GENTING HIGHLANDS LANDSLIDE MAPPING USING DEEP LEARNING

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ABSTRACT

Using methods of deep learning, this thesis conducts an extensive study on landslide mapping in the Genting Highlands with the goal of creating an automated tool to identify land locations most suitable for development by evaluating probable landslide hazards. The research makes use of Digital Elevation Models (DEMs) and SPOT-7 satellite data to classify and analyse different landslide formations in the training area in accordance with Varnes' 1978 categorization. In order to identify possible landslides, this study trains two models Mask R-CNN and YOLO v3 in Kundasang and then applies them to the Genting Highlands. The approach comprises data acquisition from many sources, including open source DEMs and SPOT-7 satellite images, and then processing the data, including mosaicking, georeferencing, and manual landslide delineation. Deep learning methodologies are used, which include model training, object labelling, and accuracy assessment with metrics including F1-score, precision, and recall. The outcomes show how well Mask R-CNN and YOLO v3 can detect landslide-prone regions; comprehensive landslide maps for the Genting Highlands are produced. These results emphasise the advantages and disadvantages of each model and offer important insights into the effectiveness and dependability of automated landslide detection techniques. According to the study's findings, combining deep learning models with conventional remote sensing methods greatly improves the accuracy and efficiency of landslide detection, which helps with risk management and preventive measures in mountainous areas and provides a useful tool for land-use planning and development in landslide-prone areas.

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CHAPTER 1

INTRODUCTION

1.1 Background Study

Across the globe, landslides are more common than any other geological occurrence (Ji et al., 2023). Large volumes of dirt, rock, or debris slide down a slope as a result of human action or natural phenomena. Another common form of rapid-moving landslide is a debris flow or mudslide (EMDAT, 2023). Torrential rains, earthquakes, volcanic eruptions, or droughts can all be followed by landslides (Ji et al., 2023). The areas most susceptible to landslides are those with steep terrain, such as the bottoms of canyons; slopes near anthropogenic activities, such as construction or deforestation; at the stream gradient along a channel or slope of the river bank, where surface runoff is directed; and heavily saturated land (Ji et al., 2023). Nowadays, landslides are particularly common in mountainous regions, largely due to complex geological and geographical factors (Ji et al., 2023).

A landslide results from rock or soil moving under the force of gravity; the movement is typically not extremely gradual but rather sluggish and quick (Smith et al., 2024). The materials must form a mass that is either part of the slope or the slope itself, regardless of how deep or shallow it is. The motion needs to be free-faced, downward, and outward. Rapidly moving water and debris flow can result in significant fatalities and injuries to people living within the vicinity of the debris flow (EMDAT, 2023). Any form of mudslide, debris flow, or lahar that occurs at a moderate to fast pace in dry conditions can be particularly hazardous (EMDAT, 2023). Debris flow may cause water, gas, electricity, or sewage pipelines to break, potentially causing harm and injuries (Nguyen & Ho, 2024). Both mortality and loss due to landslide events in