Wireless Sensor and Monitoring System for Intensive Care Unit (ICU) Patients

Overview
Patients in a hospital intensive care setting are connected to multiple monitoring systems at all times. The electrical and mechanical tethers that link patients to these monitoring systems can become caught, snagged, or dislodged, which drastically reduces the mobility of the patient and represents a critical safety issue. Creating an integrated system that eliminates as many tethers as possible will accelerate patient transport, increase patient mobility, and eliminate accidental tether removal.

Objectives
The team’s objective was to convert electrical wires for electrocardiogram (ECG) and pulse oximeter monitoring into a wireless format fit for the hospital setting. We focused on “proof of concept” for the wireless transmission of signals compatible with the current monitoring system at Hershey Medical Center, which is manufactured by Dräger Medical, Inc.

Approach
• The team gathered customer needs and requirements by discussing the problem with doctors in the Surgery Innovation Group and observing the Intensive Care Unit at Hershey Medical Center
• Relevant patents and existing products focus on wireless monitoring in the home, and are not designed for the cost restraints of the hospital for use in monitoring more than one patient.
• Through the concept generation process, the team explored the use of individual wireless sensors, a new Bluetooth-capable display monitor, and the incorporation of a wireless system into the Dräger Medical technology – ultimately, we decided to adapt the current system.
• The team designed a system that uses Bluetooth to wirelessly communicate patient vital signs to a Dräger patient monitor between two HUBs which are hard-wired to either side:
  o Sensors on the patient connect to HUB 1, which prepares the individual signals for Bluetooth transmission by amplifying, digitizing, and multiplexing them.
  o A serial digital signal is sent to HUB 2, which separates, reduces, and converts them into their original analog form to be displayed on the Dräger monitor.

Outcomes
• The total cost of the final prototype was $760.
• The ability to wirelessly transmit patient vital signs to a nearby monitor has been demonstrated to be feasible.
• Our project demonstrated this feasibility by reverse engineering to identify the relevant signal, calibration, and power wires from the Dräger monitor, and wirelessly transmitting signals across a Bluetooth link.