● Previous projects focused on hazard detection and wireless heart rate transmission.
Objectives

- Create a wearable device to be worn in the field
- Must detect heart rate, motionlessness, and temperature inside bunker gear
- Must work in at least 140°F environments and wet conditions inside a firefighter’s bunker gear
- Sends data to an outside team of responders
System Block Diagram

Block Diagram Life Monitor System
Power Supply

- Supplies +3.3 VDC and GND to microcontroller and sensors
- Utilizes 6V from four alkaline batteries

Results
- Produces 3.28 output voltage
Power Supply - Original Design - Buck Converter

Power Supply with Buck Converter

\[ V_{out} = V_{FB} \left(1 + \frac{R_1}{R_2}\right) \]

\[ C_1 = \frac{1}{2\pi R_1 f} \]

\[ C_2 = \frac{1}{2\pi R_2 f} \]

\[ f = 45 \text{ kHz} \]
Power Supply - Linear Voltage Regulator

$$V_{out} = 1.25\left(1 + \frac{R_2}{R_1}\right)$$
Sensor Unit

Functions:
- Motion Detection
- Temperature Sensing
- Heart Rate Sensing
Sensor Unit - Vibration Sensor

- Acts as open switch when still and closed switch when moved
- Sensor is connected from one Microcontroller pin to ground
- Microcontroller reads high value when motionless and low value when movement occurs

Results:
- Responds to movement successfully
Reading Data:

- Max31850K IC
- Data transmitted using 1-Wire protocol
- Accuracy to 0.25 of a degree

Results:

- Successfully measured temperature however the IC had trouble with higher temperatures.
Sensor Unit - Heart Rate Sensor

- Measures infrared light reflected back as blood pulses through veins
- Analog Data output to microcontroller

Results:
- Measures Heart rate successfully however movement disrupts the heart rate reading
Heart Rate Sensor Data and BPM
RF Network

- 434 MHz RF transmitter and receiver
- Amplitude Shift Keying (ASK)
- Transmits Data over 200 feet
- Sends one CHAR array
- Transmits at a rate of 2000 Bits/sec

Results:
- Only transmitted about 15 feet before no new data was received
- Displayed data updates slowly
Control Unit

- ATmega328p microcontroller
- Programmed with Arduino IDE and USB Programmer

Results:
- Enables communication between sensors and transmitter
Display Unit

Consists of:
- Arduino Uno
- LCD Display

Results
- Displays temperature, heart rate in bpm, and a binary value for motion
Software Algorithm-Receiver

1. Start
2. Initialize Variables, LCD, and RF Receiver
3. Initialize Received Data Variables (Array holding data and Array Length)
4. Data Received?
   - Yes: Separate Data for Temperature, Heart Rate, and Motion
   - No: Go to step 3
5. Print Data on LCD
Overall Results

- Produced a functioning device
  - Detects heart rate
  - Measures temperature
  - Detects motion

- Maximum range of approximately 15 feet

- Vibration could be more sensitive

- High level objectives achieved but improvements could be made before produced for market
Future Development

- Implement RF Error checking
- Utilize more accurate pulse sensor and sensitive vibration sensor
- Improve Antenna Design
  - Incorporate 12V input unit to increase detection range
  - Increase number of transmitters one receiver can communicate
- Smaller Size
- Store collected data
SWOT Analysis

Strengths:
● Modular design
● Compact
● Utilizes Alkaline batteries

Opportunities:
● Support multiple transmitters per one receiver
● More applications than just firefighting

Weaknesses:
● Short range
● Some inaccuracies in sensors

Threats:
● Must endure harsh environmental conditions
References

Questions?