TinyML Based Self Diagnostic Kit for Respiratory Diseases

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Diseases that affect the respiratory systems of humans are one of the main causes of death across the globe according to the World Health Organization (WHO). More than 90% of respiratory deaths occur in low- and middle income countries. Many of the germs that cause respiratory diseases are spread by droplets that come from breathing, coughing and sneezing making them highly contagious. From the COVID-19 experience, there is a need for a personalized, easy to use and convenient mechanism to self- detect a potential contagious disease at home before going to the public, thus to limit the spread of infections.

The integration of Artificial Intelligence (AI) and Internet of Things (IoT) provides a great opportunity to bring detection and monitoring of respiratory diseases at home at low cost. However, current IoT/AI integrated solutions are based on cloud based architectures, with IoT sensors uploading data to cloud AI models. This architecture is a challenge in Africa due to connectivity, cost and privacy issues. This study is an extension of a master's thesis project that validated the concept of using tinyML in detection of respiratory diseases through use of open datasets. The focus of this extension is real implementation through the development of working prototypes of an embedded offline intelligent diagnostic kit for respiratory diseases and use them to collect data for training on prediction of a number of diseases.

A given person will breathe into a tube that canalizes the exhaled air towards VOC sensors while his/her body temperature is being captured contactless by an infrared temperature sensor. The collected data will be processed on the device and a tinyML algorithm used to detect if the sample is infected or not. A feedback will be shown on the device and also sent to a mobile phone via GSM. We will explore the use of tiny machine learning (TinyML) and develop an offline model for detecting respiratory diseases. In addition to early detection of respiratory diseases, the proposed solution will be a great value in the process of mass collection of exhaled breath data, complementing the few breaths that are collected in healthcare facilities. This will enable the training of efficient AI models for respiratory diseases and contribute towards the achievement of sustainable development goal on good health and wellbeing by the year 2030.