UNIVERSITY OF NEBRASKA AT OMAHA

Lessons Learned from Designing a Health Monitoring System to Improve First Responders Safety User Interface

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Introduction

Every day, first responders put their own lives at risk to help individuals, families, and communities. They experience many safety and health hazards on the frontline that can lead to injuries, chronic illnesses, and even death. Chronic illnesses include cancer, heart diseases, and behavioral health issues that often cause first responders life expectancy to be significantly shortened.

According to the National Fire Protection Association, there were 64 on-duty firefighter deaths in 2018. Sudden cardiac death accounted for about 40% of the on-duty fatalities. During 2017, there were an estimated 44,530 documented exposures to hazardous conditions (e.g. chemicals, fumes, radioactive materials) and 15,430 collisions involving fire department emergency vehicles responding to or returning from incidents.

To help minimize the health impact of first responders, the overarching goal of the **University of Nebraska at Omaha - Mid America Transportation Center - Department of Transportation (UNO MATC DOT)** research project is to build a health and environment monitoring system that can be used during a hazardous material exposure. The system aims to improve first responders' safety by integrating bio and environmental sensor data and employing decision support technology to send alerts when a first responders' health is at risk. Sensors are useful to monitor the activities and track the individual's health vitals such as heart rate, heat index, respiratory rate, blood oxygen saturation levels, and blood pressure. Through the monitoring of health vitals, an incident commander or medic can take immediate action to remove a first responder from the front-line to minimize long-term health issues when their vitals reach certain thresholds. This poster presents the lessons learned while participating in the design of the user interface and analyzing what technology to use for development. .

The primary goal of the REaCH System dashboard is to build a health and environment monitoring system for improving the first responder's safety during an HAZMAT (hazardous material) incidents.

Overview of REaCH System

In the REaCH System, mainly we have concentrated on hazmat first responders health and safety. First responders need a tablet- or smartphone-based dashboard showing the status of sensors worn by first responders or sensors connected to the equipment they use. Multiple technological solutions (sensors) exist in both the public safety and consumer markets today to monitor the health of first responders and to monitor their activities and equipment. The primary goal of this research is to track the individual's health vitals. Since, health data are useful to get insights about the individual's vitals. Below are the health vitals which we considered in this design
- Heart rate(HR),
- Ambient Heat Index (HI)
- Respiratory Rate (RR)
- Blood Oxygen Saturation Levels (SPO2)
- Blood Pressure (BP)

Research Question

What are the best user interface practices to design a emergency health monitoring system for first responders?

REaCH System Design

Below are the few important displays in the health monitoring system which gives the information about the first responder health vitals and which team are they in use. Also, the threshold value ranges for all different health vitals.
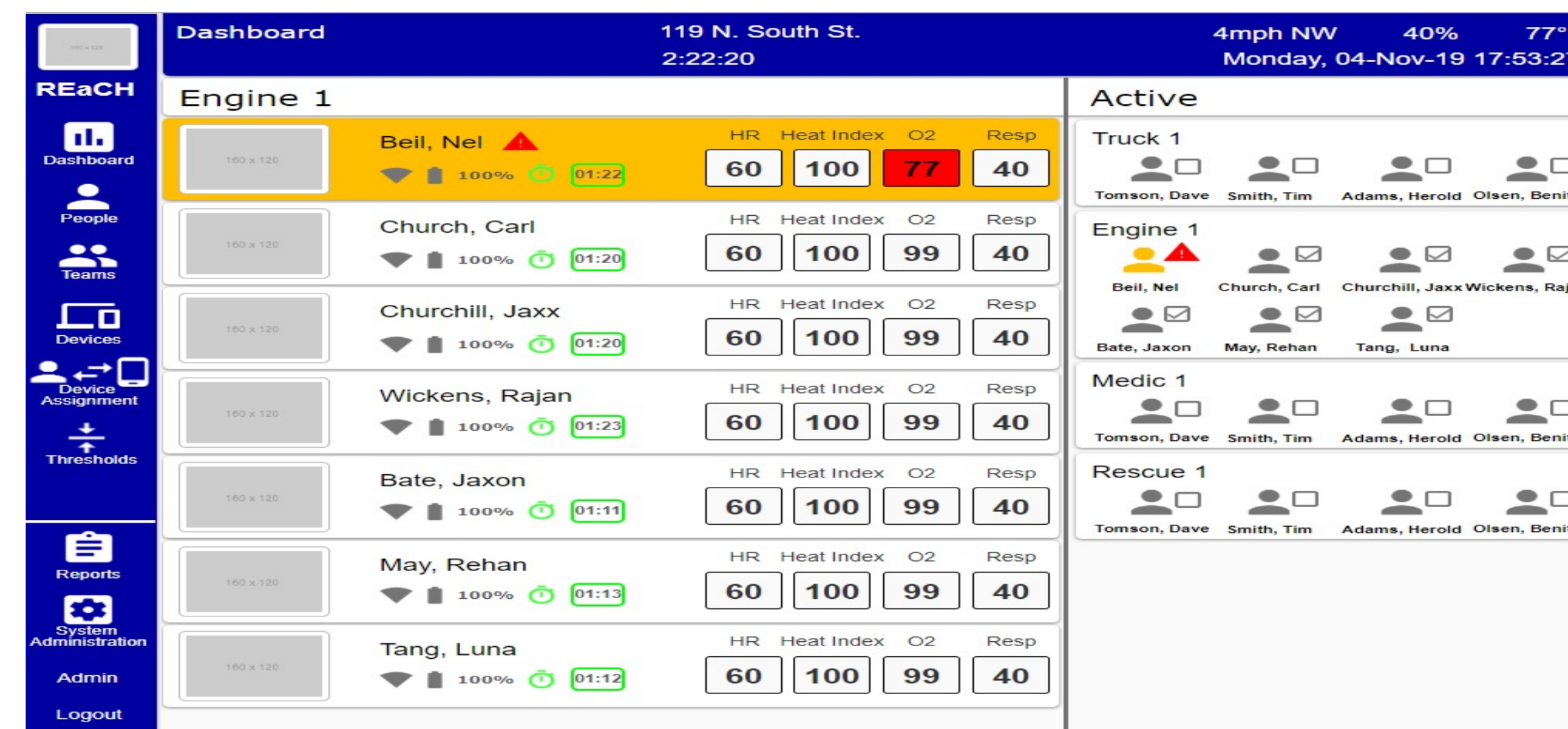

Figure1:- The main dashboard contains the information of the first responders who are in the HAZMAT event, and their health vitals (HR, BP, RR,SPO2).
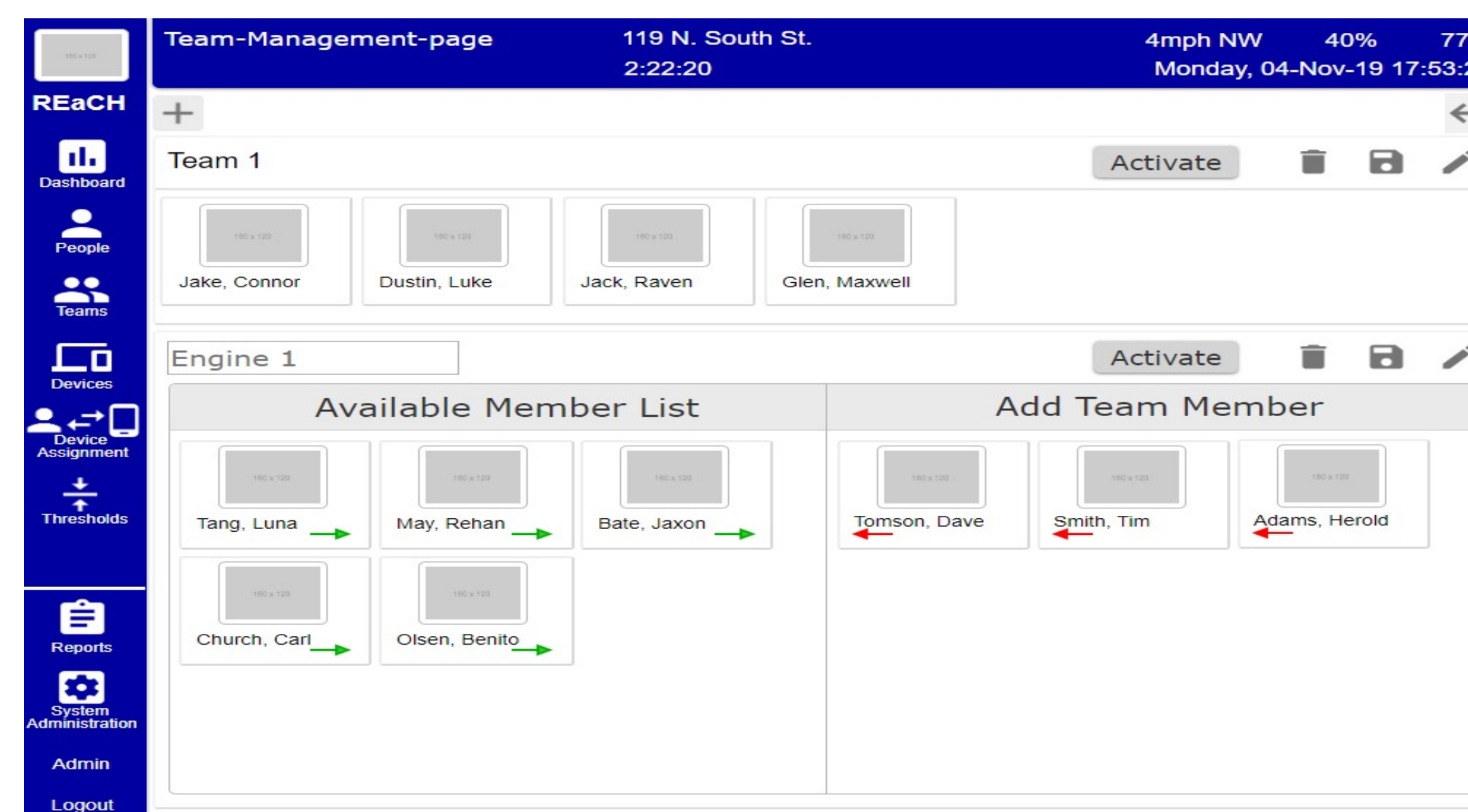

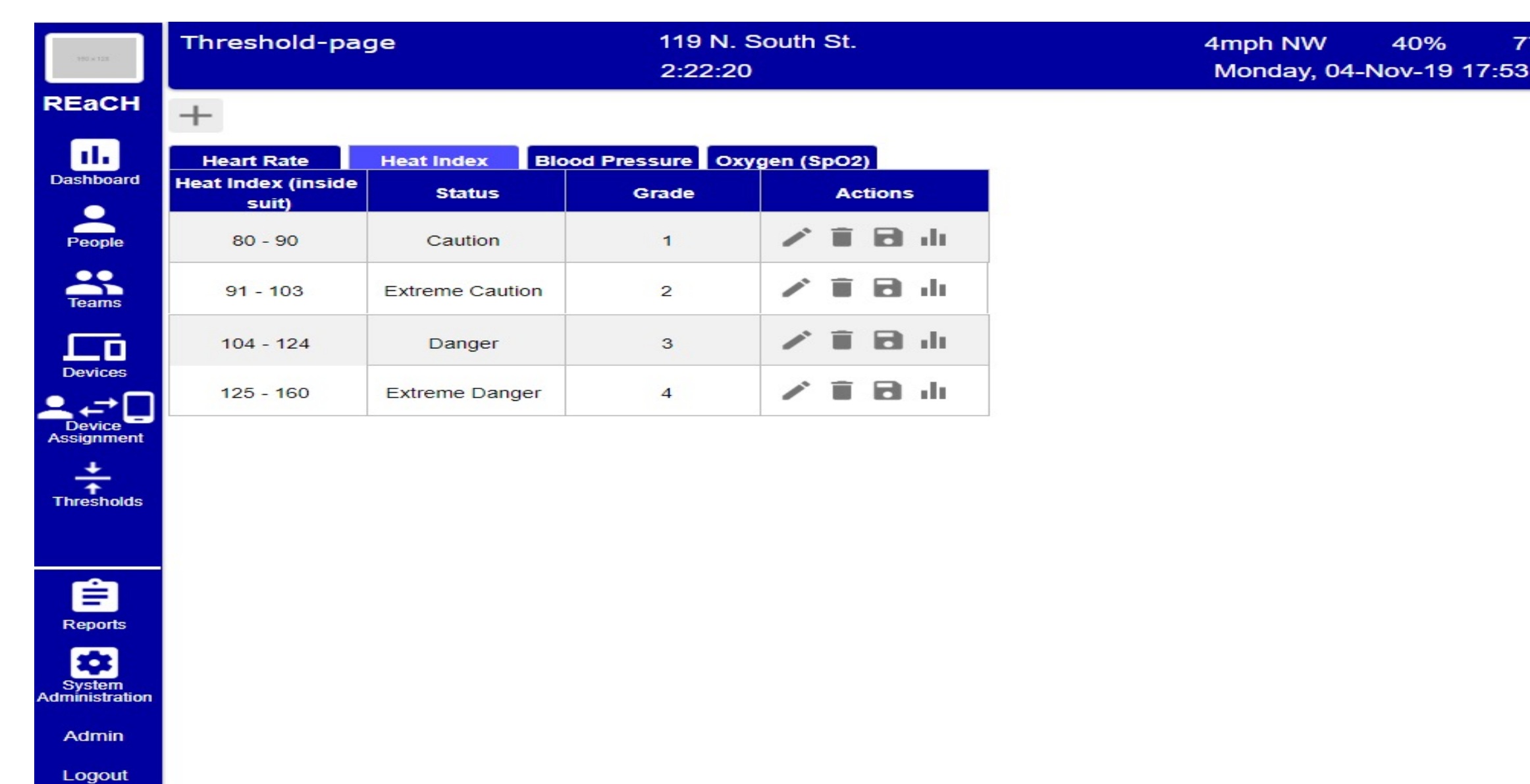Figure 2:- Teams Page- Assigning first responders to specific teams

Figure 3:- Threshold's page- Collecting all the health vitals (HR,RR,BP,SPO2) ranges and assigning a grade to each health vital parameter.

Lessons Learned

While designing this REaCH System we focused more several important design practices:
- **Concentrate on User Experience-** We discussed the process when the users open the REaCH system dashboard they need to easily understand how to navigate from one page to another. For example, on the dashboard side bar we have placed different buttons which links to each respective page. Also, the names on the buttons are easily understandable by the user.
- **Common design elements throughout the application-** We have placed all the tables, buttons, icons, logo consistently in the application. So that users has a good feel for the consistency and knows what to expect.
- **Some elements take precedence over others-** Another important design feature is when it comes to visuals and the human eye, A few elements proliferate over others (bigger sizes, bright colors, etc.), depending on how "noticeable" they are. For example, we have used the orange color to indicate that the first responder is in danger and red color for indicating which health indicator is causing or putting the first responder in danger.
- **Consistent design** - The user interface should consist of a minimum number of actions when user performing tasks. For example, if we want to delete the team, the user just clicks delete icon in the team page.
- **Consistent communication** - Every interaction with your user is communicated. For an application to be successful, it must speak to the user and keep them informed on what is happening. And, as with everything else, the way the system communicates should be consistent. For this project we had routine communication with real first responders and employed their feedback into the design.

Future Work

The future work for this prototype is developing the application which requires the following frameworks:
- Building the front end using Angular framework and styling with Angular Material
- Developing the backend using with Django REST API and Django framework
- Connecting the backend with PostgreSQL.
- Integrating front end and backend.
- Deploying and host the application on the HEROKU server.

This research is being conducted in collaboration with the Special Operations Team, Omaha Fire Department, who are responsible to contain hazmat incidents in the Omaha Metropolitan Area and UNL Nebraska Transportation Center.

Acknowledgement

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