Remote Detection System for Penetrative Bodily Injury Using an Innovative Electrical Engineering Enhancement of Wearable Fabric

Sandrapaty, Vivek (School: West Port High School)

The potential for penetrative bodily injury is a daily risk taken by those in the military, law enforcement, and other high-risk occupations. If the injured are unable to call for help or are too far away to be observed, a means of timely detection is needed for the delivery of potentially life-saving aid sooner. With penetrative injuries such as via bullet, knife, or shrapnel, the worn fabric would be ruptured, overlying the injury. An innovative idea was explored by implementing the use of conductive thread, interwoven into wearable fabric in orthogonal arrangements, with use of headers, shift registers, multiplexers, Wheatstone bridge, and customized Arduino code, to indicate which conductive threads were disrupted, providing the "XY" coordinates of the rupture in the fabric. Information was then relayed to a remote monitoring system to promptly alert of the rupture and corresponding location of the underlying bodily injury. After modeling iterations, 50 exercises were performed in which the conductive wires on the fabric were cut (representing penetrative injury), and in all cases, the system remotely detected and localized the precise location on the fabric of the simulated penetrative injury. The system was shown to be a feasible method of remote detection and localization of the penetrative injury. Potential false positives could occur if worn-out threads break, correctable by applying a "baseline" resistance value whenever the electronics are turned on; false negatives could occur with penetration between conductive threads (without getting cut), improvable by increasing the threading density.

Awards Won:
Fourth Award of $500