Project EcoCollage: Showing Chicago the 100-Year Storm Up Close

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Abstract

Chicago hit a new all-time daily record rainfall when 6.86 inches fell during the early morning hours of Saturday, July 23, 2011, at O'Hare airport. The previous record was 6.64 inches set on September 13, 2008. This rainfall fell between the hours of 1 to 3 a.m. This 100-year storm for the Chicago area is 4.85 inches. Obviously, this storm far exceeded that. During the rainy storm season the Chicago area becomes extremely flooded, ruining transportation systems, flooding sewers, and making it nearly impossible to even walk on the flooded sidewalks.

Keywords

Swale, Green Roof, Permeable Pavement, Rain Barrel, SIFT, SURF, OpenCV, InqScribe, Transcribe, xCode

Introduction

Professor Leilah Lyons and her team of graduate students and researchers have been on a mission for over five years now to show the effects of the flooding in Chicago. Flooding stops the transportation systems including trains, buses, taxis, etc. These are highly important means of transportation to Chicago commuters. Flooding can also tamper with the sewer systems, and if the waters that flood the streets cannot all make it through to the treatment center, then the water is dumped straight back into Lake Michigan. If this pattern continues it will slowly deteriorate the lake and ruin the ecosystem.

Past Work

In the past the team began with a prototype consisting of a simple map of squares (See Figure 1). The map was a 3x3 large squared map with 6x6 smaller squares making up the bigger squares and the spaces in between were to be considered the streets.

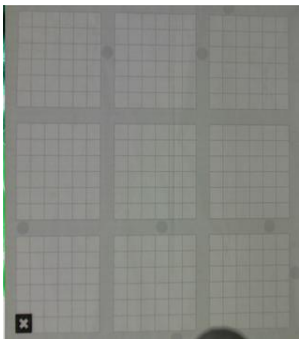

Figure 1

There were also a few light circles on the streets to represent sewers. With this map they recorded volunteers attempting to try the program. The volunteers were informed of the problems and where the "gardens" were to be placed. The goal of the game was to find the best positioning of gardens that would cost the least money and soak up the most water. The "gardens" that the volunteers were using were known as swales. A swale is a low or hollow place between ridges, that can be used to redirect or catch water, and then it creates a marshy area.

In doing this research they had to take into account the proprietors aspects of these items. When it comes to rain barrels, swales, green roofs, and permeable pavement they were worried about the look and cost. Many people were mainly worried about their own households, basements flooding, or gardens becoming a marshy mess. They'd rather let the water just roll into another neighbors yard. So, the goal for them was to get people to see the short and long term benefits of installing one or more of the systems to prevent flooding.

Related Work

Transcription

Transcribing was a great deal of work for this project. Transcribing is a way of putting thoughts, speech, or data into a written form. Using the program InqScribe I transcribed the videos mentioned earlier to see what the groups' focus (See figure 2).

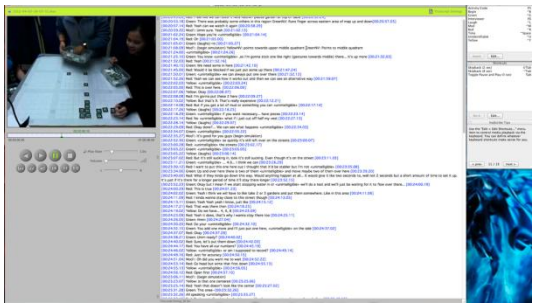

Figure 2

To transcribe the videos was very tedious work. Each person wore a wristband of a different color, so to keep his or her identity anonymous and I had to record the times in which each person began to speak and the time his or her sentence ended. I also had to record the "color" that was speaking and what that person was saying. Once I finished the normal transcriptions I then had to do gesture transcriptions. This was basically like the first transcriptions, but this time I had to keep track of their hand motions to see where they were pointing, or what expressions they were making.

Transcription was a way to see their main focus. It was necessary to know if they were more focused on the money, the gradient of the land, where the sewers/streets were, or if they began with a few gardens until they tested it, and moved to less or more once they saw the results. Strategies used are important to record as well. These are key things to think of while making the game. One has to incorporate what the user focuses on the most.

xCode

A few research hours were spent looking up how to use xCode. xCode is a program used to make applications used on mobile devices. When

beginning to work with the interns from DREU this summer they attempted to incorporate mobile devices per the learning objective of the original interns that eventually did not show up. During this process I was able to bring up a working application that took the image on screen and the user was able to tamper with the threshold on the image. This project brought an idea about being able to threshold a specific color and gets the coordinates of the object. The other intern did not show up, and it was decided that a mobile application would be more complicated than necessary for the project at hand.

Eclipse

Much time was spent coding for the program. Research time was spent looking up the difference between the feature detectors SURF and SIFT. SURF is a robust local feature detector, first presented by Herbert Bay in 2006, that can be used in computer vision tasks like object recognition. SURF was partially inspired by SIFT, which bundles a feature detector and a feature descriptor. The detector extracts from an image a number of frames in a way that is consistent with variations of the illumination, viewpoint and other viewing conditions. We also stumbled upon a helpful code for thresholding (See figure 3).

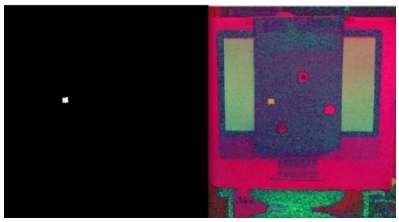

Figure 3

The threshold code worked perfectly. Whatever color was input into the HSV values was then threshed on the screen. It took me some time to learn the HSV values as well. The original code was set strictly for green, but I was told to figure out how to change it to red. Once I finally was able to do that we moved onto the SURF coding.

In doing the SURF code I noticed that it grabbed images that were very similar to whatever shape it was attempting to grasp. We used simple shapes such as; squares, hexagons, octagons, triangles, etc.

Once both of the codes were working well we combined them. We had to make it be able to give us the coordinates of the shape or color wanted. We began working mainly with SURF because we thought that feature recognition would work the best. I then had to run numerous tests with the different sizes of possible game pieces that were made. They started 1¼" and went down to 3/8". The best pieces to be detected were 1" and ¾". With this figured out and a chart that stated an estimate of how many pieces would be able to fit on the map we moved onto thresholding the pieces.

Once I began to test the threshold images things got a little more complicated considering I wasn't completely grasping the concept of the lower and higher HSV values that had to be put into the code for the camera to recognize what color was being searched for. Once the threshold testing was complete I tested all of the images with and without the projector being on. It is shown that once the projector is on the colors become distorted. The colors themselves also run very closely to one another.

Because the project is ongoing I will not be able to accurately determine the best possible detection method. However, currently the colors red and orange are hard to distinguish from another, as well as black and blue. My findings would be to pick bolder colors that are more distinguishable from one another, especially because when coding the HSV values it's sort of a guessing game to figure out the specific color you're searching for.

To use the threshold method we had to use OpenCV. OpenCV is a computer vision library, it uses many algorithms to find features such as textures and corners.

Results

We have come a long way from where we once were when I arrived. The prototype game board has been worked on for the past ten weeks. There has been color added and more intractability between the user and interface. I am sad to say in spite of this, the project is not yet complete, however I did not expect it to be completed considering they have been working on it since 2007.

From what I have seen I believe this is a very unique and will be an extremely helpful "game" for our future investors and society itself. In ecological terms it will help stop the pollution of toxic waters into the Lake and also help to keep transportation from stopping due to flooding.

There are now pieces that the team can work with and see what works the best. I also feel as if I can now look at things as a whole and how they will affect society and my surroundings. The placement of something so simple as a piece of permeable pavement can help flooding in certain areas.

The team also had plenty of ideas during the meetings after seeing the work that has been done so far.

Future Work

For future work I believe they will have much more to do and additional factors to consider. I think that working with colored pieces is easier for the user and the computer as well, but there are arguments against that. It seemed as if Professor Lyons was leaning more toward the feature detection program, but I feel as if there were too many things that could go wrong with that. They will also have to work around the projection problem of how any odd overlying colors from the projector can distort the placed piece.

I believe that they will be able to overcome all of the obstacles they are placed with; they've come this far and are set on finishing it.

They still must find what pieces are most appealing to the user, what would they like to pick up and play with? What colors or shapes best describe the object that is trying to be displayed? What sizes are best for the user to pick up, hold, and place? Also what will the computer best recognize? If shapes are set too close to one another will it mess up the reading? If the colors of the pieces are too close to one another, then will the computer be confused by this?

There is much more coding to be done in the future to get the program to run smoothly and detect each object as it's own and print out the coordinates. There should also be a specific place in where they will conduct the experiments, because to use the projector you have to move

everything to another room and end up in the way of others working.

Acknowledgements

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