Using an FSR to light LEDs
  - FSRs are expensive ($5 - $7)
- Using NFC as a switch
  - Too simple for Senior Design
- **Using NFC to send data (with a microcontroller)**
  - **Adds complexity, more interactive**

Approach Overview

NFC Enabled Phone



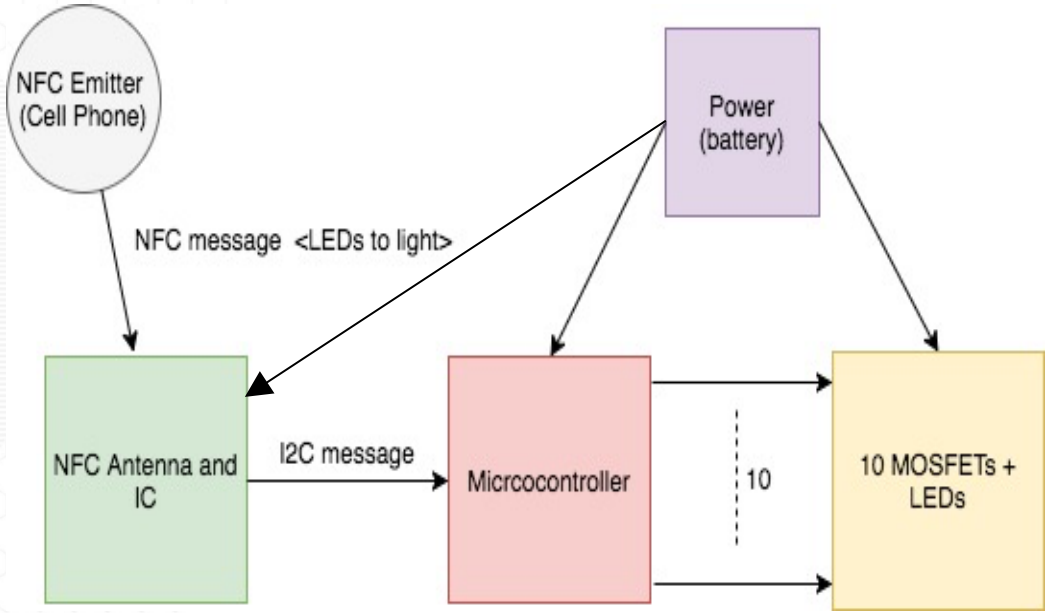


Project Specifications

Temperature Range	2˚C to 35˚C
Water Resistance	IPX4
Drop Resistance	1.5m
Active Duration	30 sec
Storage and Shipping Life	4 weeks
Cost (approx., million-unit scale)	$10
Luminous Intensity	500 mcd
Weight	20g
Form Factor	+2.5mm to bottle radius +0mm to bottle height
Light Interactivity	Wireless
Removability	eLabel is easily removed w/o tools

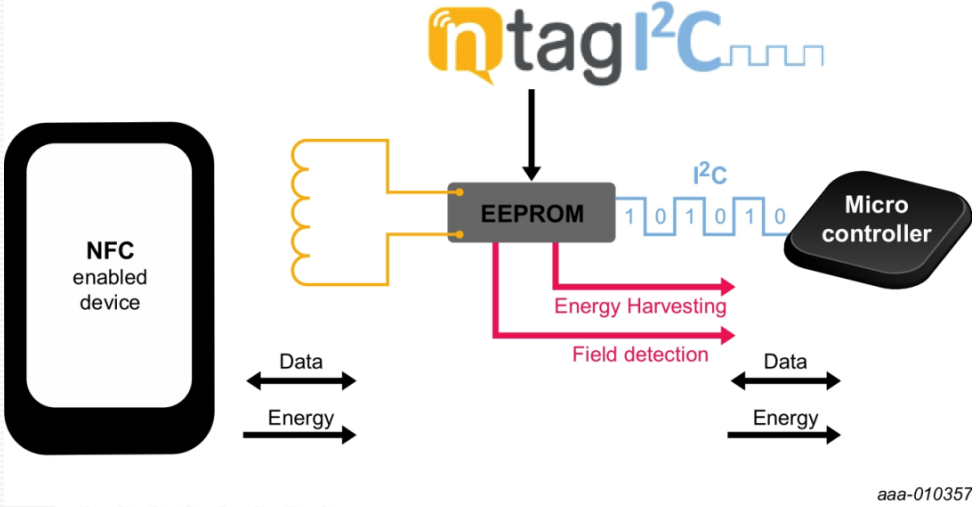
Design Overview

- Power
- NFC Antenna and IC
- Microcontroller
- Lighting (LEDs)



NFC Antenna and IC

- NXPs NTAG
- RF to I2C



Power

- Flexible Lithium Ion Battery

Table 2. Battery Specifications	
Item	**Specification**
Output Voltage	3V
Current Draw (max)	200 mA
Capacity	600 mAh
Size	50.5 mm X 50.5mm
Thickness	1.5mm

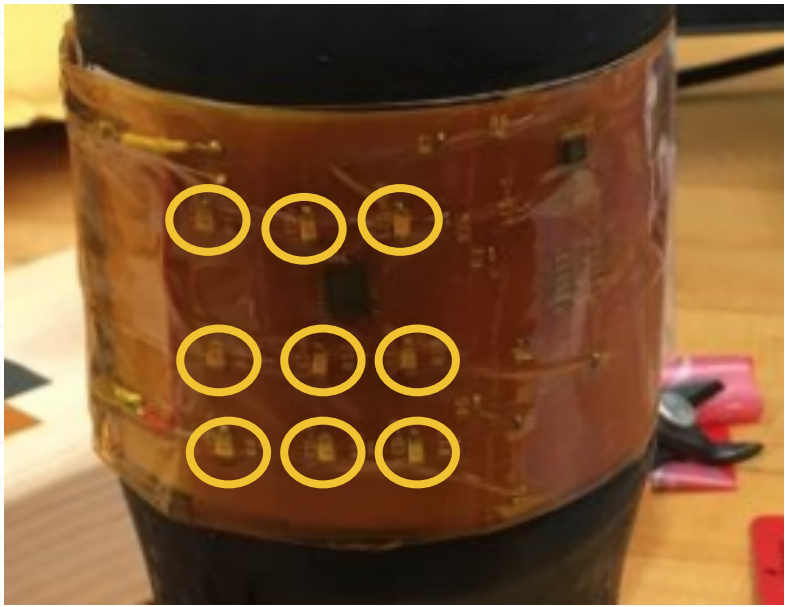
Microcontroller

- LPC812
- ARM Cortex-M0+ processor
- I2C Capabilities
- PMU

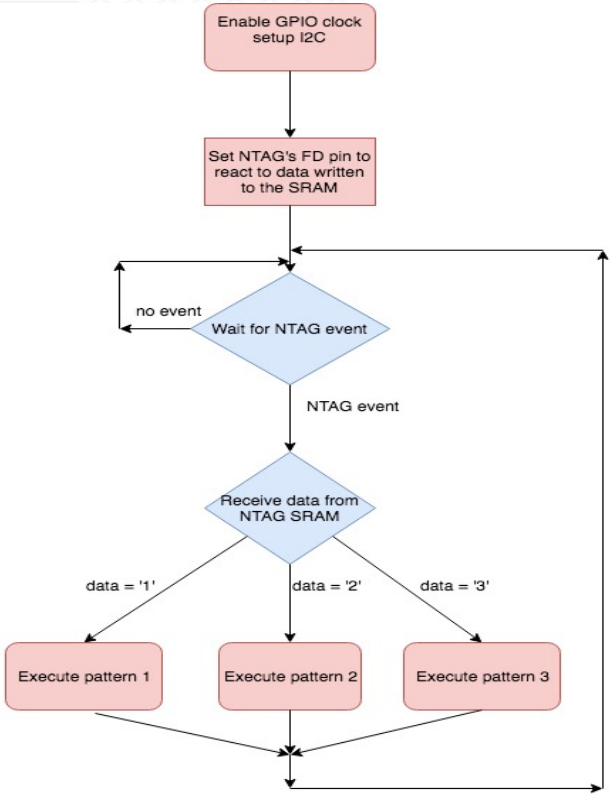
Table 2. MCU Specifications	
Item	**Specification**
Input Voltage (Min)	1.8 V
Current Draw	5 µA

Lighting (LEDs)

- 9 red LEDs
- 3x3 array
- Voltage drop of 1.9V
- Max Current draw 20mA



Firmware Design

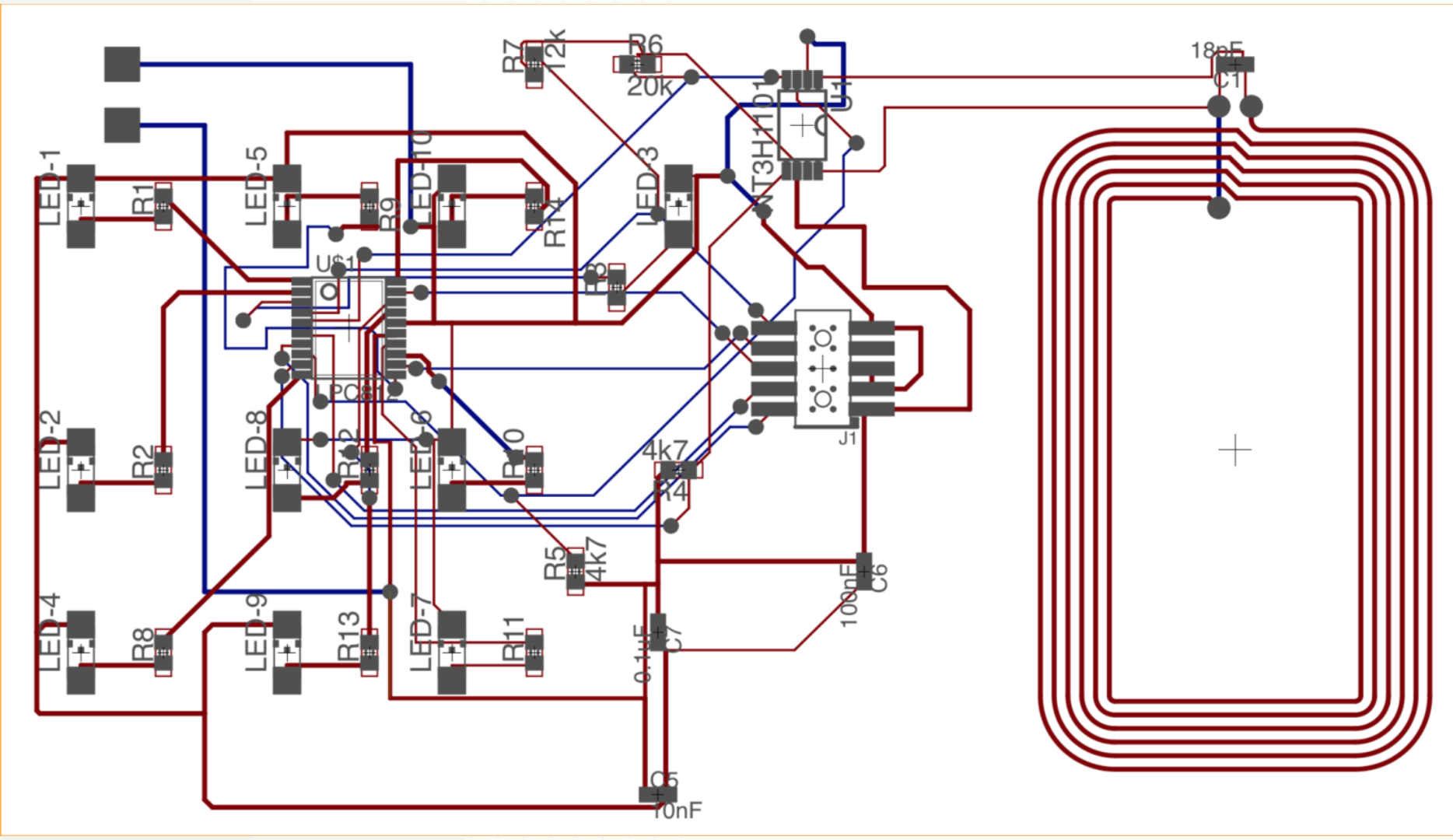


Firmware Design

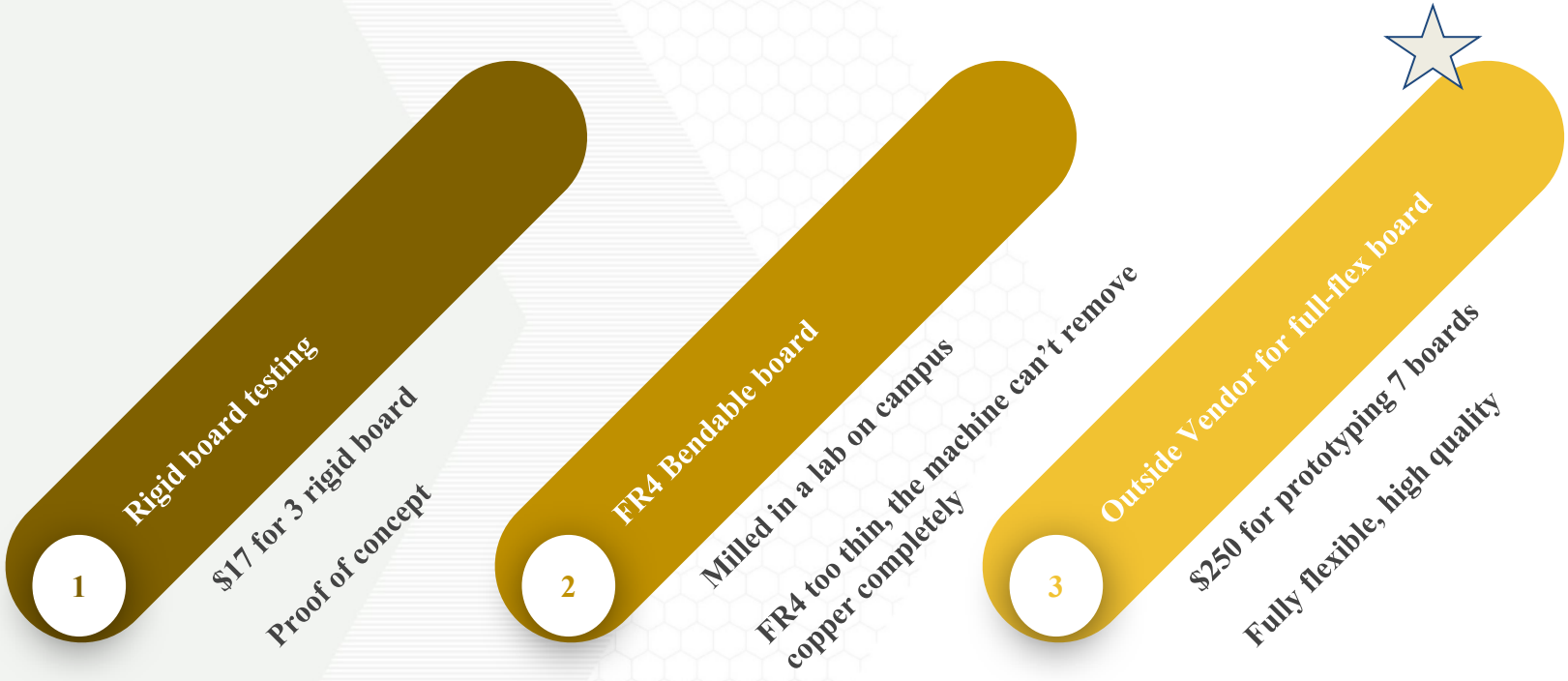
- Firmware written in C
- lpcxpresso IDE
- LPC-Link2 used for flashing

Hardware Design

- Schematic and layout done in eagle
- 2-sided board
- Antenna design from NXP demo board

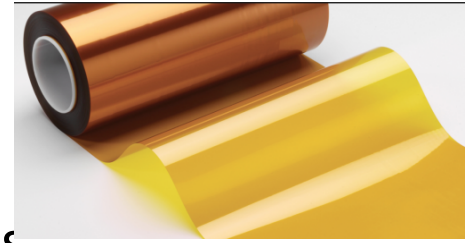

R7
12k
R6
20k
18nF
C1
LED-1
R1
LED-5
R9
LED-10
R14
LED-3
U1
NT3H1101
U$1
R3
J1
LED-2
R2
LED-8
R12
LED-6
R10
4k7
R4
R5
4k7
100nF
C6
LED-4
R8
LED-9
R13
LED-7
R11
0.1uF
C7
C5
10nF

Development stages



Prototype Hardware Assembly

- Water resistance:
  Kapton Tape to cover both sides of the board



- Battery soldered to the board by jumper wires
- “Hidden” under the label

Environmental Considerations

- Bottle is no longer recyclable
- E-waste facility not usually easily accessible
- During campaign, waste can be collected for processing
  - Customer incentive ($ deposit)
- Removable E-label?

Components Cost for Prototyping

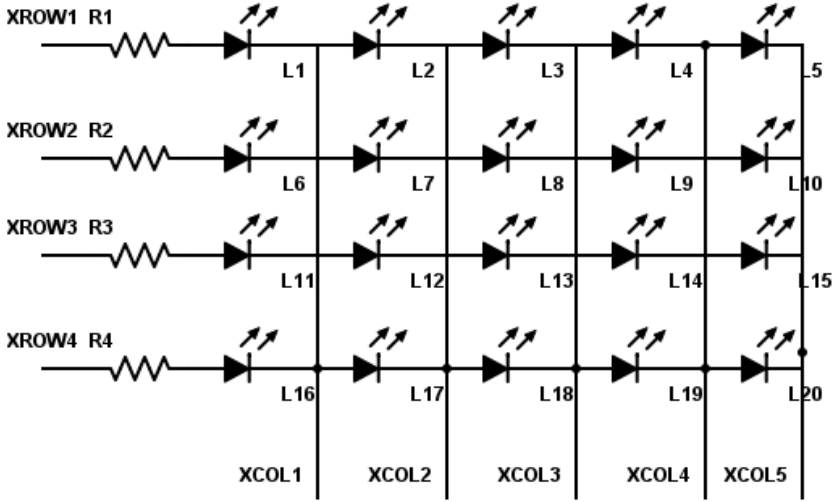
Rigid PCBs x 3	$73
Flexible PCBs x 7	$250
FR4 sheets x 2	$44
NTAG demo-kit	$18.69
Linker board	$22.48
3V Li-ion batteries x 15	$75
Xpresso Development board	$18.75
NXP Microcontrollers	$25
Components (LEDs, resistors, caps, connectors, fuses...)	$150
Grand Total (Including shipping)	**$795**

Approximate Large Scale Components Cost

FR4 sheets (for PCB)	@1	$20/4 (-1 for approx 10000) = $4
Red LED x 9	@10,000	$0.04 x 5 = $0.2
NXP Microcontroller	@10,000	$0.60
Capacitors, SMD x 7	@15,000	$0.002 x 7 = 0.014
NTAG chip	@10,000	$0.35
Li-Ion flat battery	@1	$5 (-1 for approx 10000) = $4
Resistor, SMD x14	@15,000	$0.002 x 14 = $0.028
Total		**$9.192**

Future Improvements---Software

- Variations on LEDs
  - Array (upto 20)
  - pattern
- Additional programming features

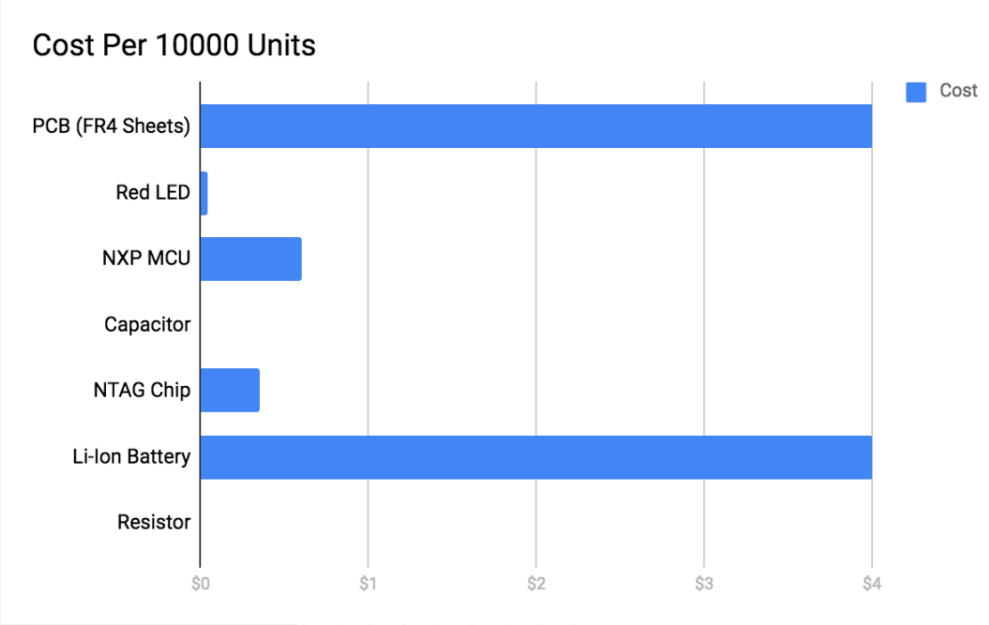


Future Improvements---Hardware

- Power Solution
  - Energy harvesting through antenna
  - E-ink battery
- Add a fuse and a switch
- Water Resistance method suitable for mass production
- LEDs arranged to illuminate Coke logo

Future Improvements---Cost

- Get rid of the battery (energy harvesting)



Questions?

Website Link:

http://ece4012y2017.ece.gatech.edu/fall/sd17f12/

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