Project Statement

**Automatic Anesthesia Expert System**

*Project for Joseph McIsaac*

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Statement of Need

In the medical field one of the primary support systems for a doctor is the ability to poison patient’s receptors by binding, blocking or activating them which will relieve the patient from consciousness, and supplying amnesia, analgesia and immobility. Using anesthesia is a precise calculation using fuzzy logic that has to be reformulated for each individual patient based on their prior resistance, acute and chronic disease states, age, weight, gender, exercise tolerance, medication usage, habits such as smoking, drug and alcohol use.

This project’s main objective is to develop a device that will act as an “Automatic Anesthesia Expert System”. With this device the anesthesiologist should be able to see all of the patient’s relevant information, vital signs and their level of consciousness.

Basic Preliminary Requirements

The main problem with designing a monitoring system for anesthesia is the fact that every patient will react differently to treatment and if the wrong dose is given it may be lethal affect. There are two possible ways to monitor a person’s consciousness that we are aware of. The first is to use an EEG (Electroencephalogram, or the neurophysiologic measurement of the electrical activity of the brain) and the second method is to monitor the ECG (Electrocardiograph, or the measuring of the electrical activity of the heart and its strength) and TV (“tidal volume” or the volume of breath inhaled or exhaled during a normal breath). The only way to be sure how the drugs will affect an individual is to predict the correct dosage based on the patient’s initial state. Then administer the anesthesia and monitor their reaction and then alter the next dosage until the desired level of consciousness is reached.

One version of anesthesia monitoring is Aspect Medical Systems BIS VISTA. This monitoring system bases the patient’s level of conscious primarily on an EEG wave, which monitors brain activity with a measurement between 1 and 100. Everest Biomedical Instruments has another anesthesia monitoring system that is called the SNAP II. This is based off of a very similar EEG wave and level of consciousness.

The requirements of this device must meet the needs of an anesthesiologist in surgery so that they are able to have a more precise measure of consciousness on a real time setup. The device also has to be durable, cost effective, long-lasting, and consistent in its readings.

Basic Limitations

The three more prominent limitations for this project are time, equipment and money. Realistically this project would take a longer period of time than two semesters to properly consider all factors, how relative they are, and implement them accordingly. As for equipment we are limited to what is in the lab and resources around campus. Our funds are unknown at this moment in time, but as the semester progresses we will negotiate with our sponsor and finalize a budget.

With a device like this it is very difficult to have a perfect knowledge of how far under a patient is. This device will give an approximation based on the vital signs that
are chosen to be observed. Every patient is different and therefore there is a high chance that the device will incorrectly calibrated and miscalculate how conscious the patient is due an unknown variable.

Other Data

The client for this project is Dr. Joseph McIsaac, an anesthesiologist at Hartford Hospital. The immediate goal of this project is to create a device that interfaces with current anesthesia monitoring systems to store and model the patient’s pharmacologic and physiologic data. This device should eventually be able to predict the patient’s response to anesthesia during surgery to aid the anesthesiologist in decision making. The long term goal is to apply this device to a system that delivers anesthesia automatically to the patient without physician interaction.

Questions

- What are the parameters for each physiological signal?
  - ECG, SaO2, respiratory rate, temperature…
- How do the initial conditions of a patient affect the drug dosage?
  - Diseases, age, weight, gender, medication usage, exercise tolerance, and habits
- What drugs are used to induce each state? (unconsciousness, amnesia, analgesia, and immobility)
  - How do they affect the body?
- What restrictions should we be aware of when developing the system?
- How different diseases affect homeostasis?
  - How are dosages affected?
  - Does the effectiveness of drugs change?
    - What are causes these changes?
- What degree of accuracy is needed?
- How will the automated system safely administered drugs?
  - What drug delivery system can we use?
- Should we monitor brain activity?
  - What parameters are we looking for?
  - How does each drug affect brain activity?
- How does the EEG correlate to the physiological signals?
- Are we limited by LABview in any ways
  - Compiling data
  - Run speed
- What other programs are compatible with Labview?
- What are we limited to, as in supplies and funding?