

# Matters of the Heart

## Swallowable Capsule Technology Project Proposal

Presented By:

Cimoya Collins

Gilbert Hopkins

Michelle Lilley

Ashley Wells

Presented On:

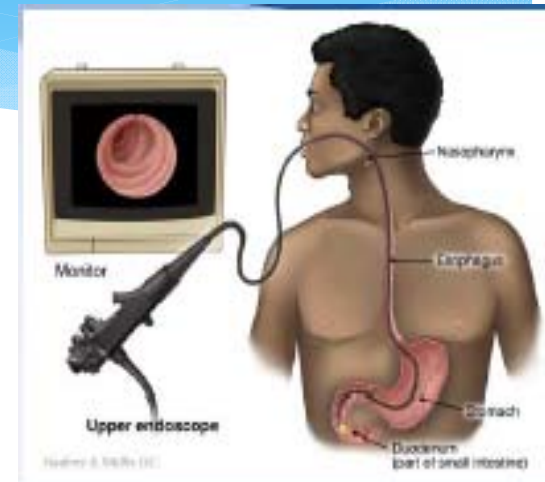
Wednesday, November 9<sup>th</sup>, 2011

# Outline

- \* Background of Swallowable Capsule
- \* Our Problem
- \* Current Status of Art
- \* Design Requirements
- \* Solution Approach
- \* Task and Project Management
- \* Cost and Resources
- \* Conclusion

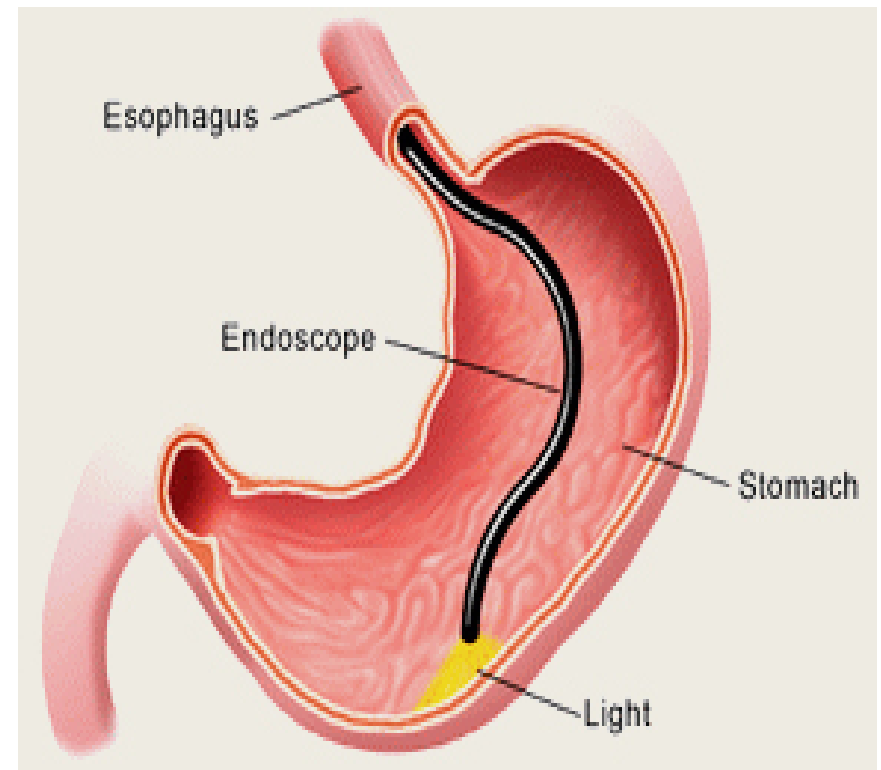
# Background

- \* Gastrointestinal (GI) diseases are ailments that affect over 3 million people in the United States alone
- \* Two Capsule Design Types:
  - \* Analog
    - \* provide a high frame rate (30 frame/s)
    - \* weak to channel noise
    - \* restoration of the data is impossible
  - \* Digital
    - \* transmits 640×480×8 resolution images by using a digital transmitter
    - \* 1 frame/s
    - \* restoration is possible



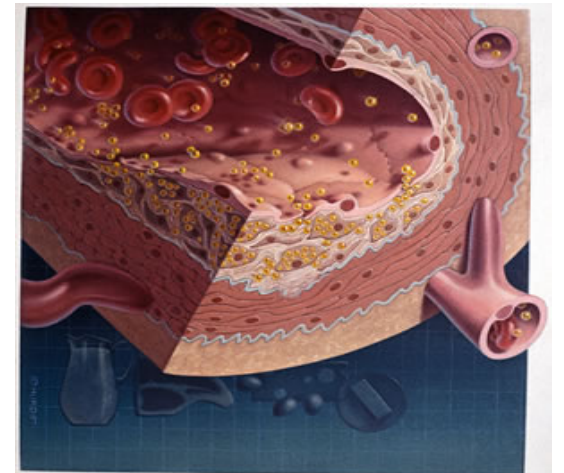
# Problem Formulation

- \* Endoscopy
  - \* Invasive
  - \* Use of anesthesia
  - \* May cause bleeding due to a puncture of esophagus or stomach lining



# Problem Formulation

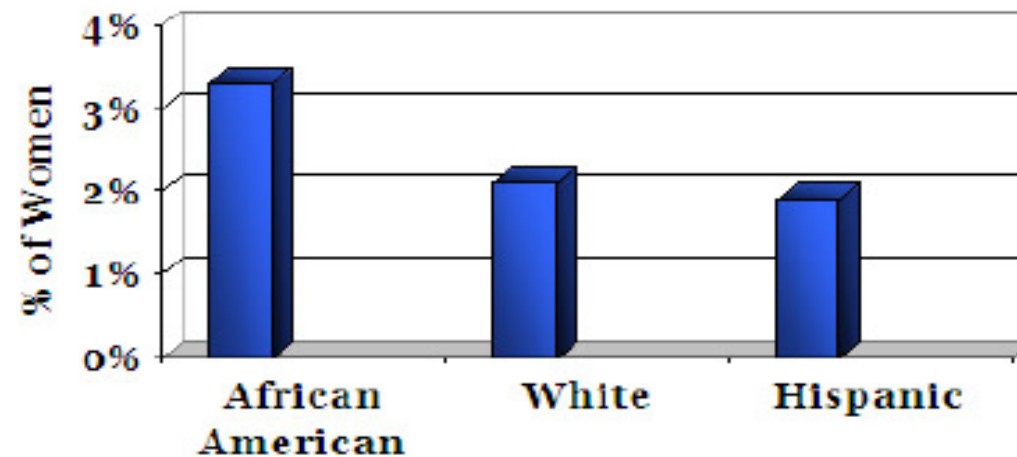
- \* To design a swallowable pill that:
  - \* gives a more accurate diagnosis than endoscopy procedure
  - \* will eliminate the endoscopy procedure
  - \* eliminate the need for surgical procedures that detect certain issues within the body
- \* Swallowable pill will be focused primarily on two classes of diseases:
  - \* Vascular and blood related
    - \* Cholesterol Levels, Stomach (Internal) Bleeding
  - \* Digestive related
    - \* Stomach ulcers, Acidity in stomach



# Motivation

- \* Death from heart disease or stroke at all ages is highest in African Americans
- \* African American women are one third more likely to die from heart disease or stroke than Caucasian women

**Heart Failure Prevalence in US Women  
By Race (2005)<sup>3</sup>**



# Current Status

- \* Ingestible Thermometer Pill

- \* Developed at John Hopkins University with NASA support
- \* Came to be known as CorTemp

- \* Olympus Optical (Imaging)

- \* Used a magnetic field outside of the body to control tracking
- \* Issues: improper illumination and capsule needed to be opened to retrieve images



- \* PillCam

- \* Developed by Given Imaging which was founded by Dr. Gavriel D. Meron
- \* Also developed PillCam SB, PillCam ESO, PillCam COLON 2, and PillCam Express



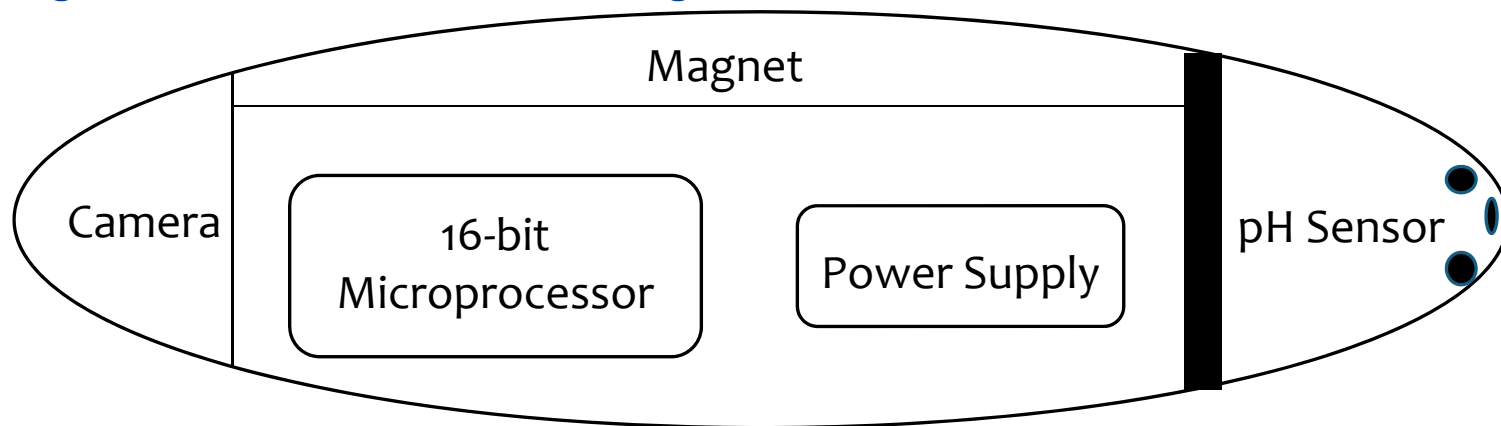
# Design Requirements

- \* Size
  - \* According to Food Drug Administration (FDA) the size of a pill capsule is given the following credentials:
    - \* Length 15mm
    - \* Width 1 cm
- \* Communication Standards
  - \* Medical Implant Communication Service: Operations in the 402-405 MHz range
- \* Regulations
  - \* FDA and HHS standards and regulations must be approved
  - \* Must satisfy and meet ROHS Directive – restricts the use of certain hazardous substances in electrical and electronic equipment such as
    - \* Lead
    - \* Mercury
    - \* Cadmium
- \* Lifespan: The pill must have a battery life of 8+ hours

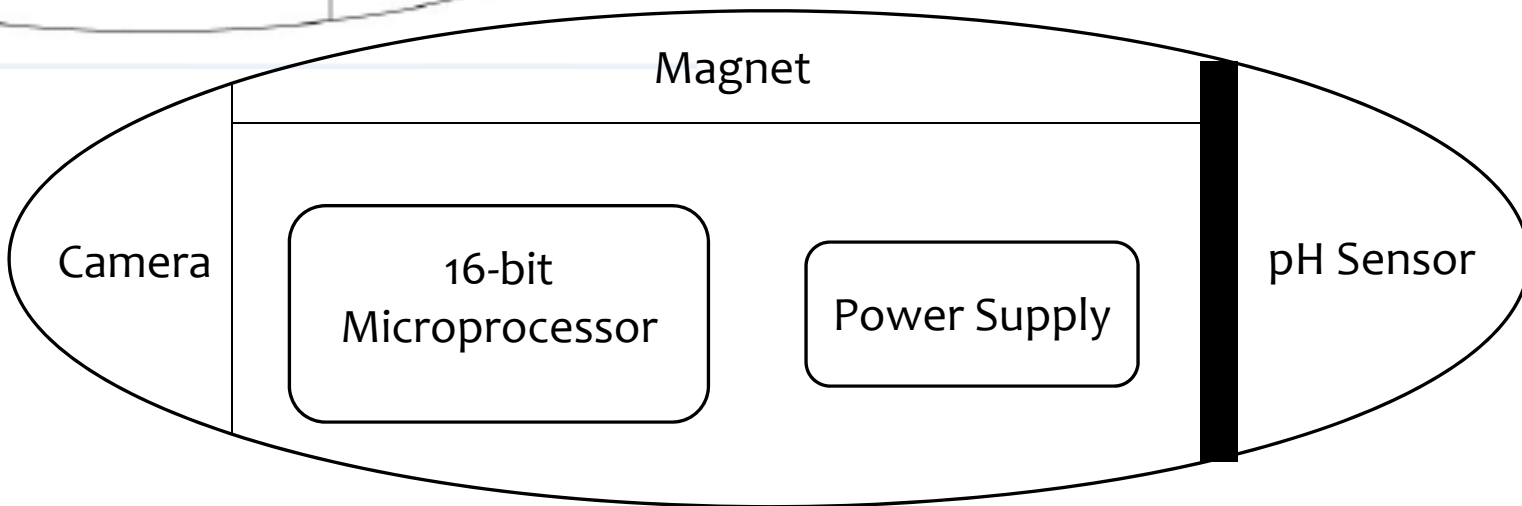
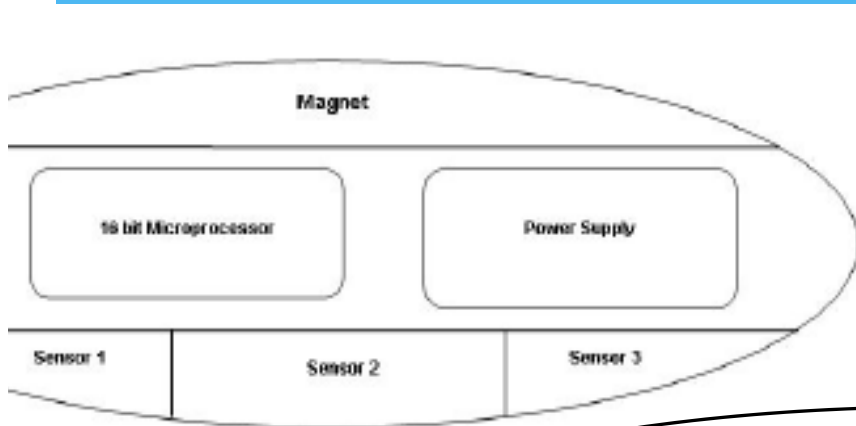


# Solution Approach

- \* The Swallowable Capsule contains:
  - \* 16 bit Microprocessor (EM250)
  - \* Power Supply (as research shows a watch batter has been used as a source of power i.e. Eveready SR92W)
  - \* Surface Mount Technology (SMT)
  - \* pH Sensor used to determine pH level (chemical sensor to detect dissolved oxygen, and conductivity)
  - \* Camera/Video Camera which will take still images as well as video segments
  - \* Magnet used as a source to navigate the pill



# Design Requirements



# Solution Approach Requirements

- \* Ember 250 Development Kit
  - \* Hardware
    - \* EM250 Breakout Board (3)
    - \* EM250 InSight Adapter (3)
    - \* MC Card to SMA Cable (1)
    - \* InSight Port Cable (3)
    - \* Power Supplies and Battery Pack (3)
    - \* Extended Debug Cable (3)
    - \* 8 Port Switch w/4 x POE ports (1)
  - \* Sample Chips
    - \* EM250Chips (10)
  - \* Software
    - \* InSight Desktop
    - \* xIDE Compiler (1 Seat)
  - \* Surface Mounted Technology
  - \* Pill Capsule Shell
  - \* Sensors for Detection
  - \* Video/Camera
  - \* Magnet



# Task and Project Management

Task	Date of Task Assignment
Research Swallowable Capsule Technology	October 2011
Evaluate Potential Solutions	October/ November 2011
Select Best Solution for Problem	November/ December 2011
Go to Nanotechnology Lab	November/December/ January 2011
Develop Capsule	February/ March 2011
Test Capsule	March 2011

# Cost and Resources

Item	Price
EM-250 Development Kit	\$2500*
SMT Components (i.e. transistors, resistors)	\$50
Fiber Optic Cables	\$25
Camera/Video Camera	\$10
Pill Capsule	\$5
Cost of Etching	\$50
Total	\$2640

# Conclusion

- \* **Our Goal:**  
To design a swallowable pill that will eliminate the endoscopy procedure
- \* Swallowable pill will be focused primarily on two classes of diseases:
  - \* Vascular and blood related
    - \* Cholesterol Levels
  - \* Digestive related
    - \* Acidity in stomach, stomach ulcers
- \* **Goal Deadline:**
  - \* Electrical and Computer Engineering Day
  - \* April 2012

