Damage Classification on Roads Using Machine Learning

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***Abstract*—Damaged roads cause many problems in transportation. Holes and cracks on the roads are hazardous to the drivers. The road damage can be manually identified by a transportation expert. However, this process was inefficient. Therefore, it is important to identify the damages on roads by using machine learning. In this study, a classification system based on the Siamese Convolutional Neural Network (SCNN) is developed to classify road images. The road images in our dataset are divided into two classes, i.e., hole and crack damage. The input images were converted to grayscale images. Then, we implemented an image segmentation method and the Canny edge detection to the grayscale images. Finally, we apply the SCNN to classify the images. Experimental results show that our approach can reach an accuracy of 84,38%.**

***Keywords*—Siamese Convolutional Neural Network, damaged road classification, canny edge**

I. INTRODUCTION

The classification and detection of road damage are important to ensure safety and comfort when transporting people and goods from one place to another. Road damage causes a significant amount of highway accidents during the transportation of humans and goods every year [1]. For the road to continue accommodating the needs of traffic movement with a certain level of safety and comfort, it is imperative to ensure it is in a good condition to provide quality service. Therefore, one of the efforts used to ascertain this process is to assess the condition of the road surface and other parts by collecting data on the existing condition of the pavement. The collected data is used to assess the conditions such as the type, level, and extent of harm. These factors are used as a reference in picking the right type of maintenance. Therefore, the availability of a reliable and accurate database is necessary for infrastructure development to be carried out effectively and efficiently.

Presently, data on the road damage is manually classified by humans, to determine the type of program to be carried out to fix the road. They are also able to acquire and recognize new patterns, understand the various concepts, and quickly form new concepts [2], [3]. Pavement Condition Index (PCI) is one of the indicators for assessing the condition of the pavement. This technique is a new guideline created to support the road maintenance management system. Therefore, to obtain the Pavement Condition Index (PCI), it is necessary to first identify and its condition through manual surveys and visual observations. The associated procedures used the conduct this process need to be compiled to obtain a standard reference. To achieve this goal, one of the well-known machine learning algorithms is used to perform image classification, namely Convolutional Neural Network (CNN). The use of this classification system is expected to make the process of surveying to obtain the desire Pavement Condition Index easier and faster.

Road pavement needs to be properly designed to last up to its predetermined lifespan. However, this is not achievable as roads tend to damage before the estimated age. Due to the difficulty in determining damaged areas while driving, it is necessary to implement a machine learning algorithm to perform image processing. One of the common methods used in carrying out image classification is the Convolutional Neural Network (CNN). This research used the Siamese Convolutional Neural Network (SCNN), which consists of two identical CNNs with the same wight [4]. In the SCNN method, the network each receives an image as inputs and outputs a similarity score. The SCNN is associated with efficiency and effectiveness in tracking problems by providing appropriate image data [5-7]. By using this method, the model achieved an accuracy of 85,59% using 1000 and 300 images on the train and test classes, respectively.

This classification model was built to classify holes and cracks due to road damage. Furthermore, the image processing method was used to make RGB into grayscale while segmenting the image to remove noise to classify damage easily and compare them with others.

II. RESEARCH METHOD

The SCNN can point similarities between two input images. When the network is ready to learn prepared pair of images in a directed way, it will generalize to predict damage type [4]. This method consists of 4