Non-contact Continuous Cardiovascular Monitoring System

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Cardiovascular monitoring at home is highly desirable for managing diseases such as heart failure. Existing technologies are inconvenient, too costly, and/or incapable of acquiring clinically valuable information. We developed a new low-cost monitoring system based on rubber tubing, mineral oil, and a pressure sensor. The rubber tube can be installed underneath bed mattresses and chair cushions to convert the ballistocardiogram (BCG) signal caused by heartbeat to pressure change. The sensitivity is increased by filling the tube with mineral oil-based on Boyle's gas law (PV = Constant). The sensor is calibrated by a Scotch Yoke mechanism built using skills we learned from robotics competition and Hooke's law (F=-kx). Preliminary tests demonstrated that the new monitoring system can record BCG with high sensitivity from the bed. From the recorded signal, both heart rate and respiration rate can be extracted. Other valuable information such as myocardial strength and respiration strength can be potentially obtained as well. The new monitoring system is low-cost, very robust, unattended, and does not need to attach any device to the patient. We believe this new monitoring system will be beneficial for the monitoring of health conditions such as heart failure, sleep apnea, epilepsy, and respiratory diseases such as COVID-19.

Awards Won:
Fourth Award of $500