Analyzing Drone Footage to Assess Necessary Streetlight Placement

Where in New Washington Heights and Poe Mill are Streetlights Most Necessary?

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I. Introduction

New Washington Heights and Poe Mill are low income neighborhoods with high crime rates and the people living there feel that more street lights would make the areas more safe at night. In our project, we aimed to answer the question: where are streetlights most appropriate in these neighborhoods? And can footage taken from the recent drone flyover help to improve our ability to accurately model streetlights in these neighborhoods? We will present our findings to the residents of Poe Mill and New Washington Heights in order to aid their efforts in making their streets safer. This question is relevant to GIS because we can use spatial analysis techniques to improve the safety of these neighborhoods.

Figure 7: : Map of Poe Mill light spread as estimated based on human perception.

II. Lit Review

A concerning article from the Public Spaces website argues that there is sometimes tendency to "over-light" a park, street, or neighborhood which can be just as bad as too little lighting in crime ridden areas. The website addresses the most successful street lighting techniques, such as the most appropriate height of luminaire, the most effective bulb type and wattage, how far apart should light posts be, etc. The website also successfully answers general questions well and may be helpful to our project like why is lighting important and what are the most common ways of light usage.

An article by Welsh and Farrington argue that there are two main theories of why improved street lighting causes crime reduction. They first believe that improved lighting leads to improved surveillance of potential offenders by improving visibility and by increasing the active number of people on the streets. Secondly they suggest that improved lighting communicates that there is a community investment within an area, leading to community pride, cohesiveness, and informal social control (pg 2).

Morrow and Hutton's report on the Chicago Alley Lighting Project actually yielded interesting and different results than that of what we would have expected. Their aim/purpose was to assess the impact of increased alley lighting on two high crime areas in Chicago. They concluded that the three crime categories actually increased over the six month testing interval, violent offences up 14 percent, property offences up 20 percent, and non-index crimes up 24 percent. This article shows the importance of the type of lighting initiatives that must be taken within each unique neighborhood and community. Something we must continually check within our own Street Light Project. To avoid these issues, we suggest shorter, closer together lights because these better address the needs of the neighborhood residents.

III. Methodology

These neighborhoods had been analyzed already and we updated the information given to us. Previous data was collected through use of a drone, which flew over Poe Mill in a predetermined flight pattern. We collected our data by visiting the neighborhoods and identifying where the streetlights were, which direction the lights were facing, if they were functional, and what type and wattage they were. The three types of streetlights we found were Metal Halide (**MH**), Mercury Vapor (**MV**), and Sodium Vapor (**S**) If a new light was found, we added its coordinates to the map. Any broken lights were not included in our maps.

We used the data collected by the drone to determine the intensity of light surrounding each streetlight. In order to do this we exported still images from the footage and analyzed the light density using ImageJ. Figure 3 is a graph which shows light decay which came from this analysis. To get the equation of how light decays as we get further from the light, we used JMP. This equation is shown in Figure 5. We combined this data with the data we collected by applying the light spread to the new lights we observed. We then used the Euclidian Distance tool in ArcGIS to show the distribution of light around each streetlight, taking into account its type and wattage.

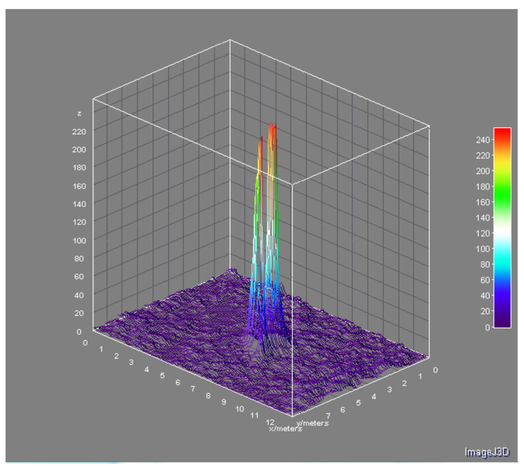

Figure 4: 3D representation of light spread around a streetlight.

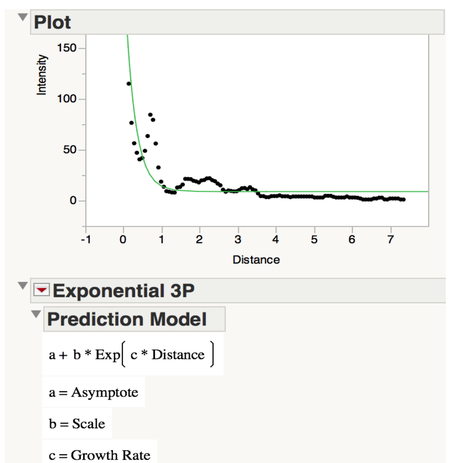

Figure 5: Equation of line representing light decay as distance from streetlight Increases.

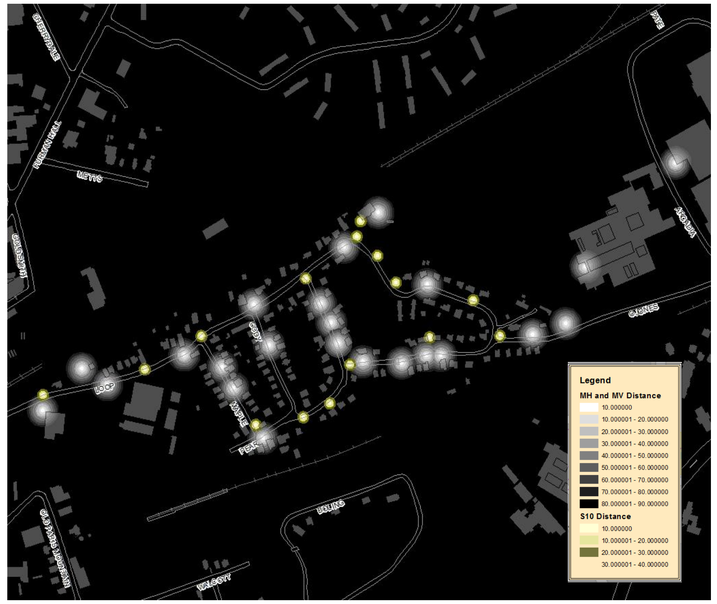

Figure 1: Map of New Washington Heights light spread as estimated based on human perception.

IV. Results and Discussion

Our results are shown in Figures 1 and 2. These maps represent perceived light cover in New Washington Heights, and the light detected by the drone. As you can see (or not see) the drone picked up on very little light. This is due to a difference in human perception and what cameras can capture. Another thing we noticed is that in the drone footage, the direction that the lamp is facing makes not difference, but on the ground it does affect light spread.

Figure 6: Poe Mill light spread as estimated by the drone footage. Note: the light fixtures and intensity appears smaller due to the neighborhood being larger.

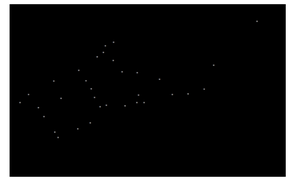

Figure 2: New Washington Heights light spread as estimated by the drone footage.

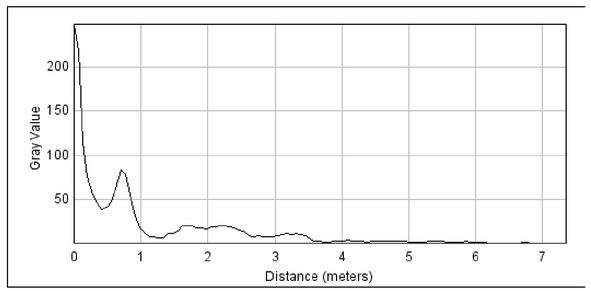

Figure 3: Graph of light decay as distance from streetlight increases.

V. Conclusion

We have concluded that there are some areas in both Poe Mill and New Washington Heights that lack adequate lighting. In the figure 1, we mapped the streetlights and applied a buffer around them based on our estimation of how much the light spreads around them. From this map, the areas that require more lighting are more clear than in figure 2. We have also concluded that a camera with better aperture and nighttime settings may produce a more accurate representation of the light spread. This could be an inherent problem with the use of cameras, as the human eye perceives light differently from computers.

V.I. Future Research

Future research would include a more accurate representation of the light distribution around each lamp. For example, certain variables were ignored in our analysis, such as the direction the lamp is facing, the age of the light, tree cover, elevation slope, and humidity.

We have also found that there is a clear difference between our created "Perception Map" and the actual drone footage. From the drone, the streetlights appear as pinpoints due to the aperture from the GoPro camera. From the ground the lights spread much farther from what you can actually see. Perhaps future research can provide a more accurate representation of perceived light.

VIII. Acknowledgements

- Drone team: Dr. John Conrad, William Lewis, Chase Fiedler, Connor Chatterton and Steve Nelson.
- Stan Reynolds from Duke Energy
- Jean Phelps and Mercia Calvin (Residents in New Washington Heights)
- Professor Mike Winiski

VII. References/ Data Sources

--Clarke, R.V., 2008, Improving Street Lighting to Reduce Crime in Residential Areas: US Department of Justice, v. 8 , p. 1-43

- Kent, F., 2014, Project for Public Spaces: Lighting Use & Design: http://www.pps.org/reference/streetlights/#Why%20is%20lighting%20important (accessed November 2014)

-Welsh, B., and Farrington, D., 2008, Effects of Improved Street Lighting on Crime: Campbell Systematic Reviews, p. 1-46.

-Morrow, E., and Hutton, S., 2000, The Chicago Alley Lighting Project, Illinois Criminal Justice Information Authority, p. 1-44.