REALM: Using Deep-Learning Algorithms, Neural Networks, and a Mobile App to Transform Communal Recycling and Education

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Currently, there is a huge problem with facilitated and single-stream plastic recycling. According to UNEP, 85% of plastics end up in landfills. However, this is not the fault of recycling facilities, as society is uneducated about the correct recycling processes of certain plastics. Government-funded programs like the CREOGP attempt to educate citizens, but public access is not at a high enough level; in 2021, recycling rates of PET and HDPE bottles were 28.7% and 28.9% respectively. To address this, we created REALM: a deep-learning algorithm that works with a GenAI in a mobile application to identify certain plastics and output the proper methods of recycling them. The plastics trained contained the polymers PS, LDPE, HDPE, PP, PUR, and PET. We trained using algorithms like an artificial neural network, but found the most success using a convolutional neural network. We were able to achieve a mAP score of 0.922 after obtaining accuracies of 97.15% with training data and 94.03% with validation data. We imported this model into a mobile application that incorporates an interactive recycling-focused GenAI. When prompted, the GenAI outputs the polymers used in the product, potential hazards of the product, and most importantly, how and where they can properly recycle their product. The GenAI was integrated and adapted using clients Retrofit and OkHttp. The GenAI then chats with the user and answers any further questions the user may have. Using this app, the public can learn how to safely recycle and repurpose their plastics, leading to higher recycling rates around the world. Using data of the amount of high schoolers in the United States, it is estimated that REALM will be able to remove about 281,000 pounds of plastic pollution per year through 5 years in just the US.

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