

# A Sensor-Enhanced Digital Stethoscope (SEDS): Design and Development of an Intelligent Sensor-Enhanced Digital Stethoscope for Patient-Friendly Remote Auscultation

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Heart disease and respiratory problems are the leading causes of death for the 40 million people aged 65 or older in the United States. Yet 36% of elderly patients report transportation difficulties in making regular doctor visits. Telemedicine provides a mechanism for elderly patients to receive diagnoses without being physically present in the clinic. A user-friendly, intelligent sensor-enhanced digital stethoscope (SEDS) was developed that allows patients to perform their own auscultation and automatically sends their doctor relevant information, including heart rate, body temperature, auscultation audio, and pinpointed auscultation location. The hypotheses were validated and engineering goals achieved: the SEDS had better audio reproduction compared to a conventional stethoscope; digital signal processing was used to reduce background noise by 75% and optimal location detection was achieved by combining input from a motion sensor and thermal camera. 300 location-detection trials were conducted for two algorithm types; the SEDS successfully located auscultation points to within a 3cm radius (95% confidence interval) and distinguished posterior and anterior frames with 100% accuracy. Biometric data from additional sensors was successfully recorded and transmitted. The SEDS offers connectivity to smartphones, tablets, or computers, allowing doctors to access health data in the cloud via a web portal interface. This holistic healthcare tool allows a comprehensive suite of metrics and diagnostic data to be easily collected by patients and utilized remotely to help efficiently identify problems and effectively achieve simple and accessible geriatric healthcare.

## Awards Won:

First Award of \$5,000

Oracle Academy: Award of \$5,000 for outstanding project in the systems software category.

Fondazione Bruno Kessler: Award to participate in summer school "Web Valley" in Trento, Italy

International Council on Systems Engineering - INCOSE: Certificate of Honorable Mention

King Abdulaziz &

his Companions Foundation for Giftedness and Creativity: Award of \$1,000 for research in Innovative Technology.