Matters of the Heart

Swallowable Capsule Technology
Project Proposal

Presented By:
Cimoya Collins
Gilbert Hopkins
Michelle Lilley
Ashley Wells

Presented On:

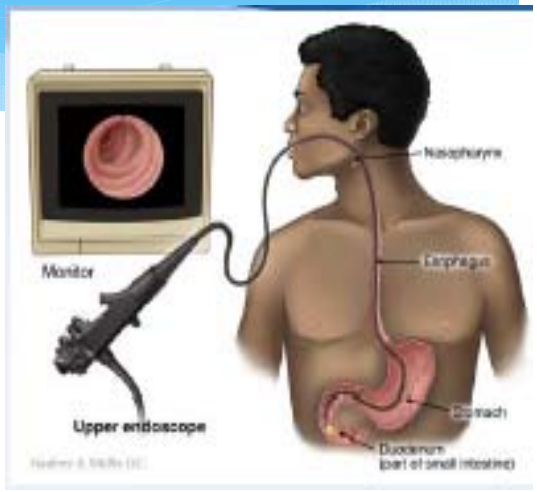
Wednesday, November 9th, 2011

Outline

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

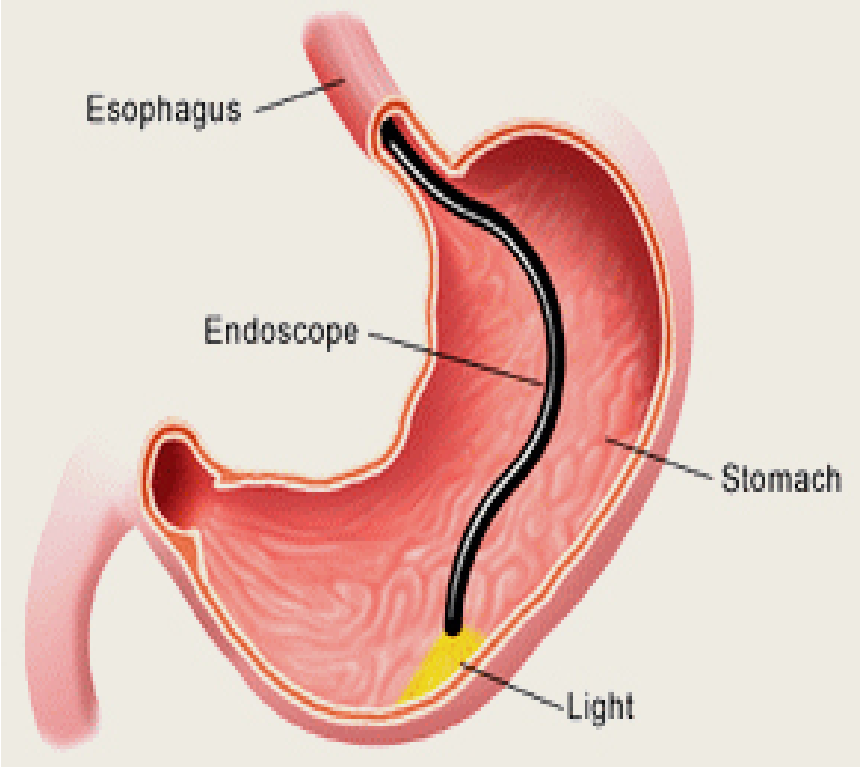
Background

* 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



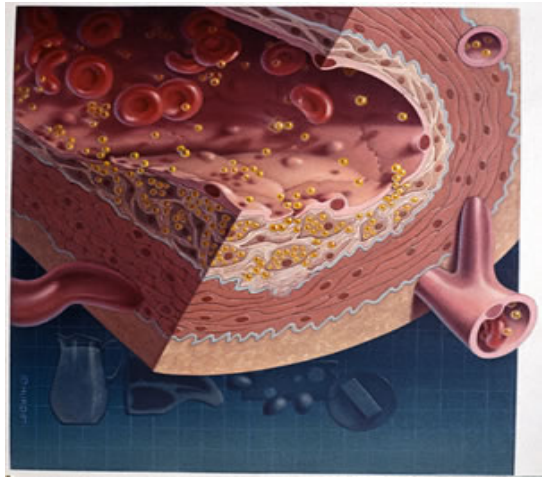
Problem Formulation

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



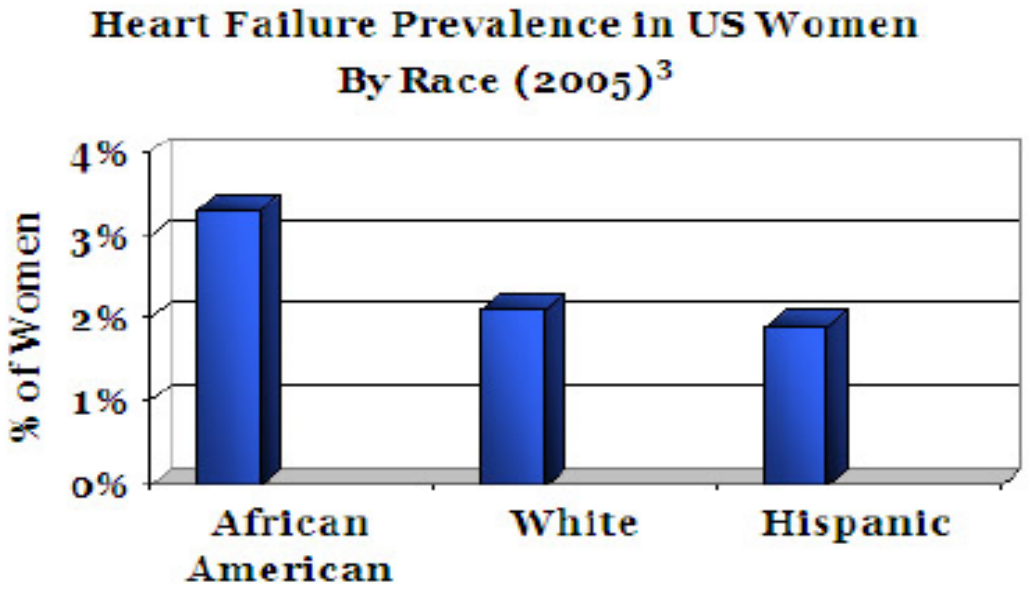
Problem Formulation

* 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



Current Status

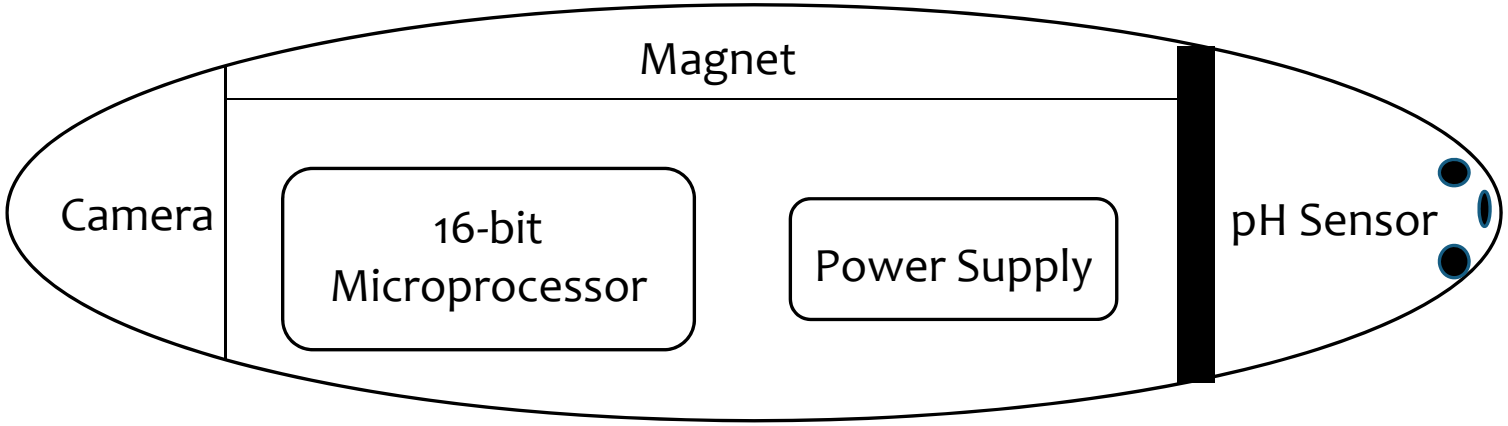
* Ingestible Thermometer Pill
  * Developed at John Hopkins University with NASA support
  * Came to be known as CorTemp
* Olympus Optical (Imaging)
  * Used a magnetic field outside of the body to control tracking
  * Issues: improper illumination and capsule needed to be opened to retrieve images
* 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

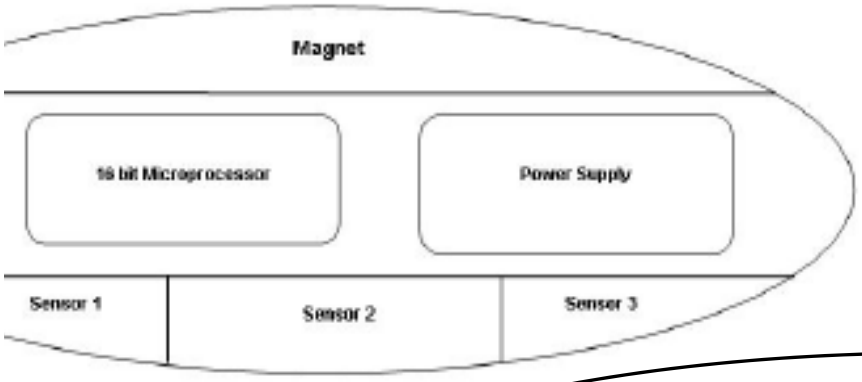
* Size
  * According to Food Drug Administration (FDA) the size of a pill capsule is given the following credentials:
    * Length 15mm
    * Width 1 cm
* Communication Standards
    * Medical Implant Communication Service: Operations in the 402-405 MHz range
* Regulations
  * FDA and HHS standards and 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

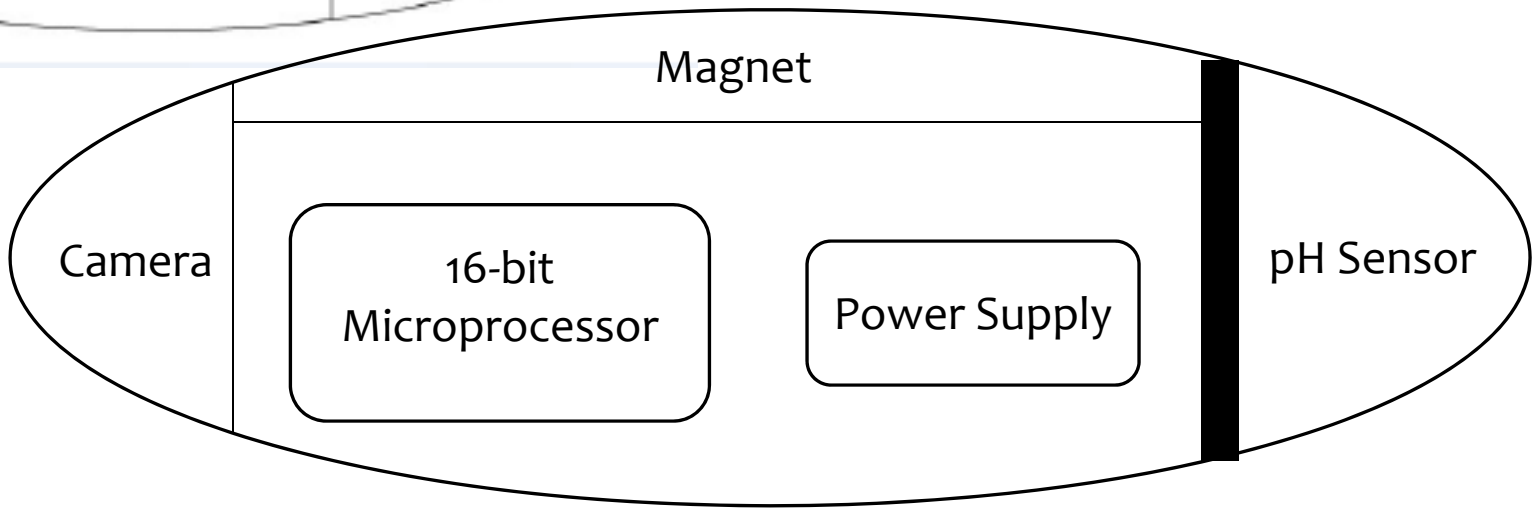
Solution Approach

* 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 Capusle 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