BENG 186B Principles of Bioinstrumentation Design

UC San Diego

FINAL PROJECT

For the final project, you group yourselves in teams of 3-5 students, and each group chooses a bioinstrumentation design problem similar to the design problems that we had in the homework assignments. The goal of the project is for you to apply the skills that you learned in this course to formulate a bioinstrumentation design engineering solution to a clinical, health, or biological problem of your choice, and validate your design using available circuit simulation tools.

(1) Choose, and motivate, your design problem. You are free to choose any problem in bioengineering that calls for a bioinstrument to measure and process biosignals of interest. For clinical applications the goal may be to monitor health to alert conditions that may require clinical intervention, or to directly improve health outcomes by acting on the biosignals in real-time. For applications in biology and neuroscience the goal may be to obtain a better system-level understanding of the functioning of organs in the body.

(2) Formulate your bioinstrument design, and analyze its function, using the principles that you learned in the class. Be sure to show a complete diagram of your design, and specify all components including the types and values where applicable. Provide reasoning for justifying your design choices, and state all assumptions supporting the reasoning.

(3) Validate your design. To check the operation of your design, observe its behavior using a simulator of your choice. Available simulators, free of charge, include:

   a. The Falstad Java applet for electronic design with several circuit examples posted at https://www.falstad.com/circuit/;
   b. CircuitLab, a complete electronic design and simulation environment available at https://www.circuitlab.com;
   c. OpenCircuitDesign, a complete open-source electronic circuit design environment available at http://opencircuitdesign.com.

(4) Analyze and interpret the results, discuss the advantages and limitations, and comment on the significance to the bioengineering discipline.

(5) Document and present your design. Write up your results in a group report about 4 pages long (0.5-1 inch margins, 10 pt. Times, double column, single space), including figures and tables as appropriate, and including references. Organize the report with appropriate headings and subheadings, consistent with the style of the *IEEE Biomedical Circuits and Systems Conference* (IEEE BioCAS). Word and LaTeX templates can be found here. Summarize your results in a 200-word abstract on the first page. List all group members. Cite references appropriately in the style of *IEEE BioCAS*. Submit the report over Canvas by the due date. The report will be graded on accuracy, thoroughness, the soundness of your approach, organization, writing and apparent understanding. Be prepared to summarize your efforts to that point in a 8-12-minute group presentation in class, as scheduled during the lecture times in the last week of classes.

EXAMPLES OF FINAL PROJECT TOPICS
Discuss with instructor and TAs

Deep brain stimulator
ECoG epilepsy detector
Infant monitor for SIDS prevention
Non-contact ECG monitoring patch
Pulse oximeter with digital readout of SpO2 and heart rate
Sphygmomanometer with digital readout of blood pressure and heart rate

Projects Archive (2021—):

Automated external defibrillator (AED)
Automatic anesthetic administrator and heart rate monitor
Bioimpedance monitoring
Blood flow monitor to detect cerebral hypoxia
Blood pressure monitor for aortic ruptures
Breathalyzer modeling: detecting alcohol concentration from exhalation gas and sweat
Determining body composition through measured impedance
Edema detector
EEG device for sleep and narcolepsy
EEG sensor for detecting Parkinson's disease
EKG monitor
EMG/EEG-controlled prosthetic
EOG eye gaze communication device
Glucose sensor and insulin injector
Glucose monitor
Instantaneous visual analysis of muscular activation
Non-invasive glucose monitor and insulin actuator
Pacemaker
pHotonics based sweat analysis
Plantar pressure sensor system for endurance sports health monitoring
Pressure sensor socks for diabetic patients
REM sleep cycle monitor using EOG
Seizure monitor
Smart bandage monitor
Sphygmomanometer and digital display
Steady-State Visual Evoked Potential (SSVEP): Brain-computer interface signals
Thermistor sensor for obstructive sleep apnea
Ultrasonic Doppler blood flow sensor
6-Lead frontal ECG bioamplifier system

etc. (see the class website for the full list with PDF copies of project reports)