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Autonomous Anomaly Detection and Classification Using Neural Networks

Search and Rescue (SAR) teams are constantly facing problems such as a lack of volunteers, hard to navigate areas, and lack of connectivity. My project aims to address these issues by implementing a novel method that combines anomaly detection and object classification to quickly identify and classify anomalies in the field of vision on an autonomous low powered device such as a drone. The anomaly detection part of the project implemented a 3-layer neural network (auto-encoder). The auto-encoder was tested initially on a dataset of about 200 gray-scale images with a Binary Cross-Entropy loss function, resulting in an accuracy of 23%. Subsequent trials increased the size and quality of the training data set and changed the loss function to a Mean-Squared-Error, resulting in an accuracy increase to 72%. Final trials involved changing the images to include color and gathering more data, achieving a final accuracy of 87.5%. For the subsequent Object Classification stage, a convolutional neural network called MobileNet was retrained to classify objects into categories of interest (backpacks, boots, hats, and water-bottles). The final classification accuracy achieved on the training set was 93%, after a previous trial accuracy of 53%. The two models were then compiled into a super model and deployed on an autonomous intelligent device with an AI-capable chip. The contributions of this project include performing real time object classification and anomaly detection that does not require Wi-Fi or cellular service, and can be extended to help SAR teams respond to floods, avalanches and other natural disasters.