Chapter 1

Introduction

1.1 Background

Cell confluency is a standardized quantification to give information about the percentage of space that is occupied by the cells. The cells must be adherent to the space and can be used to estimate the cell growth phase. Besides, cell confluence is used in experiments related to the effect of drugs on tumor cells, the interaction of substances with cell growth, gene editing, etc. However, counting cell confluency is heavily reliant on instinct and proficiency, which a new researcher still lacks, especially when encountering various cell types (Lobo et al., 2024).

Wrongly counting cell confluency will result in redoing the experiment, which costs more material and more time (Chiu et al., 2020). So, most people use ImageJ software for counting cell confluency. But it can waste time due to editing (about 7 minutes per image, especially when handling large samples) and the data result may not be persistent (Burger & Burge, 2016; Elliott et al., 2022). Thus, this experiment will use an AI-integrated application, such as the YOLO AI model, to measure cell confluency accurately and efficiently. The YOLO AI model is chosen because of its versatility in many applications, and this AI model only needs a single neural network for its operation. Due to its single network system, it is also fast and precise, making it suitable for quick application in measuring cell confluency, especially in handling large amounts of samples (Murat & Kiran, 2025).

In the past, cell detection using AI was done to differentiate cells among other types of cells, to check the cell's morphology, and to count cells individually using YOLO version 8 (Hildebrand et al., 2025). In another publication, OpenVINO AI software and NCS2 (Intel Movidius Neural Compute Stick 2) to boost the AI performance were used to determine cell confluency percentage (Shamhan et al., 2023). In this project, the cell detection will be optimized to detect cell confluency, not just count cells singly,

and will use the newest YOLO AI version 26, which has higher precision and speed compared to YOLO AI version 8 (Ultralytics, 2025). Other than that, this AI model will only need a single system in order to work properly compared to using OpenVINO and NCS2 (Neural Compute Stick 2), which are two independent systems, allowing for simplicity and a fast response from the cell confluency detection application. Furthermore, the overfitting AI model can hinder the object recognition process; thus, it is preferred to have accuracy between 85%-95% and precision of the AI imaging should be above 95% (Matsuda et al., 2025; Obuchowicz et al., 2024; Salman & Liu, 2019; Zhang et al., 2025a). The performance of the AI will also be compared to other platforms (human, ImageJ, and random web cell applications) to ensure that the AI can compete and works well.

1.2 Objective

The aim of the project is to develop an application based on YOLO AI for efficient cell confluency counting and test the capability of the YOLO AI application compared to other platforms.

1.3 Hypothesis

H0: The AI application failed to find the cell confluency and have lower performances compared to other platforms

H1: The AI application successfully finding the cell confluency; however, the performance is still lower compared to the other platforms

H2: The AI application successfully finding the cell confluency and have the best performance among all other platforms