Near Infrared Imaging System (NIRIS)

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Overview

Purpose

- Background
  - Commercial Products
  - Patents

- Project Description
  - Electrical Components
  - Hardware
  - Software

- Budget

- Conclusion
Purpose

- Near-Infrared Spectroscopy
  - Imaging method that manipulates light at 650 – 950 nm
  - Probes concentration and oxygenation of hemoglobin in the brain, muscle, and other tissues
  - Can penetrate several centimeters of biological tissue

- A relatively simple and a non-invasive technique
  - Portable
  - Does not require a dedicated technical staff
  - Does not require the patient to be injected with any isotopes

- The project aims to create a near-infrared imaging system using laser diodes for imaging biological tissue
Products and Patents

- Design of a portable Near Infrared System for topographic imaging of the brain in babies
- Design of a hand-held laser breast scanner (LBS) which accurately distinguishes between malignant and benign tumors
- Near Infrared Chemical Imaging Microscope
Project Description

Laser Diodes

- **Multiple Quantum Well Laser**
  - Inner layer of diode is very thin, creating a Quantum Well

- **Consists of 3 pins**
  - Pin 1: Photodiode
  - Pin 2: Ground
  - Pin 3: Laser Diode

- **Operating Current: 75 mA**

Figure: 1.0: Laser Diode
Current Driver

- Keeps current at a constant value
  - Fluctuations in current damages laser diode

- Considering Stmicroelectronics’ current driver, STCS1

- STCS1 current driver controlled with external resistor

- Can drive from 0 amps to 1.5 amps

Figure 2.0: STCS1 Current Driver
Project Description (cont’d)

Photodetector

- Avalanche Photodiode (APD)
  - Detects optical signal and converts to electrical signal

- Why APD?
  - APD has inner gain which makes signal amplification easier

Figure 3.0: Avalanche Photodiode
Hardware

- **NI PXIe-1073**
  - National Instruments Data Acquisition Device
    - Used to process analog signal from photodiodes into digital signal for further processing

- **NI PXI-5114**
  - 8-bit digitizer for high-speed application
  - Uses a Bayonett Neill-Concelman (BNC) connector to receive signal
Project Description (cont’d)

Software

- LabVIEW 2010
  - Software language used to create user interface and digital filter
    - Digital signal processed through the data acquisition device will be accessed programmatically and filtered
      - Bandpass Filter
    - User interface will display two graphs and the states corresponding to the two laser diodes
## Budget

<table>
<thead>
<tr>
<th>Component</th>
<th>Price (USD)</th>
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<tbody>
<tr>
<td>Avalanche Photodiode x2</td>
<td>$100 x2</td>
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<tr>
<td>Laser Diode x2</td>
<td>$75 x2</td>
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<tr>
<td>NPN Transistor</td>
<td>$3</td>
</tr>
<tr>
<td>PNP Transistor</td>
<td>$3</td>
</tr>
<tr>
<td>Current Driver x2</td>
<td>$3 x2</td>
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<tr>
<td>BNC Female Bulkhead Jack</td>
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<td>BNC Male-to-Male Cable</td>
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<td>Miscellaneous Circuit Components</td>
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<td><strong>TOTAL</strong></td>
<td><strong>$441</strong></td>
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</table>
The near-infrared imaging system will exhibit the properties of spatial coding and target detection using laser diodes.

No training necessary to operate device.

Current state of design shows to be cost effective and well within budget.

Has great potential for industrial and medical use.