Impurivision: A High Performance Mobile Application for Identifying Water Contamination Using Deep Learning

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One of the biggest problems in both developing and developed nations is the lack of clean water, which induces disease and poverty in communities globally. Mobile applications carry immense potential to address the issue, as over 6 billion individuals are projected to have a handheld device by 2020. The proposed project integrates image processing methods with a deep convolutional neural network (CNN) trained on thousands of tagged “difference images” of pure and contaminated water. Each “difference image” was generated by 1) taking a picture of an empty cup, 2) taking a picture of the same cup filled with pure or contaminated water, and 3) subtracting the RGB channels of the former from the latter. The deep learning and subtraction algorithms are packaged into a phone application that enables users to take the empty and filled cup pictures, runs the “difference image” through the CNN, and determines whether their water contains any of 15 major contaminants and contaminant mixtures. If the water is deemed unsafe, the mobile app displays the detected contaminants to the user and plots the results on a publicly-accessible map to aid governmental and private assistance efforts. The CNN evaluates water purity with an accuracy of 97.4%, and identifies specific substances with an accuracy of 89.6%. These results demonstrate the viability of a deep learning approach to image-based water purity analysis, which has been neglected in favor of expensive probing techniques. On a global level, the automated and handheld identification of contaminants could inform communities of their water quality, drive them to develop solutions, and empower them to hold public officials accountable, ultimately helping to alleviate sickness and hardship in the world.

Awards Won:
Third Award of $1,000
Fondazione Bruno Kessler: Award to participate in summer school "Web Valley" in Trento, Italy