



EWH Infant Respiratory Monitor

Team Members

Chris Besaw (Team Leader)

Zac Weier (Communicator)

Steve Young (BWIG)

Ben Smith (BSAC)

Advisor

Professor Paul Thompson

Client

Dr. Amit Nimunkar and Dr. Laura Houser

Overview

- Problem Motivation
- Current Designs
- Design Requirements
- Design Alternatives
 - Microcontrollers
 - Power Sources
- Future Work
- Acknowledgements

Engineering World Health

- Develop & implement healthcare technology in resource-poor settings
- Self-sustainability for medical devices
- Improve quality of healthcare in these places [1]

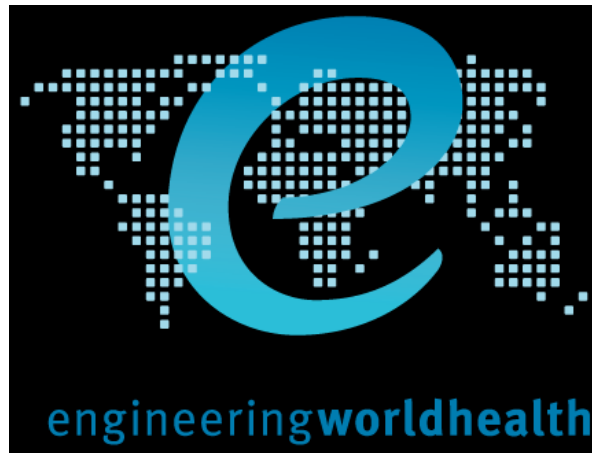


Figure 1: EWH logo

Project Motivation

- Sudden Infant Death Syndrome (SIDS)
 - Sudden, unexplained death of an infant <1 year old [2]
- 4 million neonatal deaths per year
 - 99% occur in low-mid income nations [3]

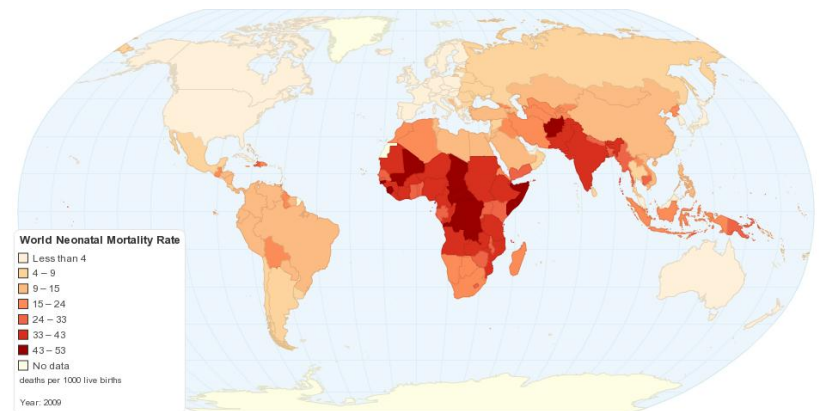


Figure 2: Neonatal death rates worldwide

Problem Motivation

- Environment
 - Unreliable power sources
 - Limited resource availability
 - Medical technology limitations
 - Mobile clinics
 - Moveable, compact

Current Devices

- Babysense
- Angelcare
- RespiSense



Figure 3: Babysense II



Figure 5: RespiSense



Figure 4: Angelcare AC201

Design Requirements

- Alert in event of breathing cessation of 20 seconds
- Highly reliable
- Safe to operators and infant
- Low cost
 - \$40-50
- Power efficient
 - <40 mA

Design Requirements

- Mobile hospital operating environment
 - Portable
 - Robust
 - Simple to operate
 - Suitable for use in third-world countries

Prototype

- Impedance pneumography
- Mbed NXP LPC 1768 microcontroller
- Breadboard circuitry
- 9 V batteries
- Audible alarm

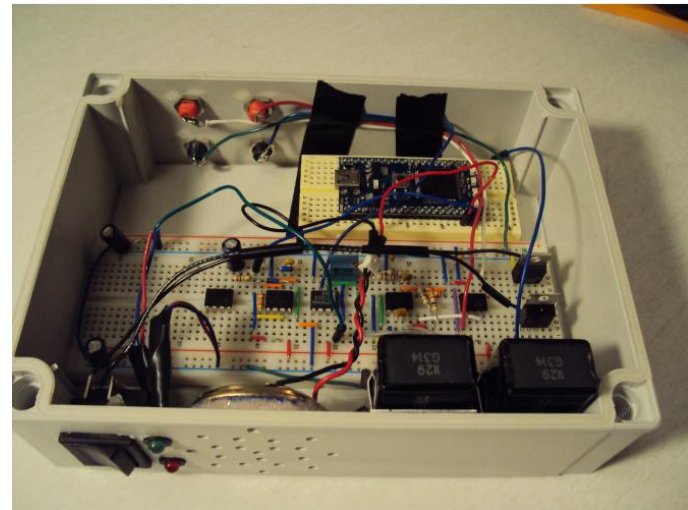


Figure 6: Prototype Device

Design Alternatives

Cypress CY8C3244LTI-123

- 6.6 mA at 50 MHz
- Sleep (1 μ A) and Hibernate (200 nA) modes
- \$ 4.92
- Programming System on Chip: PSoC

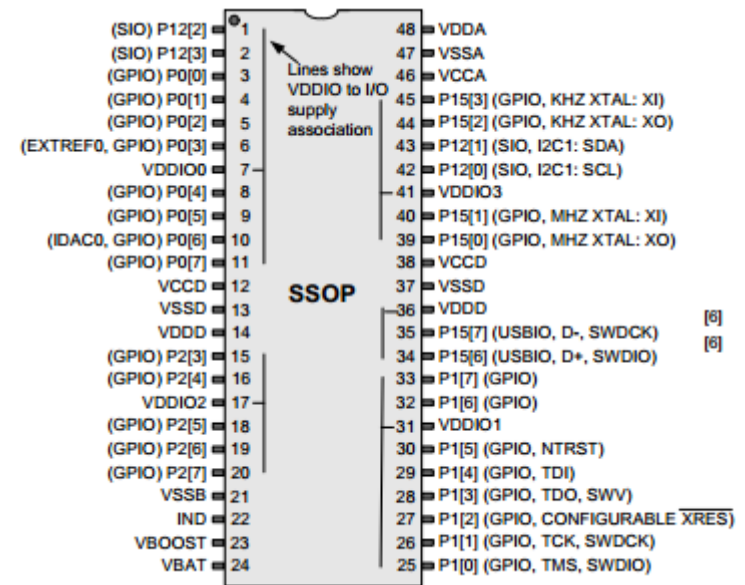


Figure 7: Pin out Diagram for the Cypress Model Microcontroller

Design Alternatives

Microchip PIC18F14K22-I/P

- 6.6 mA at 50 MHz
- Sleep (34 nA)
Mode
- \$1.50
- In Circuit Serial
Programming:
ICSP

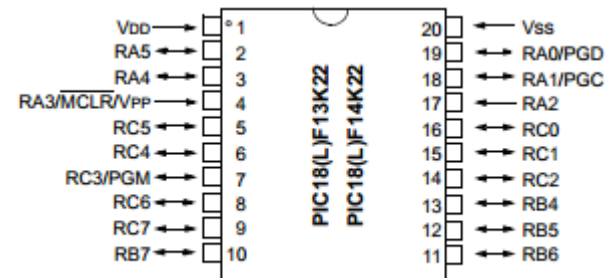


Figure 8: The Pin out diagram for the PIC18 Model Microchip

Design Alternatives

Atmel ATxmega32A4U

- 9.8 mA at maximum parameters
- Idle (3.8 mA)
- Price \$ 3.06
- Program and Debug Interface (PDI)



Figure 9: The Atmel controller is specified in a TQFP- 44 packaging.

Microcontroller Design Matrix

Category	Weight	CY8C3244L TI-123	PIC18F14K 22-I/P	ATxmega32 A4U
Cost	0.3	1	4	2
Programmability	0.3	4	5	5
Current Requirement	0.25	4	4	2
Required Peripherals	0.15	2	5	3
Total	1.0	0.56	0.89	0.61

Design Alternatives

Batteries

- 9 V Energizer Batteries
 - 625 mAh
 - Unit cost: \$1.42
- T-energy 9V Rechargeable Battery
 - 250 mAh
 - Unit cost: \$4.34
- Kyocera Cell Phone Battery
 - 3.7 V
 - 1000 mAh
 - Unit cost: \$5.99



Figure 10: 9 V batteries from energizer



Figure 11: 9V rechargeable batteries

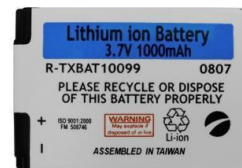


Figure 12: Kyocera 3.7 V cell phone battery

Design Matrix

Batteries

Category	Weight	9V Regular	9V Rechargeable	Cell Phone
Initial Cost	0.1	5	3	3
Recurrent Cost	0.35	1	5	5
Voltage	0.1	4	4	2
Capacity	0.2	2	2	4
Availability	0.25	5	2	4
Total	1.0	0.58	0.67	0.81

Future Work

- Program microcontroller
- Build recharging circuit
- Modify signal processing circuit
 - 3.7 V vs. ± 9 V
- Power microcontroller with battery
- Make reusable electrode belt
- Test device

References

- [1] www.ewh.org
- [2] <http://www.nlm.nih.gov/medlineplus/suddeninfantdeathsyndrome.html>
- [3] Lawn et al. 4 million neonatal deaths: When? Where? Why?. Lancet. 2005 Mar 5-11;365(9462):891-900.

References

Figures

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Questions?