

# SEG3904 Project Proposal

## *Project Title: Hand Gesture Calculator*

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### **Overview:**

The purpose of this project is to develop a Hand Gesture Calculator that interprets numerical hand gestures (0-9) using a webcam and performs basic arithmetic operations (addition, subtraction, multiplication, and division). The project will involve implementing computer vision techniques and machine learning algorithms to detect and classify hand gestures in real-time. The application will be developed using Python, leveraging libraries such as OpenCV and TensorFlow. This project will help in understanding how to develop and deploy real-time machine learning models for practical use cases.

### **Learning Outcomes:**

At the end of this project, the student will have learned to:

- **G1:** Implement and optimize a real-time computer vision application using Python.
- **G2:** Train and fine-tune a machine learning model specifically for gesture recognition.
- **G3:** Design a standalone application with a simple and intuitive GUI.
- **G4:** Apply advanced debugging and testing techniques for machine learning applications.
- **G5:** Use version control and documentation tools effectively to manage project progress.
- **G6:** Work individually on software engineering activities.

### **Technologies:**

- **Python:** A versatile programming language widely used in ML and AI projects.
- **OpenCV:** A computer vision library for image and video processing.
- **TensorFlow/Keras:** Libraries for building and training machine learning models.
- **MediaPipe:** A framework for real-time hand tracking and multimodal ML pipelines.
- **Tkinter/PyQt:** For developing a simple graphical user interface (GUI) for the application.
- **GitHub:** For version control and project management.

## Resources:

- Géron, A. (2017, March 13). Hands-on Machine Learning with Scikit-Learn & Tensorflow. [https://powerunit-ju.com/wp-content/uploads/2021/04/Aurelien-Geron-Hands-On-Machine-Learning-with-Scikit-Learn-Keras-and-Tensorflow\\_-Concepts-Tools-and-Techniques-to-Build-Intelligent-Systems-OReilly-Media-2019.pdf](https://powerunit-ju.com/wp-content/uploads/2021/04/Aurelien-Geron-Hands-On-Machine-Learning-with-Scikit-Learn-Keras-and-Tensorflow_-Concepts-Tools-and-Techniques-to-Build-Intelligent-Systems-OReilly-Media-2019.pdf)
- OpenCV Documentation: <https://opencv.org/documentation/>
- TensorFlow Documentation: <https://www.tensorflow.org/tutorials>
- MediaPipe Documentation: <https://mediapipe.dev/>

## Deliverables:

| Deliverable   | Weight |
|---|--------|
| Project plan and detailed system requirements   | 15%    |
| Initial prototype of the gesture recognition system   | 10%    |
| Refined model with increased accuracy and basic GUI   | 15%    |
| Arithmetic operation integration based on recognized gestures   | 15%    |
| Final application with complete GUI and error handling  | 15%    |
| Documentation of code, model, and user instructions   | 10%    |
| Final report with system architecture, challenges faced, solutions implemented, and a reflection on learning outcomes | 20%    |

## Work Plan (135 hours):

| Week | Met? | Action  | Hours |
|------|------|---|-------|
| 1    |      | Project planning, environment setup, and requirement analysis | 10    |
| 2    |      | Data collection, preprocessing, and initial model setup       | 15    |
| 3    |      | Development of the initial gesture recognition prototype      | 10    |
| 4    |      | Refinement and optimization of the gesture recognition model  | 15    |
| 5    |      | Integration of arithmetic operations based on gestures        | 15    |
| 6    |      | Development of the GUI and integration with the model         | 15    |
| 7    |      | Testing and iterative improvements                            | 15    |
| 8    |      | Final adjustments, debugging, and performance tuning          | 15    |
| 9    |      | Comprehensive testing and user experience enhancement         | 10    |

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|----|--|---|----|
| 10 |  | Drafting of the final report and preparation for submission | 10 |
| 11 |  | Submission of the final project and report                  | 5  |