



UNC Charlotte – Lee College of Engineering Senior Design Program Company Information

Company Name	Systems Engineering	Date Submitted	11/03/2021
Project Title	Data Analytics for Facility Layout Design Optimization via Virtual Reality with Eye-Tracking (UNCC SE EYE)	Planned Starting Semester	Spring 2022

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical		Electrical	
Computer		Systems	4
Other ()			

Project Overview and Requirements:

This is a continuing series of department projects that utilize a Virtual Reality (VR) environment that enable people to assess various designs, and statistical analysis to optimize the design. The students will develop VR models for facility layout designs and collect data from an eye tracking device. Initial layout designs are developed using mathematical optimization that consider only physical factors without considering psychophysical criteria. For example, designing a manufacturing facility can be driven by minimizing only the total material flow costs, or a dining area of a restaurant can be configured only to satisfy social distancing/fire capacity requirements. Such layout designs are built into 3D models in the VR environment. Data will be collected from the eye tracking device while testing the VR models using the HTC Vive Pro Eye along with a 360-degree treadmill (see the figure below) in the SEEM Department lab. To model 3D environments, [Unity](#) will be utilized.



Students will use various analytics techniques to identify the relationship between the physical design factors of the facility and the psychophysical performances. Techniques to be implemented include, but not limited to:

1. Multi-Dimensional Scaling (based on Singular value decomposition) and Hierarchical Clustering analysis will be used to determine potential similarity and organization within the input variables and output variables.
2. Data Envelopment Analysis will be used to determine potential directions of improvement based on performance criteria.
3. Develop potential Bayesian Network models to enhance the diagnostic and prognostic capacity for potential system verifications and validations.
4. Choquet Integrals will be used to visualize the priority based on various classifications of design requirements.

The resulting relationship will be incorporated into the mathematical optimization model to improve the designs.



Expected Deliverables/Results:

Deliverables include:

- 3D models built for VR environment.
- Data collection from VR experiments.
- Report providing detailed analysis on collected data.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- SEGR 4141 (completed or plan to take in Spring 2022)
- SEGR 4202 (completed or plan to take in Spring 2022)
- Basic knowledge on VR headsets/models