Using deep neural networks to predict air pollution($PM_{2.5}$) over time and understanding its relationship to greenness in a city

Context and Problem

- 7 million people die every year from exposure to air pollution yet 97% of cities in low and middle-income countries do not meet World Health Organization air quality guidelines (WHO'18).
- Cities from low income countries have very few air quality monitoring stations.
- There is need for analyzing and predicting future air quality to aid in decision making by the population and policy makers using the limited data from the few monitoring stations.

Methods

- Used Long Short Term Memory (LSTM) Neural Network to develop models for predicting air quality.
- Air Quality data, Meteorological data and Greenness data were obtained for 10 selected locations in Kampala.
- Data Sources : AirQo, US Embassy, Trans-African Hydro Meteorological Observatory (TAHMO), NASA.

Results

- Figure 4 shows the average of $PM_{2.5}$ concentration for each hour & Figure 5 shows the 24-hour average for selected locations.
- Table 1 shows the performance scores after evaluating the models. Figures 2 and 3 show plots for predicted vs. actual $PM_{2.5}$ at selected locations.
- Weak linear relationship between $PM_{2.5}$ and Greenness was observed.

Figure 1: Pipeline for deep neural network models

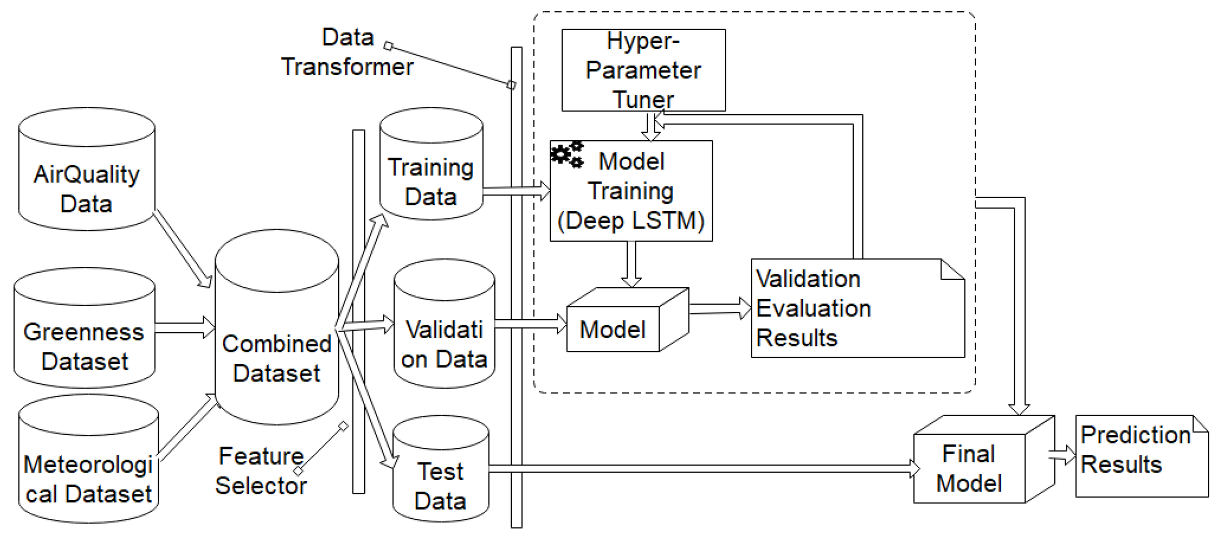


Table 1: Performance Score

Location	RMSE	MAE
I	7.58	4.54
2	6.83	3.51
3	8.48	6.54
4	7.22	4.35
5	8.98	6.15
6	7.54	4.97
7	11.34	8.27
8	23.53	14.51
9	49.29	33.33
10	20.45	13.65

Figure 2: Plot showing predicted Vs. actual $PM_{2.5}$ for Location 7

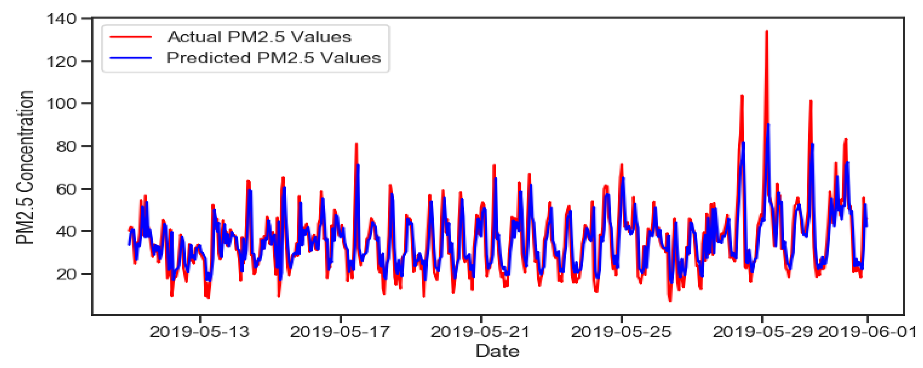


Figure 3: Plot showing predicted Vs. actual $PM_{2.5}$ for Location 8

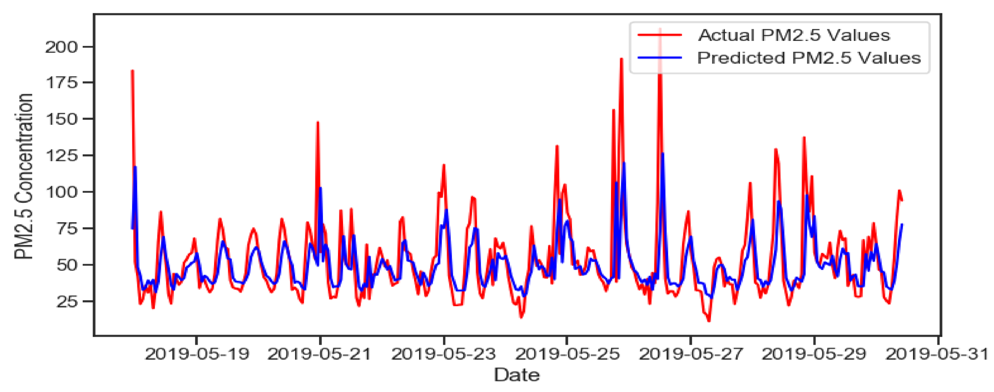


Figure 4: Plot showing average $PM_{2.5}$ for each hour at selected locations

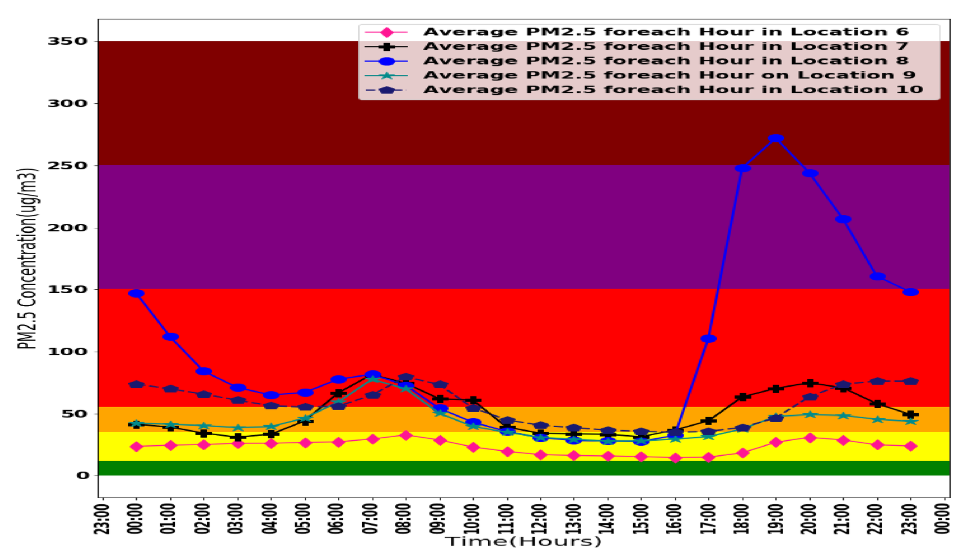
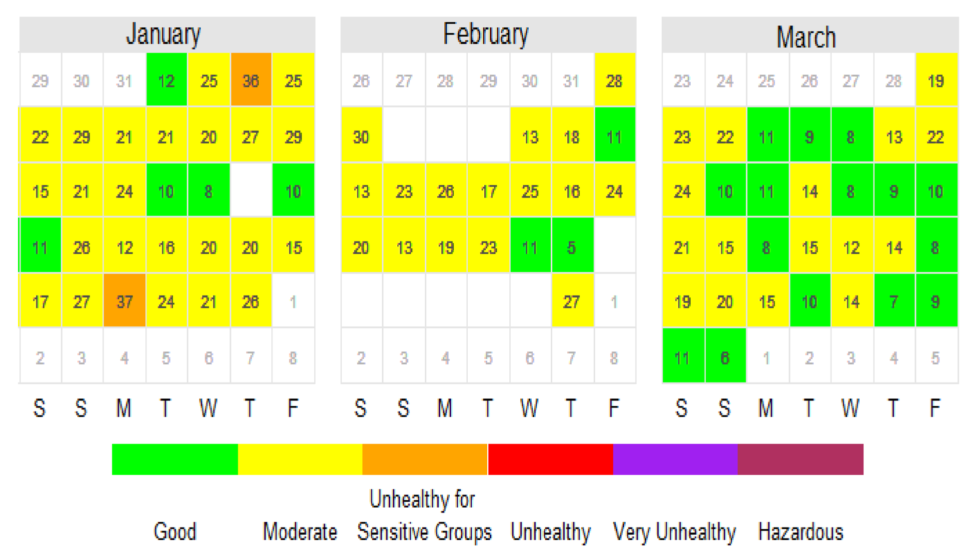


Figure 5: Calendar plot showing 24 -hour average for location 5



Key References

- World Health Organization. 2018. WHO | WHO Global Ambient Air Quality Database (update 2018). Retrieved from http://www.who.int/airpollution/data/cities/en/
- Bruce Kirenga et.al. 2015. The state of ambient air quality in two Ugandan cities: a pilot cross-sectional spatial assessment. International journal of environmental research and public health 12, 7 (2015), 8075–8091.

Deep Neural Networks for Air Quality Prediction and Analysis

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