Low Cost Breath-Based System to Detect Cancers

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In 2025, the American Cancer Society reported 2.1 million Americans were diagnosed with cancer, which is the leading cause for 1 in 6 deaths. This can largely be attributed to late diagnoses, which can reduce survival rates by up to 13% every month (The BMJ). Current diagnostic tools like MRIs and CT scans cost thousands of dollars per test, are invasive, and are only administered 1-2 times per year, resulting in 46% of cancer patients being diagnosed at later stages (Stages III and IV) (Cancer Research UK). As cancer cells alter the metabolism, they produce elevated levels of volatile organic compounds (VOCs) released in the breath, creating a unique signature for each cancer (NIH). Therefore, the goal of this research was to develop a low cost, breath-based test to diagnose cancer, called OLAF (Oncological Low-Cost Airway Forecaster). OLAF uses an array of 10 gas sensors called an electronic nose to record these cancer-related VOC levels. Correction factors were applied for both temperature and humidity. The sensor readings are sent to a machine learning (ML) model trained to recognize the type of cancer from its unique VOC pattern, distinguishing between pancreatic, lung, colon and breast cancers. The entire system was built for $416, with the XGBoost, out of the three ML models trained, having the highest accuracy of 91.25%. OLAF was trialed on a group of clinically diagnosed participants with and without cancer and was successfully able to identify all cancers / non-cancer cases correctly. OLAF can make early cancer screening more accessible by serving as a preliminary test that can be integrated in local clinics to refer people for further testing quicker if needed.

Awards Won:

Third Award of $1,200

Patent and Trademark Office Society: First Award of $500

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