



# Non-Invasive Deep Brain Thermometer

Authors: Pallav Gupta  
Sukhesh Miryala

Advisor: Dr. Britton Chance

Department of Electrical and Systems Engineering

Demo Date: April 24, 2005

Demo Times: 9:30 AM, 10 AM, 11:30 AM  
2:30 PM

Location: RCA Lab

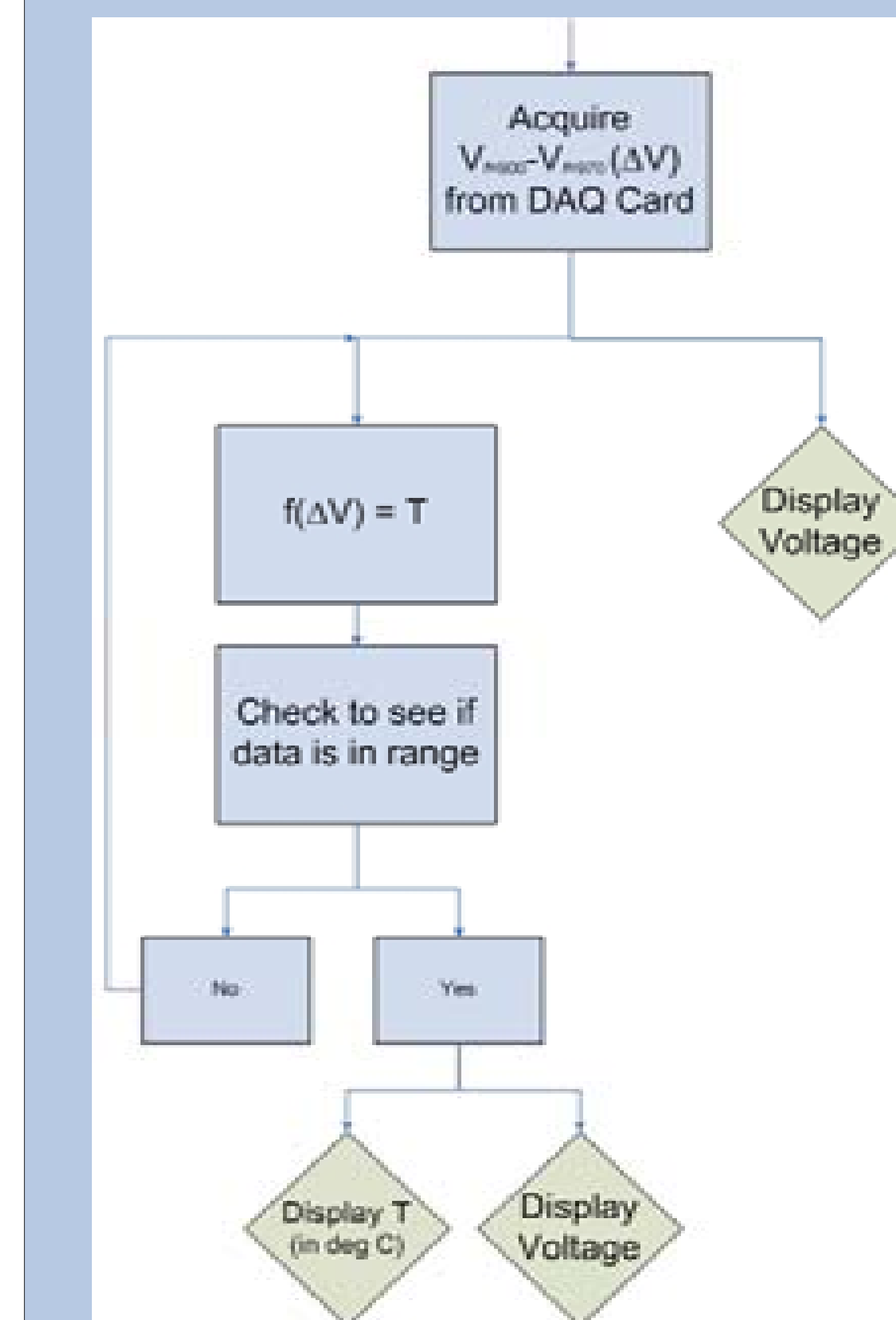
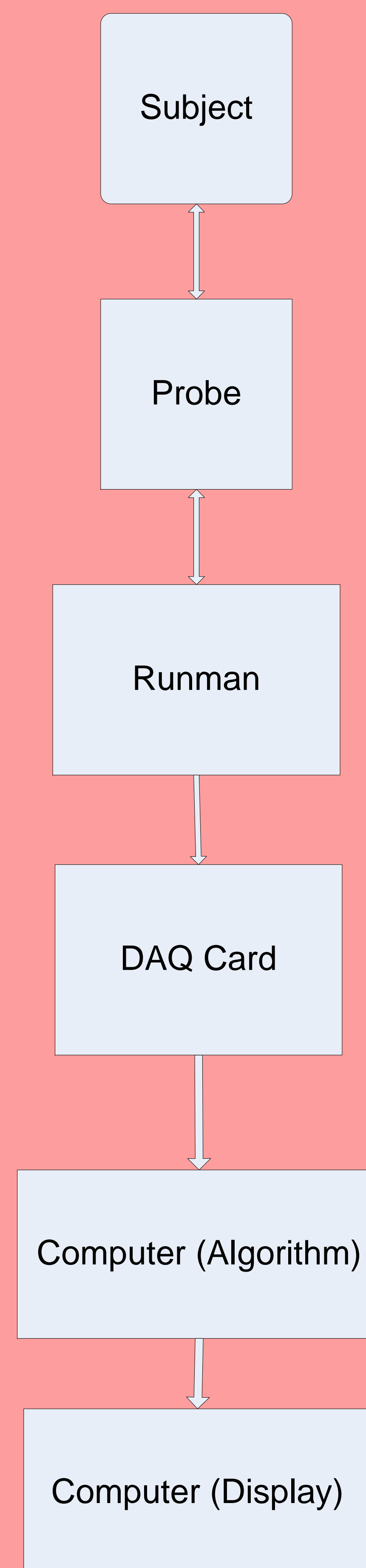
## Abstract

During cardiovascular bypass surgery, the body temperature of the patient is lowered to 20 degrees Celsius. After surgery, the temperature of the patient needs to be raised to normal body temperature, namely 40 degrees Celsius. During this critical revival if the temperature of the brain exceeds 42 degrees Celsius, complications may arise. If the temperature of the brain exceeds 44 degrees Celsius, irreversible damages will follow, and there is possibility of fatal consequences. As a result, the need for an accurate measuring device to measure the temperature of the brain during surgery is necessary. The goal of this project is to design and construct a new non-invasive device to measure brain temperature based on Dr. Chance's research of Near Infrared Spectroscopy.

The absorbance of light at particular wavelengths in the brain is a function of temperature. Hence, if one can make a device which can measure the absorbance of infrared light accurately at different temperatures, and develop an algorithm to relate absorbance with temperature, brain temperature can be measured.

A probe has been constructed which can accurately convert absorbance into a voltage signal. This voltage signal will be amplified by the Runman continuous wave imager, and then input into a DAQ card connected to a PC. A LabView Virtual Instrument has been developed to extract this signal and convert it into a temperature to be displayed on screen.

## System Overview

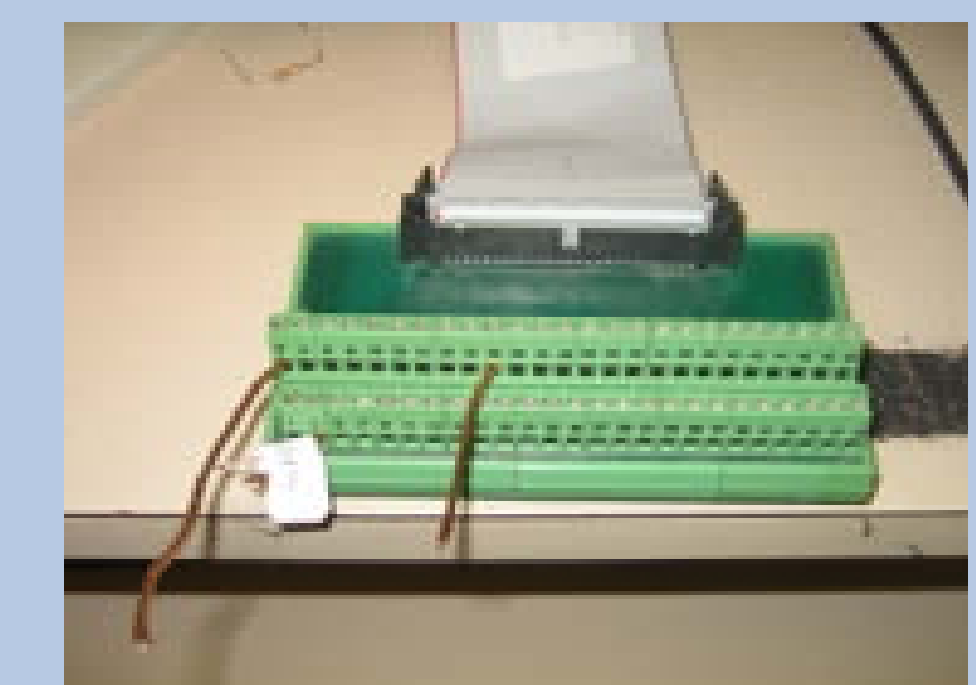
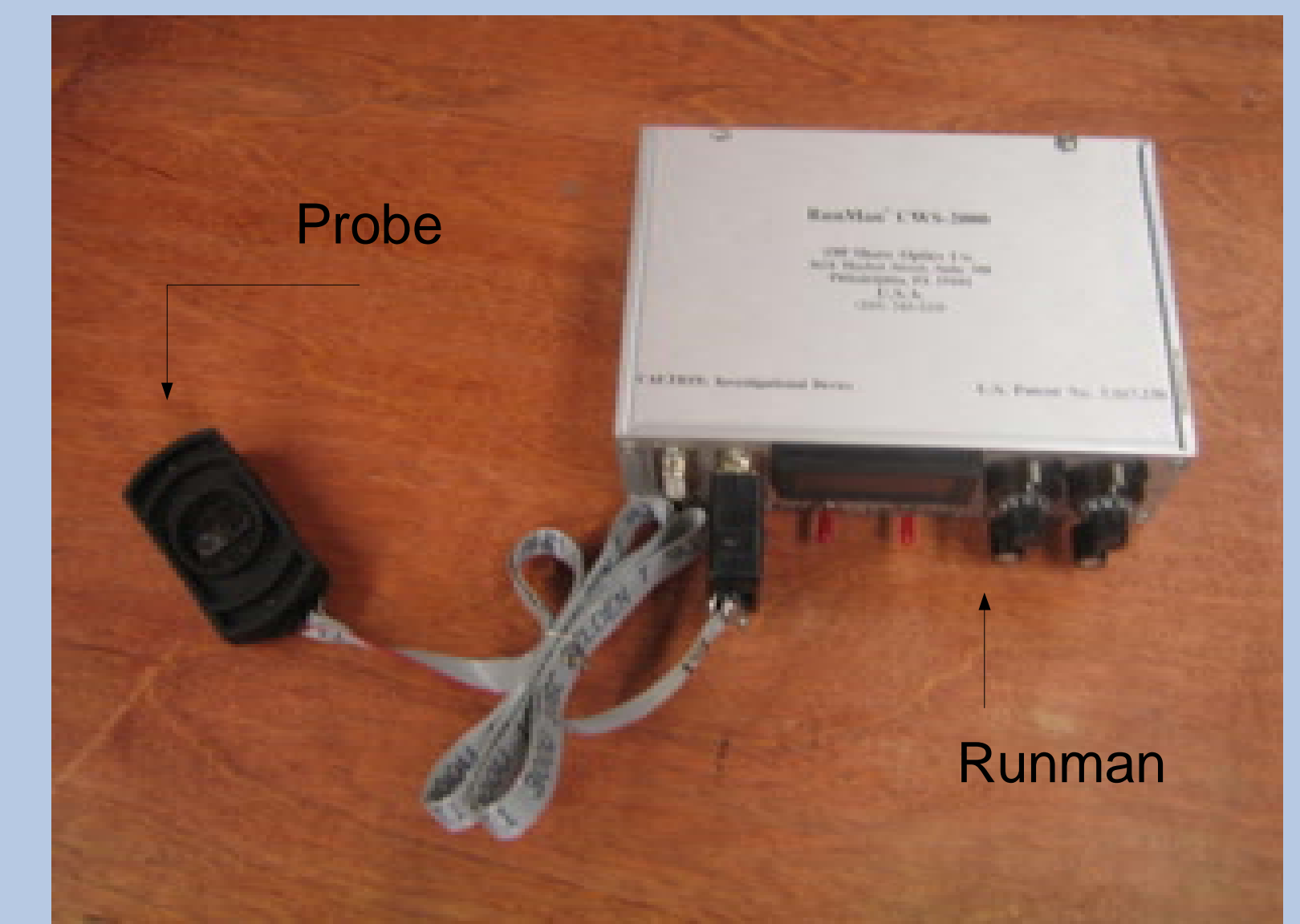


## Software Overview

The LabView Virtual Instrument acquires the difference voltage signal from the DAQ card. This voltage is a function of temperature, and an algorithm that relates the two values has been developed. The difference voltage is then input into the algorithm mentioned previously, and the temperature of brain is determined. The software then tests whether or not the temperature is in the acceptable range of temperatures. If not in the acceptable range, then the above process is repeated. If it is in the range, the software will display the current temperature.

## Hardware Overview

The temperature sensor system uses a non-invasive probe consisting of two near infrared LEDs (one 900 nm LED, one 970 nm LED) and corresponding detectors. This probe is placed on the forehead, and measures the reflection of the light emitted from the LEDs. Two signals, corresponding to the 900 and 970 nm wavelengths are inputs to the Runman device, which filters signals and calculates a difference signal. This difference signal is input into the data acquisition (DAQ) card. The DAQ card converts the analog signal into a digital signal, which is processed by the software.



DAQ Card