

## Design Project Proposal

EECE 401 Senior Design I  
Department of Electrical and Computer Engineering  
Howard University

### MEMORANDUM

10/31/07

**TO:** Dr. Charles Kim  
Instructor

**FROM:** Opeoluwa Aladekomo \_\_\_\_\_ (*signature*)  
Lindelle Davis \_\_\_\_\_ (*signature*)  
Obafemi Otelaja \_\_\_\_\_ (*signature*)  
Kemal Simpson \_\_\_\_\_ (*signature*)

**SUBJECT:** Design Project Proposal Submission

Enclosed is our group's design project proposal, Multi-Sensor Infant Monitoring System. This proposal is submitted for partial fulfillment of the Senior Design requirement outlining the plan for the project pursuit through the problem formulation with functional requirement, alternative solution generation with electrical and computer engineering approaches, project management and milestones, and task assignments and deliverables. We understand this proposal, in written report as attached and oral presentation upon scheduled, would undergo a rigorous Proposal Review Panel assessment, and we are willing to accept recommendations from the Panel Review and modify and resubmit for final approval.

# Design Project Proposal

## Multi-Sensor Infant Monitoring System

Submitted by

**Opeoluwa Aladekomo  
Lindelle Davis  
Obafemi Otelaja  
Kemal Simpson**

Approved by

Proposal Review Panel Representative:

\_\_\_\_\_  
Name                  Signature                  Date

Senior Design I Instructor:

\_\_\_\_\_  
Name                  Signature                  Date

# **Multi-Sensor Infant Monitoring System**

## **Introduction**

Sudden Infant Death Syndrome (SIDS) is a syndrome marked by the symptoms of sudden and unexplained death of an apparently healthy infant aged one month to one year. SIDS is responsible for roughly *0.05%*, or *50 deaths per 100,000 births* in the U.S making it the leading cause of death in healthy babies after one month of age. Very little is known for sure about the possible causes of SIDS, and there is no proven method for prevention. Although studies have identified risk factors for SIDS, such as putting infants to bed on their stomachs, there has been little understanding of the syndrome's biological cause or causes.

The major objective of our Senior Design Project is to design a multi-sensing infant monitoring system that would help reduce the risk of Sudden Infant Death Syndrome. This device will continuously check certain vital signs in an infant and signal various alarms when these signs are below the expected values or differ in any way from the norm. Some of the major biological signs that we would be putting into consideration in the design of our device includes: respiration rate, respiration pattern, respiration intensity, temperature, pulse rate, blood pressure and any other signs that can help determine whether an infant is in danger of SIDS.

## **Problem Definition**

The National Institute of Child Health and Human Development (NICHD) has reported that the “back to bed” program has reduced the occurrences of SIDS. In addition, previous works in preventing the onset of SIDS have focused on monitoring only a particular stimulus—breathing rate, temperature, infant position, or heart rate—of the infant. However, since the cause of SIDS remains unknown, a system that monitors an irrelevant stimulus to SIDS onset in infants would have failed in its purpose.

Therefore, a multi-sensor infant monitoring system that would monitor multiple vital signs including the positioning of the infant is required. This system requires signal transduction, analysis, processing, and interpretation of the relevant stimuli. After interpretation of the sensor’s response, the system must also be able to alert the caregiver if need be with a probability of false alarm less than 0.02%. In developing this system, a working knowledge of electronics, signals and systems, probability, microprocessors and computer programming would be required. In addition, we would have to acquire some knowledge of signal processing, biology, and biomedical instrumentation.

## **Engineering Approach**

The following are some suggested design solutions:

### **Baby suit**

A specially designed baby suit which incorporates the following:

- Sensor around wrist or near heart built into suit to monitor infant's pulse rate.
- Pressure sensors located on the back of the suit connected to an alarm system which does off whenever the infant is not in the back-to-bed position
- Embedded thermometer which measures the infant's temperature and alerts if temperature gets too high or too low
- Microphone embedded in suit to monitor the infant's respiratory pattern

### **Position Monitoring Mattress**

The position monitoring mattress does not come in direct contact with the infant. It uses pressure sensors as well as a pulse detector and timer to monitor back-to-bed position of the infant. It also monitors the respiratory and heart rate of the infant. It would use signal processing circuits to turn the body movements into measurable electric signals and then compare those values to the average expected values.

The mattress also comes with a crib mounted air sensor that senses air pollutants and warns infant's caregiver of pollutants that are too potent for child inhalation, a noise monitor, and video surveillance of the infant which can be viewed in another room within good distance of the infant's.

### **PAA (Position, Apnea and Alternans) Multi-sensor Infant Monitoring System**

A system for identifying infants at risk for SIDS, comprising:

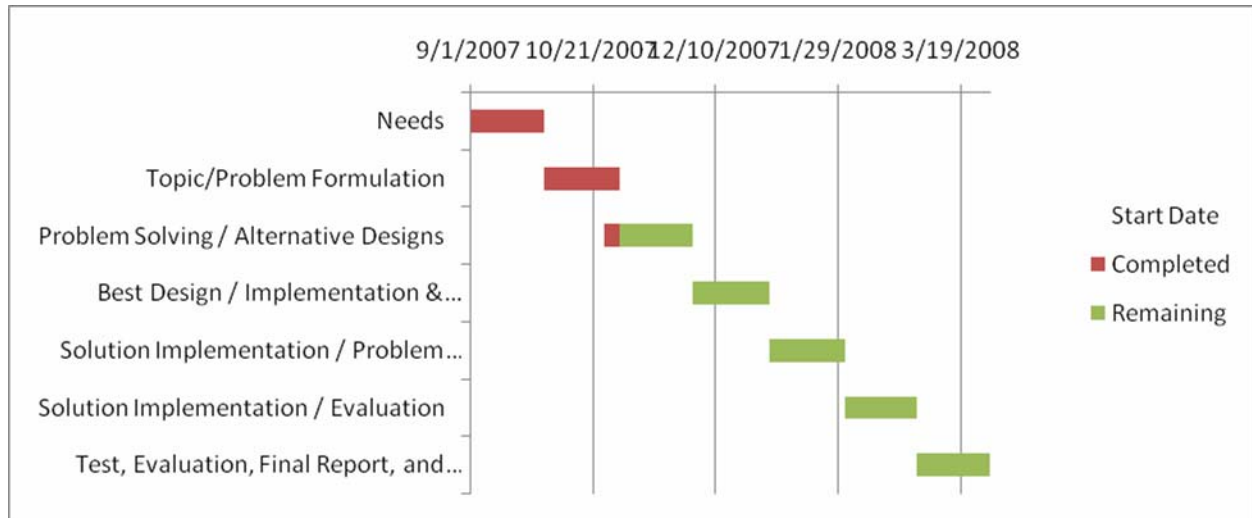
- A Position-sensing transducer affixed to the body or clothing of the infant. The transducer is calibrated to distinguish between prone and other positions assumed by the infant during sleep, and transmits a signal to a remote alarm device when appropriate.
- Incorporation of an accelerometer and a micro controller to monitor respiration movements and control apnea in infants. The accelerometer includes a motion detector and a plurality of output plugs connected to a plurality of input sockets and the micro controller which includes signal outputs that are connected to an alarm means.

An input unit configured to receive electrical signals from electrodes applied to an infant; a processor connected to the input unit and configured to process the received electrical signals to measure alternans of a heart of the infant; and a comparator configured to compare the measured alternans with alternans in a population of infants

## **Tasks and Deliverables**

- Research the issue of Sudden Infant Death Syndrome(possible causes, most common circumstances under which the incident occurs)
- Brainstorm for different ways to monitor the infant:
  1. Surroundings (air pollutants)
  2. Resting Position
  3. Temperature
  4. Pulse
  5. Respiratory patterns and etc.
- Develop a problem formulation containing such factors as:
  1. Device uses
  2. Proposed problem to be solved through implementation of device
  3. Cost
  4. Environmental effects
  5. Regulation requirements
- Meet a minimum of ONCE a week to work on project
- Establish group member roles as well as sign team contracts
- Research US Patents for to determine which kinds of monitoring systems and SIDS preventative devices are already on the market or patented.
- Brainstorm and develop a list of possible devices and solutions, that are not already created, for the problem
- Determine which device would be the best option for the project, team, and “Future consumer”
- Create a group proposal with the best solution and an additional two (2) alternative solutions

## Project Management



Each member of the team has performed extensive research on the topic of SIDS and brainstormed on possible design solutions. The specific task assignments for each member of the team are as follows:

**Lindelle** – assigned to the project management role on the team. Oversees all individual assignments while assuring that all deadlines are promptly met, and individual performance is duly noted. Uses analytical skills to evaluate each milestone throughout the project timeline to determine progressive success and correct any possible delays in schedule.

**Ope** – assigned to the secretary role on the team. Keeps track of all meeting minutes and other written and/or typed documentation specific to this senior design project. Ensures that all individual assignments are blended together to form one cohesive project.

**Obafemi** – assigned to research lead engineer role on the team. Responsible for researching the technical theory behind our project and the different technologies that can be used in problem solving as well as solution implementation.

**Kemal** – assigned to creative lead engineer role on the team. Responsible for refining solution and alternative designs and seeing how our final solution implementation can be improved.

The estimated budget for this project is about \$100. To complete our project, we will need extensive access to the EE and CLDC labs. We will also need to use the school and/or local library to further research our design topic. This project is based on the fact that it is an engineer's primary responsibility to conceptualize and build safe and practical solutions to problems facing the society. As a result, our design for a multi-sensor infant monitoring system will be innovative and still meet all the necessary safety rules and regulations to ensure that our final product is useful, efficient, and safe for use with infants.

## **Conclusion**

For the last several decades, substantial attention has been paid to the problems encountered with Sudden Infant Death Syndrome (SIDS). SIDS has been designated as the highest cause of infant mortality during the first year of life, with one infant dying unexpectedly every hour in the United States. The cause of SIDS remains largely a mystery, although scientists have been able to attribute the onset of the syndrome to certain biological signals and environmental characteristics of the infant. Therefore, our senior design project incorporates many of the important aspects of SIDS into a multi-sensor infant monitoring system that would help reduce the risk of its occurrence. This device will continuously check certain vital signs as well as environmental characteristics of the infant and compare these values to the expected values, signaling an alarm at any particular time once a large enough discrepancy is detected.

The approach we have chosen will require a strong knowledge of many engineering approaches and principles, such as circuit theory, electronics and signal processing. The cost of this project according to our current budget analysis is roughly \$100 dollars, and the projected timeline shows that we should have our finalized project report, prototype ready for demonstration by the end of March 2008. All the various solution alternatives, budget analysis, projected timeline, and engineering approaches are fairly tentative and subject to change after our project proposal review. We look forward to all comments, questions, and constructive criticism. Although designing a multi-sensor infant monitoring system will require a great deal of time and effort, the amount of young lives that it can potentially save on a yearly basis shows how beneficial this project can be to both parents and infants around the world.