A Low-Cost Flying, Life-Detection System for the Recovery of Victims after Earthquakes

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Earthquakes are devastating natural disasters which affect regions all around the world. One of the many problems is that first-response teams struggle to recover victims buried under piles of destroyed infrastructure. A system must be devised to solve this issue. The main indicators of life include respiration, heart-rate, and electric potential pulses. Doppler radar was chosen as a viable detection system because of its ability to detect minute oscillations, such as respiration and beating of the heart. Existing methods are bulky and cost more than fifteen thousand dollars, therefore this system must be mobile and cost-effective to rescue earthquake victims. A $5 Doppler radar module, HB-100, was selected. Due to a low-voltage and noisy output waveform, a 40dB amplifier and low pass filter were engineered. The signal was acquired and interfaced with MATLAB with a C++ code. In MATLAB, the data was smoothed using Least Squares Analysis, split into discrete windows, and multiplied by the Hanning function. Various frequency spectrum representations were tested for visually representing the data. The MUSIC algorithm was chosen and implemented for its ability to estimate frequency estimations with Gaussian noise. The setup was tested on four test subjects behind three feet of cinder-block wall. The system was able to detect the respiration signal with peaks at 0.3-0.4 Hz, although the heart-rate signal was lost due to attenuation. Future Research includes employing a power amplifier for barrier penetration, and low noise amplifier to reduce the Signal-to Noise-Ratio of the received signal.

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