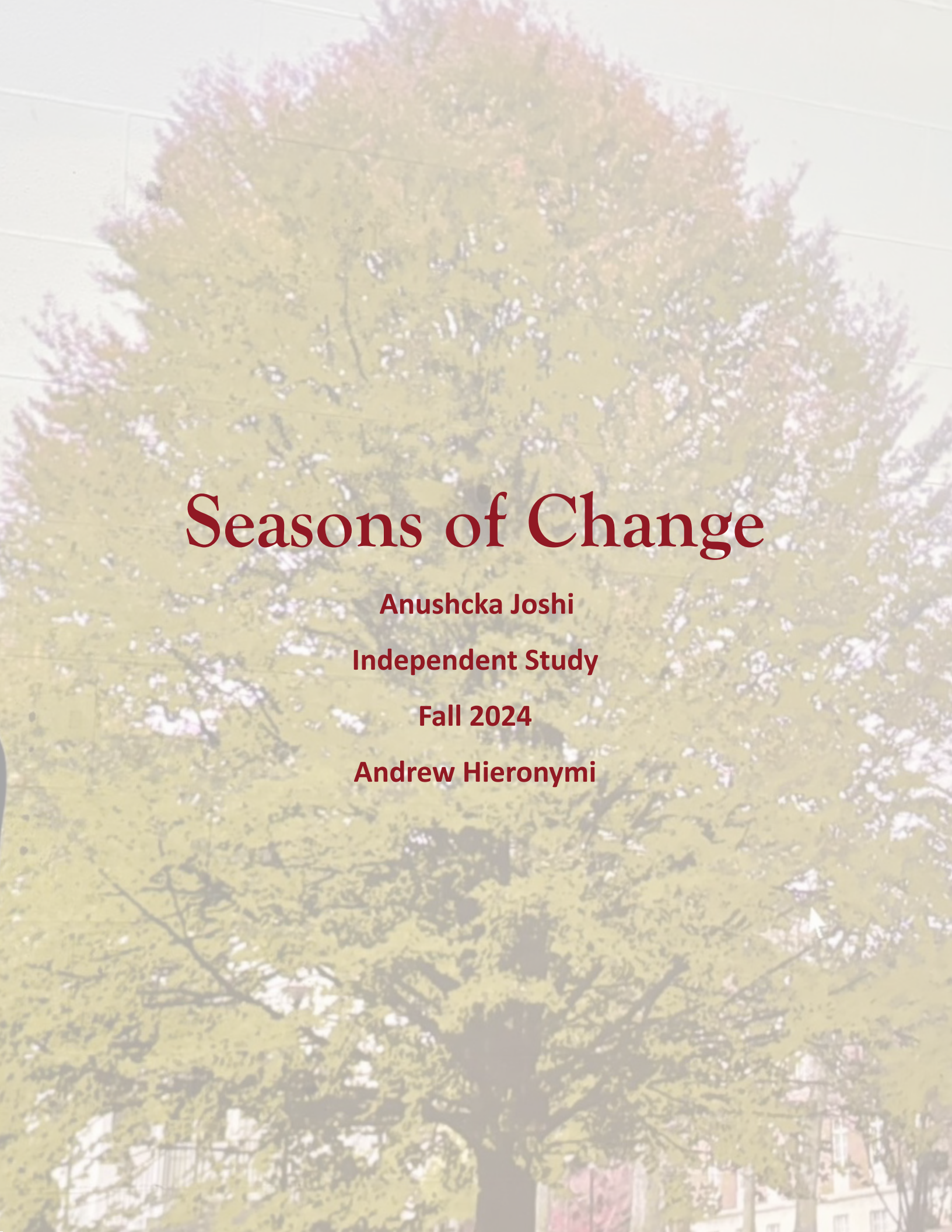


Seasons of Change

Anushcka Joshi

Independent Study

Fall 2024

Andrew Hieronymi

Table of Contents

Project Overview

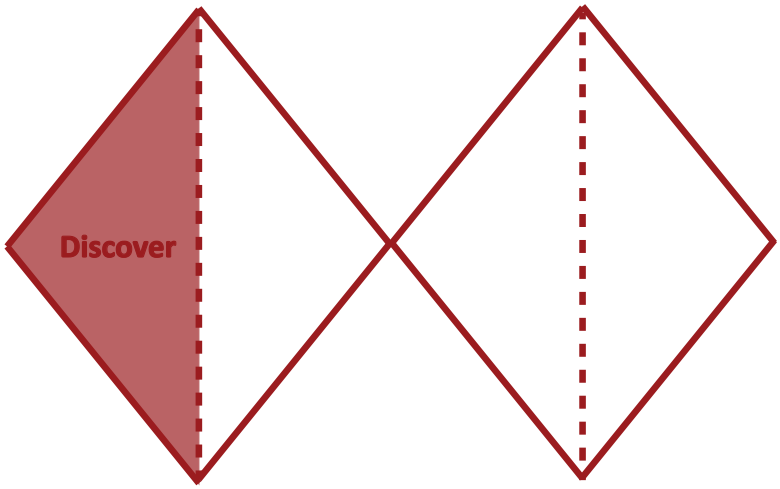
Seasons of Change is an immersive art installation that connects human movement and the beauty of transformation. At the center of the projection lies a digital semi-evergreen tree, whose vibrant leaves change color in response to the motion of a passersby. Using Kinect camera, the piece detects subtle movements, which trigger dynamic visual shifts in the colors of the tree. This reflects the interconnectedness of life, nature, and human influence.

The tree's changing colors, extracted from a dataset of fall leaf colors around Penn State's campus, symbolize the fleeting nature of life's moments and the constant flux of the world around us. Yet, beneath this transformation, the tree remains evergreen, representing the enduring essence within us that stays steady through change. This duality encourages viewers to consider how experiences shape us while challenging us to reflect on the authenticity of the transformations we witness, whether they are surface-level or deeply meaningful.

The installation also delves into the human desire to preserve fleeting beauty. It raises questions about how attempts to capture and hold onto a moment can alter its very essence, turning genuine experiences into curated imitations. Each motion leaves an imprint on the tree, creating a fleeting mark of presence and action, much like the way memories evolve over time. It highlights the tension between cherishing impermanence and the instinct to immortalize what is transient.

Seasons of Change explores themes of adaptation, paradox of preservation, embracing what is absent and also invites viewers to recognize their role in shaping the environment and the spaces they inhabit. It symbolizes our yearning to create meaning, fill voids, and engage with the natural world in a way that feels deeply personal. By blending art, technology, and nature, the installation becomes a contemplative space where visitors can pause, reflect, and embrace the beauty of transformation while acknowledging their profound influence on the ecosystem.

Research and Ideation



Overview of Research Process

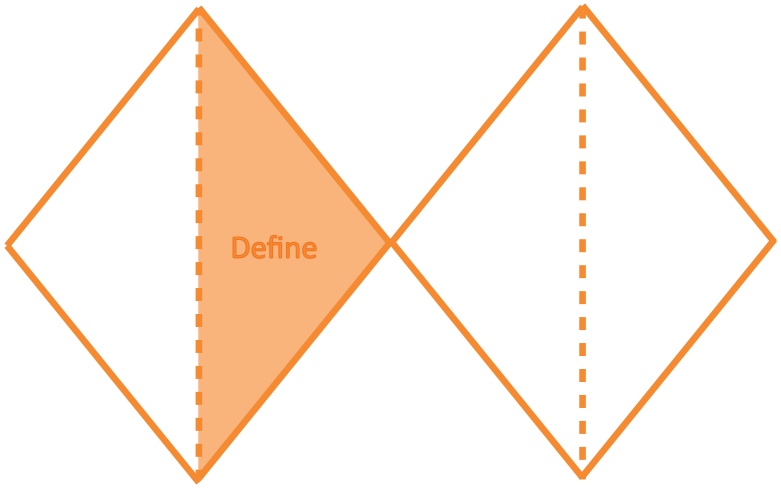
The Discover phase of this project was an exploratory process where I had to come up with three ideas for my creative coding independent study. I aimed to identify areas where technical innovation could intersect with artistic expression to create immersive and interactive experiences.

One of the key aspects of this phase was interdisciplinary exploration. I delved into concepts such as audio signal processing, real-time video analysis, and fractal mathematics to identify potential project directions. These explorations were informed by my curiosity about how abstract ideas like sound or motion could be translated into engaging visuals. Each idea was carefully considered for its feasibility, relevance to my academic focus, and potential impact.

The three project ideas I developed reflect distinct but interconnected themes. The audio visualizer focuses on turning sound into dynamic visual experiences by analyzing audio properties such as amplitude, frequency, and rhythm. This project holds particular significance for its accessibility aspect, aiming to enhance the auditory experience for the Deaf and Hard of Hearing community. The second idea, generative art from camera feed, leverages real-time video processing to create art that responds to motion, color, and edges in a live feed. This concept not only aligns with my interest in computer vision but also offers an avenue for artistic innovation. Lastly, the Interactive fractal exploration combines mathematical beauty with user interaction, allowing participants to explore Julia set fractals dynamically through gaze or mouse input, blending technical complexity with user-friendly design.

This phase was deeply personal and flexible. The research and ideation process also provided an opportunity to consider how these projects could extend beyond artistic exploration to serve broader purposes such as accessibility, relaxation, and education. It set a solid foundation for the Define step, where I could focus on refining and selecting the project that best embodies my vision and potential for an Independent Study.

After receiving feedback from the Professor, I decided to move forward with the generative art project. While it showed great potential, my project needed more clarity. The interaction design required clearer details on how motion, color, and edge detection would influence particle behaviors and user interactions. Similarly, the technical implementation needed a more cohesive integration of methods like K-means clustering, Sobel edge detection, and optical flow, along with plans for optimizing real-time processing.



Dynamic Generative Art

This project transformed real-time motion and color data into dynamic generative art by using particle systems. It utilized a motion camera to detect intensity and direction vectors, guiding particle trajectories and behaviors, while an RGB camera provided live color analysis via K-means clustering to create dynamic palettes. The result was an interactive visual experience, where user movement and scene colors dynamically influenced the aesthetic balance of structured and organic elements in the generative artwork.

The research process for this project focused on combining real-time motion and color data to create dynamic generative art. I began by identifying how motion detection, edge analysis, and color extraction could intersect to develop an interactive visual experiences. This phase involved exploring software tools like Processing and OpenCV, understanding their capabilities, and brainstorming methods to transform motion and color data into an engaging particle-based art form.

Key ideas for this project included using motion vectors to guide particle trajectories, extracting real-time colors to create dynamic palettes, and simulating edge shapes through Sobel filtering. The artistic intent was to create visuals that evoke a natural fluidity while reflecting the viewer's interaction with the system.

Once again, I received constructive feedback from the Professor, who suggested exploring my interest in motion study through a more refined data visualization process. The feedback also emphasized that the artistic intent of the project needed greater clarity, with a more defined narrative or emotional theme to guide the visuals and provide a stronger connection to the audience. Additionally, it was noted that the project leaned heavily on its technical aspects, and incorporating a more balanced approach would help create a cohesive and impactful outcome.

Fall Motion Study

Through the Fall Motion Study, I aimed to capture the subtle beauty of fall by focusing on motion and color using computer vision. My goal was to transform these natural phenomena into dynamic video art, visualizing the movements of falling leaves while highlighting their gradual color transitions as they descended along a vertical axis. Tools such as the Kinect for motion tracking, OpenCV for Processing for motion and color analysis, and Perlin noise for creating naturalistic transitions were central in integrating real-time data into a cohesive, layered visual experience.

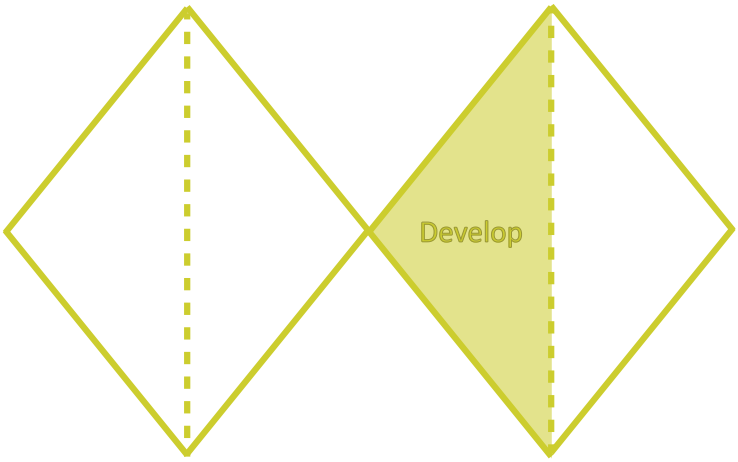
The Fall Motion Study was to use dynamic layering to create a visually immersive representation of fall. The foreground captures real time motion trajectories of falling leaves, with rapid movements generating

angular shapes and slower sways forming smooth trails. This is overlaid on a background of evolving color gradients that mimic the gradual transition of autumn hues. Motion intensity adds depth, with transparent particles for fast motion and opaque ones for slower movements. The layers interact seamlessly, with particles blending into the background, creating a natural “bleeding” effect that enhances the realism and harmony of the visual composition, evoking the fleeting beauty of fall.

Coming from India, where fall is a rarely experienced season, I was naturally drawn to this project. The vibrant colors and beauty of fall on campus have always captivated me, making this season a meaningful and inspiring subject for exploration.

Climate change emerged as a significant external force shaping the project. Research revealed how rising temperatures and extreme weather events are altering fall foliage, causing delayed color changes and rapid browning. For instance, the arrival of peak fall colors has shifted dramatically, with red maple leaves now changing color over a month later than they did in the 19th century. Furthermore, the cool nights essential for vivid color displays, requiring a 9°F to 12°F difference between day and night temperatures, are becoming increasingly rare. According to Climate Central, fall nights have warmed in 87% of 243 U.S. locations analyzed, with an average temperature increase of 2.7°F between 1970 and 2023. These changes add an environmental layer to the project, emphasizing the fragility of nature and the importance of observation.

The next step was to begin transforming the Fall Motion Study concept into reality by developing a working prototype. This phase involved putting the ideas into practice, integrating tools like the Kinect, OpenCV, and Perlin noise into a cohesive system that captured and visualized the movements and colors of falling leaves. The focus was on testing and refining the technical elements to bring the project to life and lay the groundwork for an impactful piece.



Production and Development

In the Fall Motion Study, the production and development phase was about bringing my vision of capturing the beauty of autumn leaves to life. Using Kinect sensors, I set out to record and visualize the motion and color changes of falling leaves in real time.

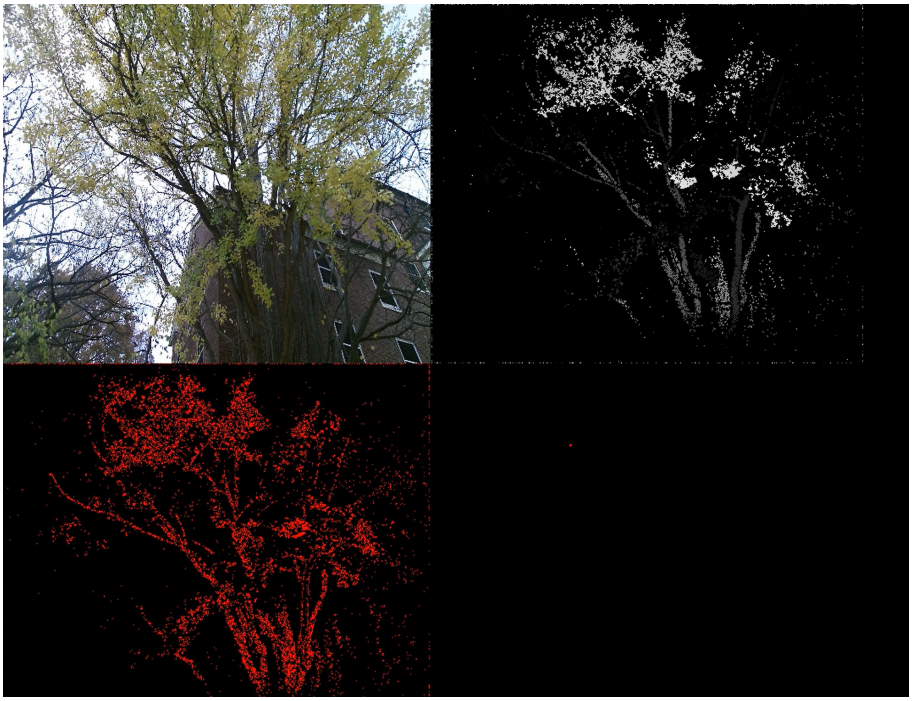
The Kinect allowed me to capture two types of data. The RGB camera picked up the vibrant colors of the scene as reds, yellows, and oranges, while the depth camera tracked the motion of leaves as they fell. These two data streams were displayed side by side, with an additional layer underneath showing a motion overlay. This overlay highlighted areas of movement, painting them red to bring focus to the motion, like the flutter of a leaf caught in a breeze.

Saving these moments was equally important. With the press of a key, the system would begin recording everything: the colors, the motions, and even the subtle differences between frames. It saved this data as images and compiled it into a video that captured the whole scene as it unfolded. I wanted this to be something that could be revisited and analyzed. To make the motion look as natural as possible, I used Perlin noise, a tool that added an organic quality to how the leaves moved, mimicking the randomness and elegance of their real-life fluttering.

This phase was about more than just creating a prototype, it was about finding a way to preserve and share the fleeting beauty of autumn in a way that felt both meaningful and alive.

Depth Capture

RGB Capture



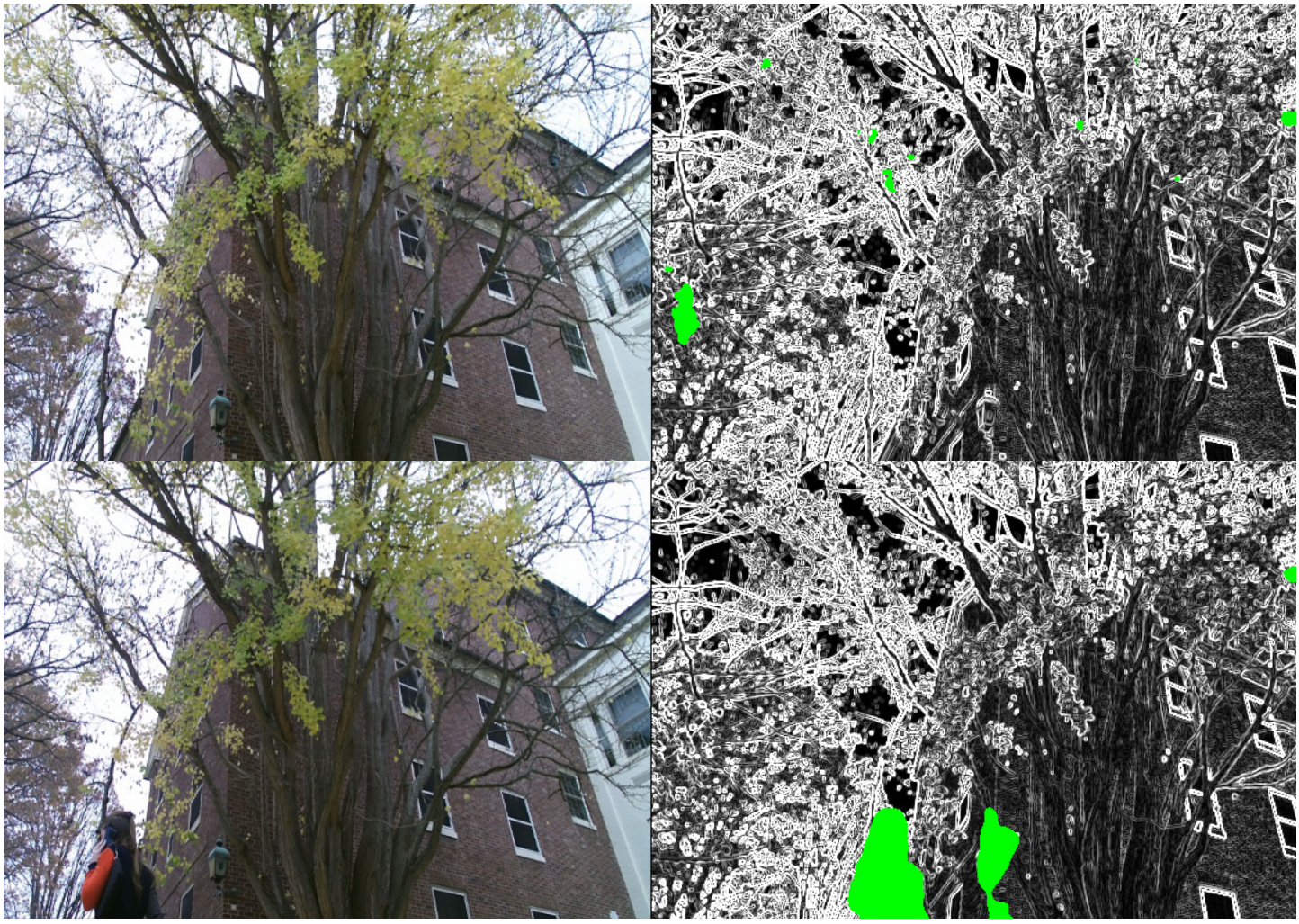
Visuals from the video recording

The outputted video from the initial processing phase, showcasing the dynamic interplay of motion and structure, was now used as input for further analysis. Each frame of the video, with its overlaid motion highlights and structural outlines, provided a rich dataset to delve deeper into the patterns of motion and the gradual color transitions captured during the leaf fall.

Using this video, further analysis was performed to study the dynamics of leaf motion and their interaction with tree structures. The highlighted areas of motion (in green) were examined frame by frame to quantify the intensity and trajectory of movement. This analysis allowed for deeper insights into how leaves move in relation to environmental factors, such as wind or gravity, and how these dynamics change over time.

The edge detected outlines of tree trunks and branches in the video were also leveraged for structural consistency checks. By isolating static elements, the analysis ensured that the motion data was not corrupted by noise from non-moving parts of the scene. This separation of static and dynamic components helped refine the overall system and provided clarity in understanding the motion patterns.

Additionally, the processed video was used to explore artistic possibilities. By adjusting the motion thresholds, the visual output was further refined to create more nuanced representations of fall. This iterative process of feeding the processed video back into the system and adjusting parameters allowed for both scientific exploration and creative expression, ensuring the project retained its dual focus on technical precision and artistic narrative.



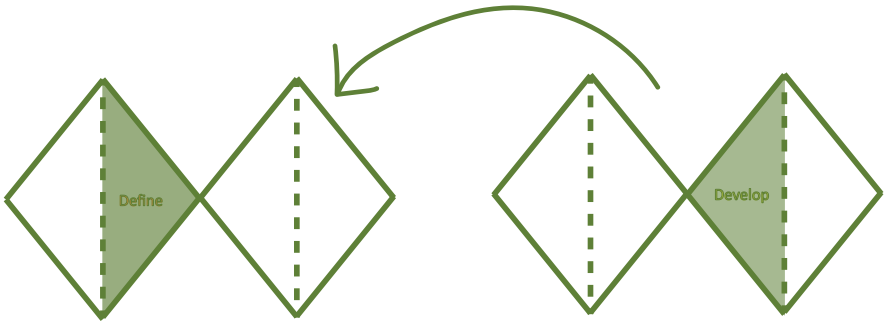
Motion detected in green

Drawbacks

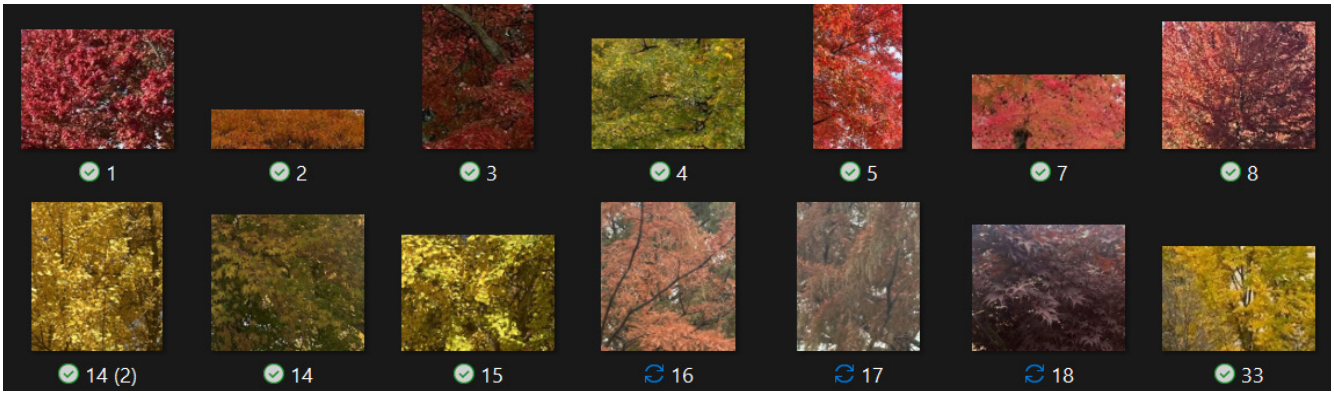
This phase of the project revealed several challenges that impacted the overall effectiveness of the Fall Motion Study. One major drawback was the difficulty in capturing the subtle movement of falling leaves. The small size and erratic motion of individual leaves made it hard to detect them consistently, even with precise motion detection and frame differencing techniques. It was harder more so because of the leaf density on the tree, making it difficult to focus on a particular leaf. As a result, visualizing this movement dynamically in the processed video often failed to meet the intended impact.

Additionally, the tree I selected for the study proved to be unsuitable for the project. Its placement and angle relative to the camera limited visibility and framing, making it difficult to capture a clear and continuous view of falling leaves. The leaves from this tree would also fall infrequently, providing limited opportunities to gather meaningful motion data during each session. This inconsistent activity further hindered the project's ability to produce engaging and dynamic visuals and analyze the effect of climate change for which a lot more data was required. Given that only a few weeks of the Fall season were remaining, time was another constraint.

These limitations highlighted the need to reassess my approach. I realized that switching to a different tree with a more favorable angle and a higher frequency of falling leaves would provide better opportunities for capturing motion and visualizing the dynamics of autumn. This experience reinforced the importance of selecting the right subject and environment for motion studies, prompting adjustments in methodology to ensure more successful results in subsequent iterations.



After revisiting the Define phase of my Fall Motion Study project, I decided to shift my focus from capturing motion to emphasizing the vibrant and transformative colors of fall. The beauty of this season lies in its rich palette of hues, and I wanted to create an artistic representation that would celebrate this essence. To do so, I developed a new approach where I collected data on fall colors from different patches of trees across campus. Using K-means clustering, I identified the most dominant colors from each of the 21 patches, ensuring that the diversity and vibrancy of the season were accurately captured.



Colors dataset

With this dataset, I used the updated code to project these dominant fall colors onto a new semi-evergreen tree. This tree, which maintains much of its green foliage year-round, became a canvas for exploring the themes of **adaptation, change for the sake of change, and embracing what is absent.** The semi-evergreen nature of the tree introduced a subtle irony as it does not naturally reflect the spectrum of fall colors, yet it now became a medium to display and embody these transformations.

Themes and Core Insights

The Fall Motion Study delves into themes of **adaptation, change, and the tension between impermanence and preservation.** It reflects on the irony of projecting fall's vibrant spectrum onto a semi-evergreen tree, symbolizing resilience while showcasing how life's transitions color us in unexpected ways. The project critiques performative change, exploring what truly transforms versus what remains unchanged, urging reflection on the authenticity of transitions we observe. It also highlights the paradox of preservation, where attempts to capture fleeting beauty often reshape its essence, raising questions about memory, authenticity, and the human desire to hold onto what naturally fades. Finally, the project embodies the longing to fill voids by embracing what is absent, creating a narrative that speaks to our universal desire to reconnect with lost experiences, emotions, or a sense of belonging, turning absence into meaning. These insights are visually represented through the dynamic projection of fall colors, merging nature's process with a reflective exploration of human connections to change.

This new focus gave me the chance to create a visual story that felt more connected to the essence of the project's themes. It turned the Fall Motion Study into a reflection on the momentary beauty of fall and our deep desire to hold onto and reimagine nature's cycles, even as they begin to change or disappear. The final result was a vibrant, colorful depiction of fall that not only celebrated its temporary nature but also reminded me of its lasting impression, both on the environment and on us.

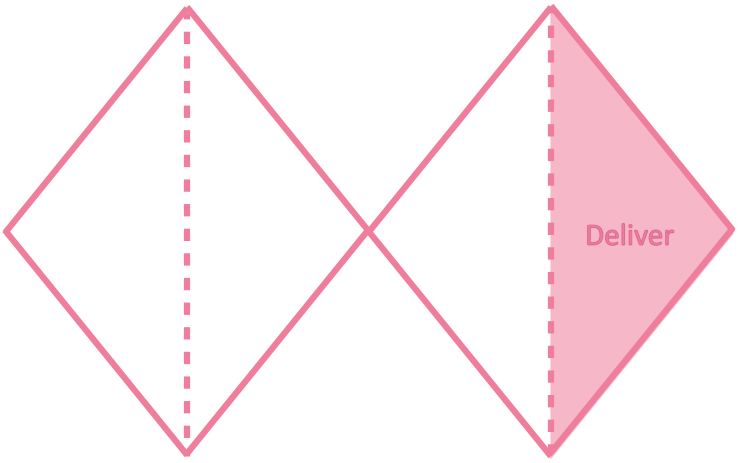
The transition of the tree from the beginning till the end of the output video

This updated Processing program resulted in a dynamic video of a tree transitioning through vibrant fall colors by analyzing and enhancing video frames in real-time. It used edge detection to identify the tree, and color transitions to overlay fall hues sourced from a JSON file of dominant colors. Smooth color transitions progressing through time are achieved through linear color interpolation (lerpColor), while Perlin noise adds subtle, natural variations to the overlays.

From the feedback I received further, I decided to evolve the visualization project into an interactive installation. Building on my previous experience with motion sensing using the Kinect, I envisioned an

experience where viewers could actively participate in transforming the colors of the tree as they moved past it. This interaction allowed them to become part of the piece, bridging the gap between the observer and the artwork.

This approach not only aligned with my theme of change and adaptation but also offered a symbolic reflection of how humans undergo similar internal transformations, much like the tree's evolving colors. I embraced this idea for its more hands-on and engaging nature, making the project not just a visual experience but a playful, immersive one. It added a layer of connection and fun, enabling viewers to feel as though their presence and movements were directly tied to the artwork's evolving narrative.



Seasons of Change

The production phase for the interactive art installation was an exciting process of refining the technical aspects while incorporating viewer interaction. The goal was to turn the static visualization of fall colors into a dynamic, participatory experience where viewers could actively engage with the evolving visuals. Using the Kinect for motion sensing, the installation allowed participants to transform the colors of the tree as they moved in front of the camera placed on top of the projector.

To bring this idea to life, I integrated my previous work with the Kinect to track viewers' movements in real time. These interactions triggered dynamic changes in the colors projected onto the tree.
I invited friends to interact with the piece. Their diverse approaches to engaging with the installation revealed its potential for personal expression. Some walked through slowly, watching the colors change subtly in their wake. Others experimented with exaggerated gestures and shadows. These interactions were joyful and reflective, bringing the project's theme of human connection to change to life.

The interactions with the installation were fun to watch and be part of. Everyone seemed to enjoy experimenting with how their movements could transform the colors of the tree. The piece was well-received, sparking casual and warm conversations among friends. Some shared their favorite fall colors, with reds and pinks being popular choices. Others reminisced about trees they loved, like maples with their fiery leaves or oaks that seemed to hold on to their golden hues the longest. The playful side of the piece really came out as people waved their arms, walked slowly, or even jumped around to see how the colors changed. The installation not only let people interact with it but also made everyone reflect on how they connect with nature in their own way. It was simple, fun, and brought out stories, laughter, and creativity, a reminder of how something as small as fall colors can bring people together.

Viewer interaction with the installation

Seasons of Change

This interactive art installation uses a Kinect camera to track motion, transforming the foliage of a digital evergreen tree as people pass by. Each movement triggers a shift in the tree's colors, symbolizing the fleeting nature of life and our impact on the environment.

At its core, the tree remains unchanged, reflecting resilience and adaptability. It invites us to consider how life shapes us, coloring our experiences, without altering who we fundamentally are. This dynamic transformation challenges viewers to question whether the changes they see in themselves or the world are surface deep or truly transformative.

The installation also explores our desire to preserve beauty, even as that act changes its essence. It highlights the tension between cherishing fleeting moments and the impossibility of holding on to them without altering their meaning.

Finally, the piece symbolizes a human longing to fill life's voids, whether with experiences, emotions, or connections. By blending art, nature, and technology, it creates a meditative space to reflect on change, impermanence, and our place in the ecosystem.

Anushcka Joshi
Pennsylvania State University
Fall 2024

Artist Statement

Conclusion

Seasons of Change achieved its goal of creating an engaging and reflective experience that celebrated the beauty and transformation of fall. Viewers interacted with the piece in playful and creative ways, triggering dynamic color changes with their movements and sparking conversations about favorite fall colors and memories tied to trees. The installation successfully connected the themes of adaptation and human connection to change, turning the audience into an integral part of the artwork.

The process, however, was far from linear. It was highly iterative, requiring me to go back and forth between ideas and technical implementations. Initially, the project focused on motion visualization, but challenges in capturing subtle leaf movements and the unsuitability of my chosen tree led me to rethink the approach. Shifting the focus to color transitions added depth to the concept and aligned better with fall's essence. Incorporating motion sensing later to make the piece interactive brought the final iteration to life, blending technical precision with human engagement.

This iterative process taught me the importance of flexibility and embracing feedback. It showed how returning to earlier stages of a project like redefining goals, refining ideas, and incorporating new elements can lead to a richer outcome. The result was not just a visually compelling piece but an experience that resonated emotionally, offering a sense of joy, nostalgia, and reflection on how we interact with nature and change.

For future iterations of the installation, I would like to enhance the interactivity by linking the speed of the viewer's motion to the rate of color transitions. For instance, a fast walk could result in a quick, abrupt shift in colors, while slow, deliberate movements would produce a gradual, more seamless change. This could further enhance the layer of interactivity and make the experience feel even more personalized and reflective of the participant's energy and pace.

Additionally, one of my friends pointed out that the quality of the projection wasn't as sharp as it could be. This was likely due to the expansion of the video onto a large wall surface, which reduced the resolution and clarity of the visuals. Improving the projection quality, whether through higher-resolution equipment, better calibration, or more optimized video settings could potentially make the colors and details more vivid, enhancing the overall impact of the piece. These changes would not only refine the technical aspects but also deepen the immersive and emotional connection viewers have with the installation. Overall I am quite happy with how *Seasons of Change* turned out!

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