# CSI 6900 Proposal

# Smartphone-Based Jugular Vein Assessment System

Yiqun Hao (300302981)

**Supervisor**: Miodrag Bolic

Date: 1/14/2024

**University of Ottawa**

## Introduction

Since the outbreak of COVID-19, people all over the world are paying more attention to their personal wellness. Furthermore, with the emergence of self-detection kits for the coronavirus epidemic, this self-detection technology has gradually come into people's vision. In the past, the common belief was that disease testing required specialized equipment in hospitals, and portable testing was rare, expensive and unaccurate [1]. COVID self-detection kit reshaped this misbelief proving portable self-detection can be accessable, cheap, and reliable. Therefore, more online or physical health-related self-testing tools are getting admitted and widely used [2][3].

Our project is to develop a smartphone-based jugular vein assessment system that allows users to detect their vein pressure to assess the possibility of a heart failure by simply taking a picture of their neck. The jugular venous assessment is an important aspect of assessing a patient's volume status, especially in patients with heart failure, liver failure and kidney failure [4]. Both elevation of the neck veins and the variations of the neck vein waveforms share valuable information about a patient's diagnosis.We believe this application is accessible, affordable, and benefitial to a large group of patients as heart failure is one of the leading causes of death nowadays [5]. As a result, this project is both novel and valuable.

## Problem Description

Currently, monitoring vein pressure, particularly in the jugular vein, often requires specialized equipment and can be intrusive. This limitation poses challenges in continuous monitoring, especially in outpatient settings or for personal health management. The proposed system seeks to address this gap by utilizing the advanced capabilities of modern smartphones.

The core of this project is the development of an Android application capable of collecting critical data types – video and accelerometer data – directly from the smartphone. The video component will focus on capturing real-time videos of the jugular vein, while the accelerometer data will help in assessing the motion artifacts that could impact the accuracy of vein pressure detection.

A significant challenge lies in processing this data effectively to account for variables such as motion artifacts, which can distort readings, and ensuring optimal illumination and correct positioning of the phone relative to the neck. These factors are crucial for accurate data capture and subsequent analysis.

Once collected, the data will be sent to the cloud for processing and storage. This approach not only facilitates the handling of large data volumes but also enables advanced computational methods to be applied for more accurate and insightful analysis. A powerful machine learning algorithm will be used to analyze the data and give a diagnosis.The results will then be presented back on the smartphone, offering users immediate feedback on their vein pressure status.

This system promises to revolutionize vein pressure monitoring by making it more accessible, non-invasive, and user-friendly, thus paving the way for better preventative health measures and more responsive patient care.

## Project Scope and Objectives

The project scope I am going to work on is the development of the front end of our proposed system which is an Android application. Specifically, the Android application should be able to collect videos and accelerometer data. The accelerometer data will be processed for motion artifacts. For the video collected, I will examine the illumination and the position of the video taken to ensure we can clearly see the neck and the jugular vein.

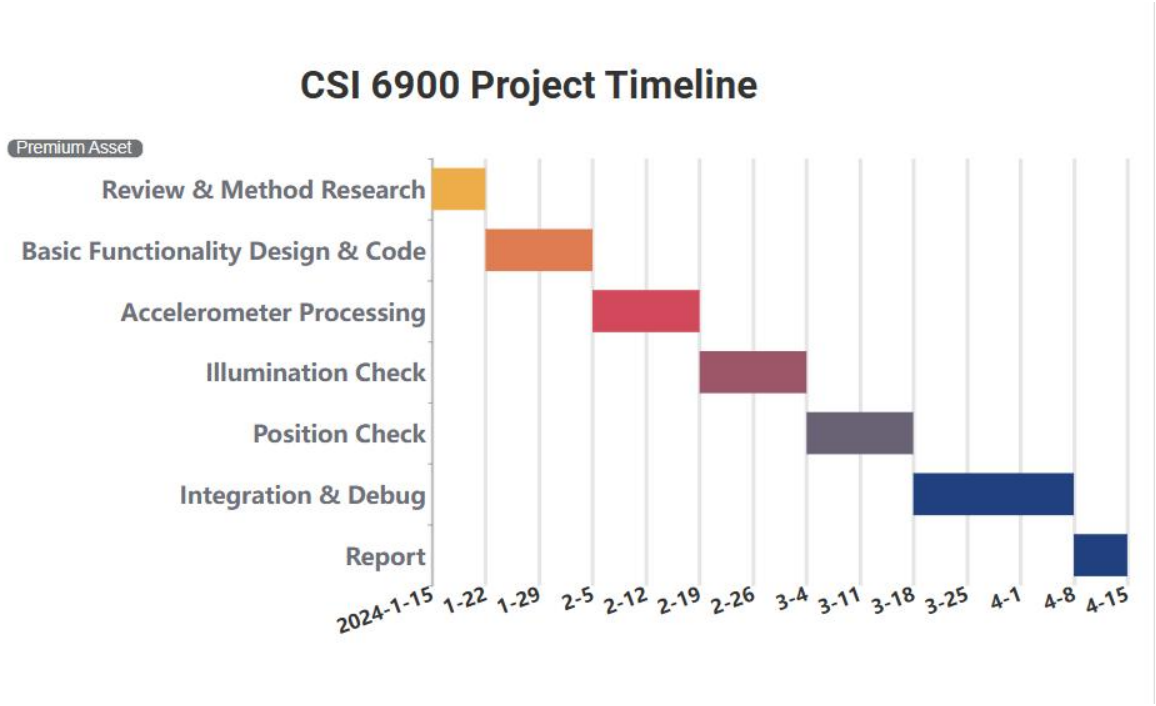
The primary learning objectives of this project is not only aiming to enhance the technical capability of Android development but also to deepen the understanding of how machine learning algorithms get applied in a real world scenario. I have done many theory projects before but this is the first one to actually apply a cutting-edge technology so that people can use it on their phone. Major objectives are outlined as follows:

- Review Android development and develop the Android application that can take videos with user-friendly interface.
- Learn and code the functionality of accelerometer data processing as well as use it for motion artifacts.
- Learn and code the functionality of illumination and position check.
- Understand the architecture of the system including how does front end interact with back end and how the machine learning algorithm gets applied.

By achieving these objectives, this research project could significantly enhance the capabilities of Android development and provide me new understanding regarding real-world application development .

## Workplan

The workplan is shown in a Gant chart as follows:




## Evaluation Criteria & Marking Scheme

This project may result in the following several key deliverables:

1. **Android Application**: The Android application used to take videos. It also includes a user-friendly interface and other functionalities such as interacting with back-end (40%)
2. **Accelerometer Processing**: The functionality to process accelerometer data for motion artifacts use (10%)
3. **Illumination Check**: The fuctionaility to check the illumination of the video taken (10%)
4. **Position Check**: The functionaility to check the position of the video taken (10%)
5. **Report**: The final report detailing the project methodology, development process, and outcomes (30%)

## References

[1] Lanseng, E.J. and Andreassen, T.W., 2007. Electronic healthcare: a study of people's readiness and attitude toward performing self‐diagnosis. International Journal of Service Industry Management, 18(4), pp.394-417.

[2] Al Husaini, M.A.S., Hadi Habaebi, M., Gunawan, T.S. and Islam, M.R., 2021. Self-detection of early breast cancer application with infrared camera and deep learning. Electronics, 10(20), p.2538.

[3] Van Heuverswyn, F., De Buyzere, M., Coeman, M., De Pooter, J., Drieghe, B., Duytschaever, M., Gevaert, S., Kayaert, P., Vandekerckhove, Y., Voet, J. and El Haddad, M., 2019. Feasibility and performance of a device for automatic self-detection of symptomatic acute coronary artery

occlusion in outpatients with coronary artery disease: a multicentre observational study. The Lancet Digital Health, 1(2), pp.e90-e99.

[4] Chiaco, J.M.S.C., Parikh, N.I. and Fergusson, D.J., 2013. The jugular venous pressure revisited. Cleveland Clinic journal of medicine, 80(10), p.638.

[5] Roger, V.L., 2013. Epidemiology of heart failure. Circulation research, 113(6), pp.646-659.