

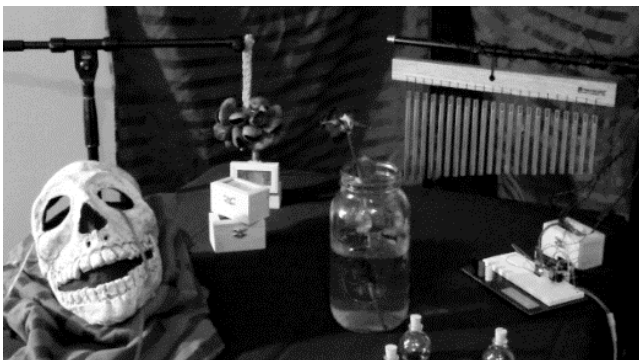
# Days of the Muertos: A Rose for Dynamic Control of Musical Robots to Communicate Metaphor in the Context of a Días de Los Muertos

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## ABSTRACT

In this paper, I present a Días de Los Muertos altar that incorporates the use of musical robots that are dynamically coupled to the life of a live rose. The robotic aspect of this altar is a closed loop system designed to produce a stochastic musical score. The stochastic music for this piece is composed using a first order Markov chain. This Markov model is used to drive five bots to play chromatic chimes and a seedpod rattle. A web camera is used to track the progress of the rose as it blooms and then dies. The camera data is then used to drive the tempo of the composition. So as the rose blooms, the music becomes more present or dense in its texture, and as the rose dies the music slowly fades away.

The music dynamically altered by the rose is written to commemorate life through spiritual philosophies and fascinations with the macabre inspired by the Latin American Indigenous celebration of Días de Los Muertos, as well as American gothic subcultures. The installation is informed by the work of Edward Gorey, Edgar Allan Poe, and Jose Guadalupe Posada. *Days of the Muertos* is a musical installation that draws from my bilingual roots as a Chicano American. This piece is a Días de Los Muertos reflection altar that is created with the cultural, political, and spiritual intent that we may appreciate life by reflecting upon death, and by remembering our ancestors who have died.



A photograph showing the Day of the Muertos altar.

## INTRODUCTION

In this paper, I present a Días de Los Muertos altar that incorporates the use of musical robots that are dynamically coupled to the life of a live rose. The robotic aspect of this altar is a closed loop system designed to produce a stochastic musical score. The stochastic music for this piece is composed using a first order Markov chain. This Markov model is used to drive five bots to play chromatic chimes and a seedpod rattle. A web camera is used to track the progress of the rose as it blooms and then dies. The camera data is then used to drive the tempo of the composition. So as the rose blooms, the music becomes more present or dense in its texture, and as the rose dies, so too will the music slowly fade away.

The music dynamically altered by the rose is written to commemorate life through spiritual philosophies and fascinations with the macabre inspired by the Latin American Indigenous celebration of Días de Los Muertos, as well as American gothic subcultures. The installation is informed by the work of Edward Gorey, Edgar Allan Poe, and Jose Guadalupe Posada. *Days of the Muertos* is a musical installation that draws from my American and Latino bilingual roots. This piece is a reflection altar that is created with the spiritual intent that we may appreciate our mortality by reflecting upon the life and death of a rose. By creating an altar to reflect upon death, I am able to appropriate contemporary technologies to sustain an aspect of my heritage. Días de los Muertos is a North American Indigenous tradition that some scholars speculate originated with the Olmecs approximately 3000 years ago [5]. The festival is held yearly on November 1<sup>st</sup> and 2<sup>nd</sup>. It is a time of remembrance when our dead ancestors come back to the world of the living to celebrate life and reunite with loved ones who are living. To commemorate the occasion, it is customary for latinos to build altar pieces to express aspects of death that range from somber to comical.



A photograph showing a traditional Dias de Los Muertos Altar. [www.misrecuerdos.net](http://www.misrecuerdos.net)

I consider *Day of the Muertos* an early iteration of a large scale Chicano social justice piece that I expect to pursue completion for the 2009 Días de Los Muertos Altar Exhibition, hosted by the Arizona State University Anthropology Museum. As an end goal I am interested in different ways that living and visceral symbols such as a rose can be used to communicate ideas, culture, place, reflections, and information to focus upon the humanitarian crisis taking place at the U.S.-Mexican Border. The crisis that I refer to is the large loss of life over the course of a decade as Mexican immigrants face perilous journeys in their efforts to cross from Mexico into the United States. This work will follow the Mexican, and Mexican-American traditions of political art set forth by artists like Jose Guadalupe Posada to talk about the crisis [6].



*The revolution.* Jose Guadalupe Posada.

From 2001 – 2008, Mexico’s Ministry of Foreign Affairs, has cited the deaths of 2,956 Mexican migrants at the northern US/Mexican Border [4]. Since the 90’s there have been well over 3,000 deaths resulting from attempted border crossings, with one third of all bodies unidentified [1][2][3]. According to Wayne Cornelius, director of the Center for Comparative Immigration Studies at U.C. San Diego, the U.S.-Mexican border has been 10 times deadlier than the entire history of the Berlin Wall. This comparison was made over the last decade of U.S. border policy vs. the entire 28 year history of the Berlin Wall. During that history, 287 people died while trying to cross it [3]. These deaths have resulted from causes associated to the harsh desert climate, suffocation in sealed containers used for smuggling, and vehicular accidents. According to Border Patrol Statistics, the remains of 128 people have been discovered during the first six months of this 2009 fiscal year[2].

My end goal for *Days of the Muertos*, is to present a mediated altar that can provide the viewing public with information regarding the deaths that are taking place at the border. My intention is to present the issue from a humanitarian perspective. Through this altar I want to memorialize those who have lost their lives while crossing the border, while also providing my audience with a place to contemplate the loss of life without the typical mainstream media discourse that is often focused upon issues of economy, xenophobia, and nationalism.

My current iteration does not contain elements to communicate the humanitarian crisis at the border. It does however, embody an aesthetic, as well as create a mood that expresses aspects the Mesoamerican and Chicano fascination with the macabre. My intention is to use the system built for this iteration, as part of later iterations, as I work to move closer to achieving my artistic and political goals for the altar.

#### **ABOUT THE PIECE**

*Days of the Muertos*, is an alter piece arrangement set on a square table covered with a black tablecloth. This arrangement consists of a paper mache calaca mask modeled after Posada’s art piece titled *La Calavera Catrina*. As part of Posada’s social justice work, he created this piece to remind the Mexican Bourguoise that not even the wealthy can escape the fate of death. In addition to the mask, there is a living rose, along with wooden boxes that contain dead roses, and corked bottles that exhibit dead rose pedals. In addition to these objects, there is a set of orchestral chromatic chimes, and a seedpod rattle that have also been arranged as part of the altar. This arrangement was designed to use romantic symbols as devices to orient audience awareness to toward the inevitable death of the living rose.

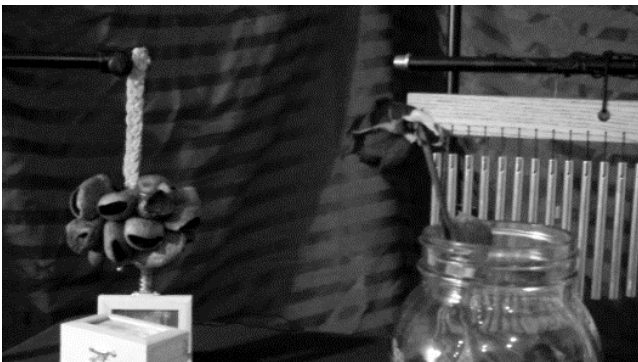


*La Calavera Catrina*, 1913. Jose Guadalupe Posada.

My intent was to highlight the death of the living rose in an effort to inspire my audience to reflect upon life as finite and fragile.

#### HOW DOES IT WORK

The *Day's of the Muertos* altar utilizes two musical instruments that are played by five bots. These bots are used to perform stochastic music composed for a seedpod rattle and a set of chromatic orchestral chimes. These hand percussion instruments were chosen for their contrasting timbre. The instrument score consists of a seedpod rattle and chromatic chimes. This produces a score of rattling sounds, and the harmonic sustain of high pitches characteristic of a music box.



*A photograph showing the seedpod rattle and chime used to generate the music in the Day of the Muertos altar. This photo also shows a rose that has died.*

The bots that are used to perform the chimes are free hanging pager motors with a weight offset mounted to the motor shaft. This offset causes the motors to swing like a pendulum. Once the offset comes in contact with a chime, a given bot begins to hammer and ricochet off a small distribution of chimes in one section of the chime rack. The chimes are struck by four of these pager motor bots.

Each bot's spindle motor behavior is controlled using pulse width modulation (PWM) programmed into an Arduino microcontroller. By varying PWM within small time frames, I was able to create asymmetrical forces upon the bots that would enable them swing in varying ways that play different probabilistic distributions of chimes.

The bot that is used to agitate the seedpod rattle is a pull solenoid with its shaft mounted to a spring that is used to return it to its resting position. A small foam platform is mounted to the bottom of the solenoid to maximize surface area at the top of the shaft to activate the rattle. This foam platform is kept at a size that can be hidden from within the rattle for aesthetic reasons. This solenoid robot is used to activate the rattle for a fraction of a second. This behavior is also programmed into the Arduino microcontroller using PWM. By varying PWM and time delay, I was able to adjust the intensity by which the solenoid activated the rattle.

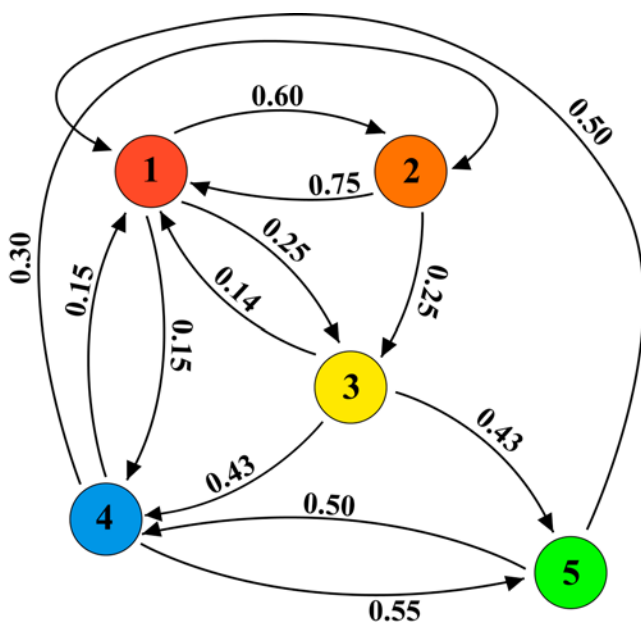


*A photograph detail of the seedpod rattle and calaca mask used in the Day of the Muertos altar.*

The PWM parameters used to activate the rattle and chimes were calibrated and controlled by the Arduino microcontroller as static events of the music composition. These events were triggered to occur by serial data sent from Max 5 to the microcontroller using a Bluetooth connection. I chose to use a Bluetooth connection to have flexible options to store and hide a laptop computer running Max 5.

A stochastic music score is programmed into Max 5 using a first order Markov chain. This Markov model is used to trigger the PWM events described above in order to activate the bots at different times. Within the framework of my Markov chain, the triggering of a given bot or musical event represents a state change in the model. A musical event consists of the distribution of chime notes performed by a single bot event, as well as a seedpod rattle that takes place once within a fraction of a second. Also as part of a musical event, predetermined lengths of silence have been encoded into the different states. These lengths of silence are either lengthened or shortened depending

upon the life state of the rose. For example as the rose blooms, moments of silence are shortened so that musical events occur with greater frequency. This causes a greater density in the texture of sound. In this scenario the rose can be thought of as a music conductor that performs the tempo changes of the composition. Currently, the probabilistic values in the model are static and do not change throughout the course of the composition. In future iterations my intention is to use sensing values taken from the roses changing behaviors to alter the probability values in real-time. Such a system can be used to transition in and out of different instruments to produce changes in sonic texture. This will enable me to produce a much richer composition with more dramatic results. This dynamic potential is one example of the benefits of using a Hidden Markov Model to write the music score.



**Figure 1.** This chart illustrates the 1<sup>st</sup> order Hidden Markov Chain that was utilized to express the musical score for *Days of the Muertos*. State change 1 triggers the bot to activate the seedpod rattle. State change 2 triggers the bot to activate chimes in the highest register. State change 3 triggers the bot to activate chimes in the upper mid-range. State change 4 triggers the bot to activate chimes in the lower mid-range. State change 5 triggers the bot to activate chimes in the lowest register.

A web camera connected to the laptop is used for sensing the rose as it blooms and dies. Live camera data is processed in Max 5 at 1 frame/ 5 seconds. The camera data is then used to conduct the tempo changes of the music

composition. So as the rose blooms, the music becomes more present or dense in its texture. As the rose dies, the music will slowly fade away. To achieve this, the web camera is mounted directly over the rose. Max 5 is used to process matrix data through a Max object called jit.flouride. With this object, cell values fade into the color red as they approach a luminance threshold. I chose to use red because I average out the R-value in the RGB color spectrum to scaled values that are used to increase or decrease the tempo of the composition. So as the red Rose blooms, the flower pedals unfold and provide a greater luminance as their surface areas increasingly come into view of the camera over time. This causes the R-value to increase, and consequently the tempo to increase as well. As the rose dies, the luminance decreases along with tempo. When the luminance drops beyond a calibrated threshold, a metronome is toggled off to stop the music. A calibration is marked by the luminance of a closed rose bulb in the context of the lighting conditions of a given room. An R-value smaller than the value obtained from a closed rose bulb will represent the death of the rose. This is based upon calibration tests that show that the R-values will only increase from this baseline as a rose blooms, and that they will only decrease below this baseline at the time of death.

## RESULTS

The *Days of the Muertos* altar was successfully deployed in the lobby entrance to one of the Arts, Media and Engineering Program facilities located at Mathews Center. The piece was installed from April 23, 2009 to May 7, 2009. On April 23, 2009, a fresh rose bud was placed on the altar. By May 4, 2009, the rose had died, throughout the life span of the rose music events increased in frequency to produce a musical climax 6 days later on April 29. After this musical climax, R-values dropped rapidly over the course of the next three days, so that by May 4, the music had ceased. The following is a time log showing the changes of R-values.

- 1) April 23, 10:20 AM, 74.5 Rose Bud
- 2) April 24, 8:22 AM, 95.5
- 3) April 27, 9:12 AM, 95.9
- 4) April 28, 9:15 PM, 107.40
- 5) April 28, 1:34 PM, 111.12
- 6) April 29, 1:32 PM, 112.41 Peak Bloom
- 7) April 30, 10:16 AM, 102.08
- 8) May 1, 10:23 A.M. 96.271
- 9) May 4, 8:56 A.M. 72.4
- 10) May 4, 5:10 P.M. 58.9 Rose Death

## USER STUDY

To capture visitor reactions, I placed a comment book on a podium next to the *Days of the Muertos* altar. I received 25 entry logs in the installation comment book throughout the

course of 15 days that the installation was exhibited. In addition to the comment book, the following artist statement was provided:

*Days of the Muertos is a musical installation that draws from my bilingual roots. It is an abstraction of a Mexican Dias de Los Muertos altar, as well as an expression of American Goth traditions that are often expressed through pop culture. This piece is a reflection altar that is created with the intent that we may appreciate life by reflecting upon death, and by remembering our ancestors who have died.*

*The stochastic music for this piece is composed using a first order Markov chain. This Markov model is used to drive five bots to play chimes and rattle. A camera is being used to track the progress of the rose as it blooms and then dies. The camera data is then used to drive the tempo of the composition. So as the rose blooms, the music becomes more present or dense in its texture. As the rose dies, the music will slowly fade away.*

*The symbolic and cultural nature of this piece calls for a slowly evolving, subtle, and quiet music.*

Hope you enjoy!

Christopher Martinez

*This project is the final project for my physical computing class. As part of this project I am conducting a user study. In an effort to understand audience reaction to this piece, I would sincerely appreciate it if you left any comments, reactions, thoughts, questions, or ideas you have about this piece. Thank you!*

The visitor feedback has been very helpful in understanding visitor expectation, how people were affected the piece, as well as how the slow temporal evolution of the music was perceived over time by frequent visitors. Most of the visitor comments suggest that the artist statement was read, and that their observations were based upon this statement as a reference.

The largest visitor expectation was that audience members wanted to interact with the piece in some way. The visibility of technology may have set up the cultural expectation that there was an interactive component that involved human computer interactivity. Many comments suggested that attempts were made on several occasions to influence the music by covering the camera sensor, or casting shadows over the rose. There was also a thread of critiques that suggested the technology be hidden from view.

Visitor reactions were described in almost all of the comments. These reactions support the artist's intent to create a haunting, subtle, and reflective altar.

The following log focuses upon the audience's musical perception of the piece in relation to the R-value increase and decrease that describes the rose's life.

Day 1: Visitors describe the music as subtle, stagnant, clam, reflective, and thought provoking.

Day 2: Visitors describe the music as subtle and irregular.

Day 3: The music is described as sparse and haunting.

Day 4: Repeat visitors note that the musical events are occurring more frequently than they did the previous week.

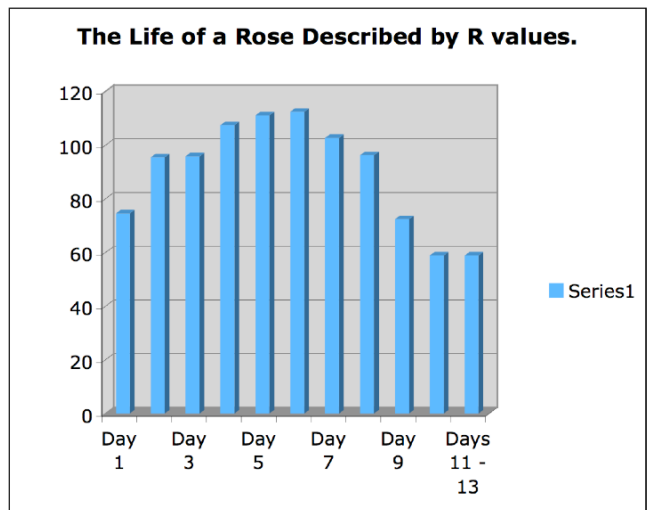
Day 5: Visitor describes piece as constantly chiming.

Day 6: A repeat visitor describes observing the rose blossom over time, and comments upon observing the changes in music, and being aware of the passage of time.

Day 12: A repeat visitor logs the following: "I miss the frequency of sounds. It became a greeting when I walked in the door.

Day 13: A visitor logs the following: "Does this ever make any sound?"

The above comments can be correlated with the R-values plotted in Figure 2 as they changed over time.



**Figure 2. This chart illustrates the rise and decline of R-values during the installation of *Days of the Muertos*. This rise and decline represents the rose blooming and then dying.**

This user feedback provides valuable knowledge about how the music was perceived by first time visitors at different points in the time line. It also shows how repeat visitors were affected by the music with the passage of several days. It is also possible to get a sense of the changes in music composition by examining the correlation between the changes in R-value data, and the visitor comments. Using comments that reflect upon the state of the music,

may be an interesting way to provide visitors with a way to think about the history of the music composition.

## CONCLUSION

Through visitor comments, I have concluded that people were able to reflect upon their lives through the symbol of a dying rose, as well as observe, understand, and visualize a sense of the music composition as a construction that lasts several days. This conclusion is applicable to those visitors who read the artist statement. Those visitors who did not read the statement were often confused about the altar. It appears that they were unable to understand the concept that it attempts to embody, as well as its cultural function. The visitor feedback received has been considered in the second iteration of the altar. The second iteration hides the robotic technologies from view of the audience. This is done to help enhance the mysteriousness or spiritual impact of the altar, as well as remove the expectation that the piece should support human computer interactivity. I also presented the work as a traditional *Días de los Muertos* altar. This is another expression of *Days of the Muertos* that is in contrast to the American goth interpretation of the first iteration.



*A photograph showing the second iteration of the Day of the Muertos altar. This iteration was based on visitor feedback.*

In the next iteration I plan to explore different ways to present visitor comments about the musical behavior, this

could be an interesting way to provide visitors with a sense of how the music has evolved over time.

The aspects explored in these altars will be used in a final iteration to communicate the border crisis touched upon in the introduction. It is important to re-state that this current iteration does not yet communicate the border concerns that were discussed in the introduction. These iterations represent sketches that will inform a final iteration that has the capability to address a humanitarian crisis in a way that disarms it as an issue of contention.

Understanding audience responses to data changes coupled to the life cycle of a rose provides valuable insights into how I might be able to implement different ways of thinking about real-time and recorded data to create an altar that provides visitors with information and opportunities of reflection regarding the loss of life occurring along the U.S.-Mexican border. It also helps me understand how to provide audiences with an opportunity to reflect upon their own lives through death and meaningful music generated through physical computing techniques. This effort is an intervention designed to help people think compassionately and empathetically towards those who are risking their lives to cross the U.S.-Mexican border.

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