SIMULATION OF BUILDING STRUCTURE EFFECTS ON THERMAL COMFORT PARAMETERS

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ABSTRACT

This paper is related to simulating the effects of the structural characteristics on thermal comfort parameters in building design. Based on the data collection from sensor networks, a more robust model with an interactive user interface is built using the Python library tkinter. This research aimed to demonstrate how major objects within a building affect the airflow and temperature. The sensor network data analysis determines which variables have a strong correlation to airflow and temperature in the simulated building. The new created user interface allows for interactive inputting of variables in order to determine approximate airflow and temperature values.

Keywords: Regression Model, Python, Thermal Comfort Analysis in Building Design

1 INTRODUCTION

A challenge faced in building design is understanding how the placement of major objects such as elevators, windows, stairs, and vents will affect the airflow and temperature at a given point. To examine the correlation between the dependent and independent variables we created a heatmap using the Seaborn library. From there we took 4 variables that had the strongest correlations and build a multi-variable linear regression model.

2 MOTIVATION

In our previous work cited below, we used sensor networks and collected real data on the distances between building structures and the airflow and temperature at one floor of a building on our campus. The motivation of this work is to find a mathematical model (based on regression analysis) that can simulate the effects of these characteristics on thermal comfort parameters in building design. We use the model by interactive user interface to simulate the effects of changing the locations of building structures on these parameters.

3 EXPERIMENTS DESCRIPTION

The temperature heatmap showed a strong correlation between window right (WR), window left (WL), vent right (VR) and vent left (VL). Using this information, we created a multivariable linear regression model in excel. The coefficients of WR, WL, VR and VL independent variables were 0.000673259, -0.000294182, 0.000782928 and 1.83577E-05 respectively with an intercept of 23.1589836. The R2 value for this regression model was 0.812250738 with a standard error of 0.47314293. Using this information, we created a user interface using the Python tkinter library (Figure 1).

The airflow heatmap showed a strong correlation between elevator right (ER), elevator left (EL), stair right (SR) and stair left (SL). Using this information, we created a multivariable linear regression model in excel. The coefficients of our ER, EL, SR and SL independent variables were 0.002653683649, -0.00993211054, -0.02827008772 and 0.02537528579, respectively with an intercept of 152.9039125. Our R2 value for this regression model was 0.731 with a standard error of 7.830013693. Using this infor-mation, we created a user interface using the Python tkinter library (Figure 2).

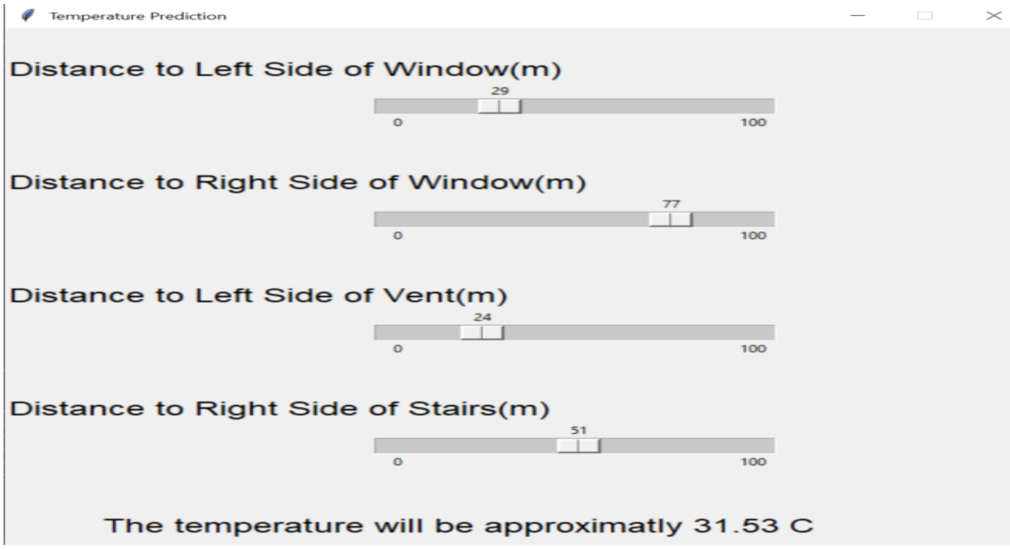

Figure 1: User interface for approximating temperature by changing distance from major objects (found to have a strong correlation to temperature).

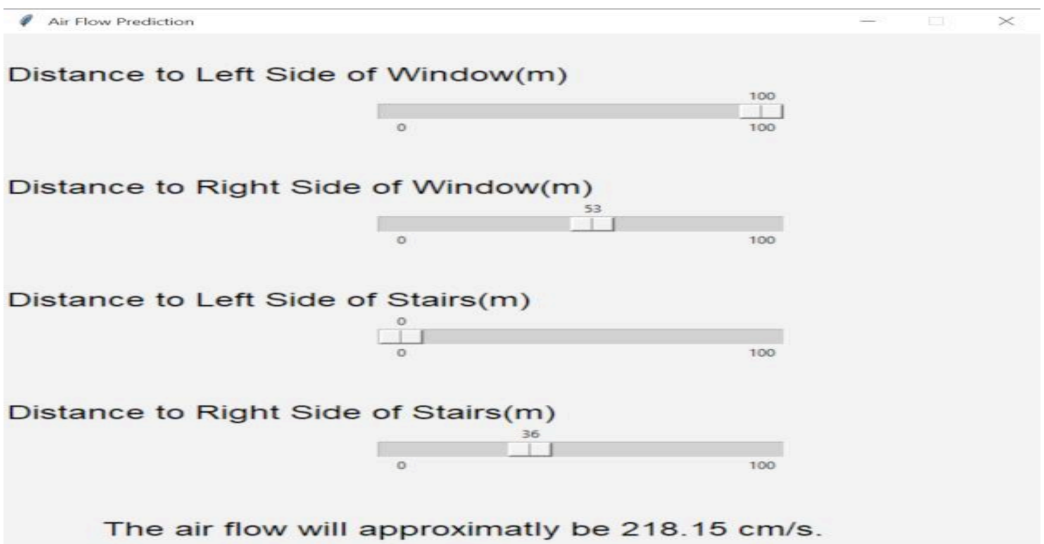

Figure 2: User interface for approximating airflow by changing distance from major objects (found to have a strong correlation to airflow).

4 CONCLUSIONS

By using real data from sensors network, we explored the correlation between building structure locations to the perceived temperature and airflow in a floor. The simulation model as well as an interactive user interface shows how the changing of the distance from major objects will affect airflow and temperature. By using the Seaborn Python library, a heatmap of correlations was created, we took the four variables that showed the highest correlation to temperature and airflow. By creating a multi-variable linear regres-sion, the model was transferred over to Python. Python library tkinter is used to create a user interface to enable users to change the distances of different major objects affects the airflow and temperature. Future steps would be to allow the embedded model and user interface in a custom floor map used in building design.

REFERENCES

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