SPOTNET: A Novel End-to-End Algorithm that Utilizes Convolutional Neural Networks to Recognize Potholes in Two-Dimensional Monocular Images

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Potholes are a significant threat for vehicles as they cause an alarming 33% of all traffic-related accidents in the United States. The current method of identifying potholes is inaccurate and time-consuming, relying on expensive and cumbersome technology that is not readily available. It is vital that potholes are identified precisely in order to minimize vehicular damage and potentially life-threatening accidents. The goal of this research was to develop an algorithm that uses machine learning to recognize potholes in two-dimensional monocular images that can be cost-effectively scaled to widespread applications— including autonomous vehicles. The dataset was retrieved from a public repository and consisted of 681 labeled images of normal roads and abnormal roads containing potholes. To construct the algorithm, I tested four state-of-the-art convolutional neural network architectures including VGG-16, VGG-19, AlexNet, and MobileNet. After training each architecture to classify images of roads as either abnormal (containing potholes) or normal (not containing potholes), I evaluated and compared each architecture on a test subset. The highest performing architecture was MobileNet which was then successfully implemented in my novel end-to-end algorithm SPOTNET. The results are statistically significant, showing that SPOTNET had a 98.4% accuracy rate and 97% sensitivity on the test set. The application of SPOTNET is far-reaching and presents a novel and accurate method to recognize potholes, minimizing the burden of costly and inefficient identification of potholes—an essential step towards improving driver and vehicular safety.