Stress detection using physiological signals in search and rescue missions employing drones.

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Project Description

The use of drones is recently gaining particular interest in the field of search and rescue. However, particular skills are still required to actively operate in a mission without crashing the drone. This limits their effective and efficient employment in real missions. Thus, to assist the rescuers operating in stressful conditions, there is a need to detect a decrease of performance due to a high level of stress that could compromise the outcome of the mission. It has been proven that specific stress state can be detected from physiological features. Therefore, detecting the stress level that provoke an abrupt drop of performance using physiological signals is the key to develop a minimally intrusive wearable interface in order to estimate a possible need of assistance.

The stress response triggers different physiological reactions in the body that can be detected from the measurement of heart rate, skin conductance, respiration rate, cardiac output (CO), among others. One of the signals that give an indication of the CO is the Impedance CardioGram (ICG), which has been rarely used for stress detection so far.

The main goal of this project is develop a set of algorithms to process and analyze the ICG data in order to extract stress related features and then adapt the developed processing algorithms to be executed on an embedded system. The complexity of this work can be adjusted according to the type of the project (Semester or Master).

The student’s task include:

1. Data collection of vital signs in an experiment that simulate a search and rescue mission with drones.
2. Develop a set of algorithms to process and analyze the ICG data in order to extract stress related features.
3. Evaluate the proposed features in terms of accuracy in the detection of drone pilots’ stress state in the context of search and rescue missions.
4. Port the algorithms and optimize them for their execution on the wearable device developed at the Embedded Systems Laboratory.
5. Optimize the embedded implementation to minimize computational complexity and memory usage.

Requirements

1. Good knowledge of MATLAB for scripting and signal processing.
2. Good programming skills C language.
3. Familiarity with embedded architectures and/or microcontrollers programming.
5. Interest in biomedical applications.

Type: Master project (Semester project also possible)
Period: Spring Semester 2020
Section(s): SEL