Visualizing Urban Mobility

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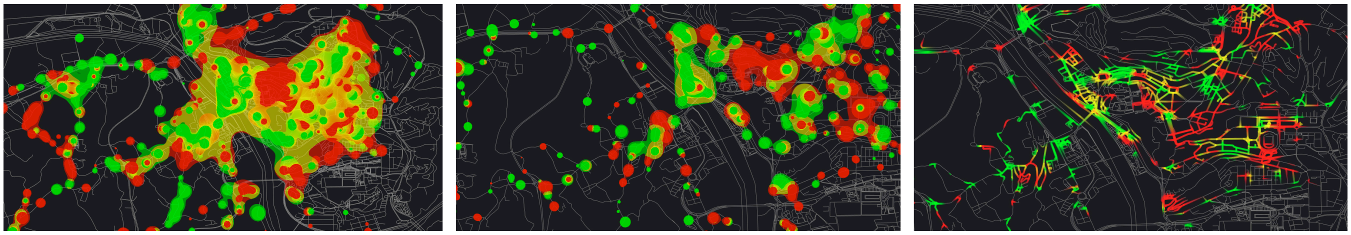

Figure 1 *Visualizations of the urban mobility created by applying the Metaball technique to colorize the pixels, the two images on the left, and to colorize the vertices of the map with global view, the image on the right.*

1 Introduction

The goal of this research is understanding urban mobility through the visualization of the use of public transport systems. We focus on the visualization of anomalies regarding the number of passengers. To find patterns of use we analyze the raw data, which contains people counts for every bus stop in Coimbra. For each stop, and for each day of the week, we calculate the average number of passengers and its standard deviation for each 30 minute interval. This allows us to identify situations that deviate from the norm.

To produce the visual artifacts we rely on the *Metaballs* [Blinn, 1982] technique. To improve performance the data is pushed to video card and the output calculated using fragment and vertex shaders written in GLSL. Our representation of urban dynamics is embodied by two visualization models. The first represents the deviations and the city map on separate layers; The second embeds the deviations into the vectors of the city map. These complex and computationally heavy representations simplify the identification of patterns in large quantities of data. To further promote visibility, we resort to exaggeration, which allows the visualization of small details, which would be invisible by direct mapping.

2 Implementation

The representation of the patterns in urban mobility is based on *Metaball* technique. We generate an *isosurface* where the position of each charge point is the *GPS* position transformed to the screen coordinates, and the force is the absolute value of the deviation. A positive deviation, i.e. an abnormally high number of passengers, is represented in red, while a negative deviation is represented in green. Forces superior to 1 are represented with an alpha component of 0.8, forces inferior to 1 and superior to 0.5 are represented with an alpha component of 0.5. The analysis of the global view of the city, presented in figure 1, and of the zoomed area, presented in figure 2, reveals the justification for using a two-band threshold. As it can be observed, forces superior to 1 tend to result in circles since the influence of other charge points tends to be negligible by comparison. This contrasts with the areas of transparent green and red generated by forces in the [0.5,1] interval, which assume a more organic nature filling in the gaps among strong forces and highlighting areas where anomalies are occurring. When we zoom in, the exaggerations caused by the representation of these small forces are reduced and the visualization becomes more rigorous.

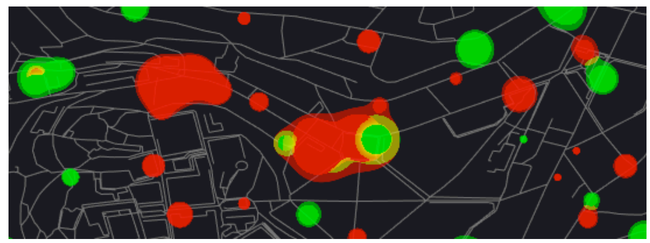

Figure 2 *Detail of visualization where we can see the behavior of Metaball technique with two classes of charge points.*

The second approach is based on the same technique. The difference is that the output of the function is applied directly to the shape vertices of the map. First, the road map is retrieved from *OpenStreetMap* and unnecessary objects are filtered. Then, the *Metaball* technique is applied to determine the color for each vertex of the map (figure 3). Although, this approach is less computationally expensive, in our opinion, the visual output is not as clear and informative.

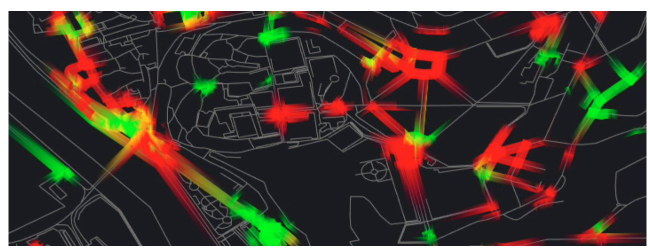

Figure 3 *Detail of visualization with Metaball applied over vertices of the map.*

The outcome of this process is an interactive visualization application with two models of visualization, one presents a clear and informative, albeit exaggerated, view of the anomalies, while the other sacrifices visibility for the sake of rigor.

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References

Blinn, J. F. 1982. A Generalization of Algebraic Surface Drawing. ACM Transactions on Graphics 1 (3), 235–256.

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