

Executive Summary

Pneumonia is the leading cause of death in children under 5 years of age throughout the world, killing over two million children annually. It is particularly deadly in low resource settings like Ghana where, in the absence of the advanced diagnostic devices, diagnosis is heavily dependent on accurately determining respiratory rate. Currently, pneumonia is being diagnosed using an Acute Respiratory Infection timer, which is a stop watch like device that counts out a sixty second test, and requires community health care workers, who are workers with very limited training, to manually count the number of breaths in this span and make a diagnosis.

Manually counting breaths makes obtaining an accurate respiratory rate very difficult, and diagnosis and referral is consequentially very unreliable. New designs have been and are in the process of being created, but there remains no device that is able to significantly improve upon the ARI timer to the extent that it can be replaced. The goal of this project is to fill this gap in sufficient and affordable diagnostic technology, and design a low cost and accurate pneumonia diagnostic device to provide a more reliable experience for CHWs making diagnosis and referrals in Ghana and similar low-resource settings.

The solution detailed in the following report is to utilize an encoder in an electro-mechanical design to create an automated, more accurate method to determine the respiratory rate. This is accomplished by tracking the chest expansion and contraction during each breath. This information is analyzed and compiled in real time during a sixty second test using an ATmega328 microcontroller and a specialized algorithm for the process. The respiratory rate during the one minute test is displayed on the device interface, and either a green or red LED will light up based on the number of breaths. A green light signifies a safe respiratory rate and no action necessarily needed while a red light signifies a dangerous rate, risk of pneumonia, and necessary referral or treatment.

The device has been designed to meet engineering specifications that require that it is accurate and repeatable, safe, requires limited training, is inexpensive, does not require maintenance, is durable, has a long lifetime, and is portable. Through an engineering analysis that included chest size, encoder, power draw, material, spring force, and cost analysis, it was determined that the device would meet a majority of the user requirements. The analysis could not confirm that the device would be accurate and repeatable, that it would require limited training or that it would not require maintenance. Further evaluation through self-testing and training sessions was performed to ensure that these requirements were met by the design.

Validation with the final design still needs to be completed, especially in validating accuracy.