Interactive Portraiture: Designing Intimate Interactive Experiences

by
Orit Zuckerman

Association Degree in Photography
Hadassah College, Jerusalem, Israel, 1992

Submitted to the
Program in Media Arts & Sciences,
School of Architecture & Planning
in partial fulfillment of the requirements of the degree of
Master of Science
at the Massachusetts Institute of Technology

August 2006

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ABSTRACT

In this thesis I present a set of interactive portrait experiences that strive to create an intimate connection between the viewer and the portrayed subject; an emotional experience, one of personal reflection. My interactive portraits extend traditional photographic portraiture in two ways: adding motion and interaction. I present seven interactive portraits prototypes that react to viewer's presence and gender, as well as portraits that react to neighboring portraits. I demonstrate how interaction design decisions influence the viewer's experience and give Design Guidelines for the design of intimate interactive experiences.

I ground my work in a theoretical framework called the "subject-object continuum", created for the art of portraiture (Brilliant, 1987). I show the relevancy of this framework for photographic portraiture, modern interactive portraits and intimate interactive experiences.

Designers and artists follow (or consciously break) design guidelines when creating visual experiences. For example, photographers must train themselves to recognize the influence that light and composition have on the viewing experience of their portrait. In the same way, designers and artists of interactive experiences must inform themselves about the influence that different interaction techniques have on the viewing experience of their interactive experience. In my thesis I focus on two design factors: (1) the style of the interaction and (2) the viewer's expectations. I evaluated these design factors using interactive portraits prototypes, and based on my findings, developed a set of design guidelines that can inform interaction designers and portraiture artists about the design factors relevant for intimate interactive experiences.

Thesis Supervisor: Pattie Maes

Title: Associate Professor of Media Arts and Sciences

Interactive Portraiture: Designing Intimate Interactive Experiences

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My father, who taught me patience, observation, and thoroughness.

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My brother, for always being there and helping me see other perspectives on life.

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INTRODUCTION

I have always been fascinated by visual representation of human personality. Over many years, as a professional photographer, I have taken hundreds of human portraits. This process has helped me develop my own aesthetic and portraiture style, as I have explored the tension between portraying the personality of the sitter and conveying my own artistic message.

In my Masters research at the Media Lab I have extended this process in several ways. By incorporating motion into my portraits, I have realized how revealing a short motion sequence can be, how it exposes the inner personality of the sitter. By incorporating interaction into my portraits, using a variety of sensing techniques such as presence-detection, gender-detection, or user viewing-time measurement, I learned how the style of interaction influences the viewer's experience, specifically on the type of connection viewers create with the portrait. By setting up networks of portraits that interact with each other, I have explored how a new, collective meaning can emerge from the interaction of individual portraits.

My work is framed around the "subject-object continuum", a theoretical framework created for the art of portraiture (Brilliant, 1987). The "subject-object continuum" framework distinguishes between the sitter's personality and the artist's message. A "subject" portrait is one that focuses on the sitter's inner personality. An "object" portrait is one that focuses on the artist's message, using the sitter as an object, a means to a goal. This distinction has been evident in portraiture for several millennia, and portraiture artists work within it, developing their personal portraiture style. Some consistently create a "subject" or "object" portraits, while others move along the continuum, exploring the tension between "subject" and "object" portraits, usually by combining aspects of both. In my research I explored the "subject-object continuum" and it's relevancy for interactive experiences.

In the Background & Related Works chapter I map photography portraiture artists along the "subject-object continuum", giving many visual examples. I cover artists such as Margaret Julia Cameron, Robert Mapplethorpe, Man Ray, Richard Avedon, Annie Leibovitz, and more. I continue and review selected portraiture works from the fields of video art and interactive art, such as Andy Warhol's "screen tests", Gary Hill's "Tall Ships", and others.

With these related works in mind, I move on to the Design & Implementation chapter, where I review the different interactive portraits I have created. I began with portraits triggered by viewers' presence and continued with more advanced sensing techniques such as vision-based gender detection. I moved some of the interaction to the portrait side, creating networks of portraits that interact with each other. For example, a network of 16 portraits, laid out as a

4x4 array that acts as a small social network. In the design & implementation chapter I describe my iterative design process at length.

Designers and artists follow (or consciously break) design guidelines when creating visual experiences. For example, photographers train themselves to understand how light and composition impact the viewing experience of their portraits. In a similar way, designers and artists of interactive experiences must inform themselves about the influence that different interaction techniques can have on the viewing experience of their interactive works.

During my design exploration, I was surprised to learn that simple, obvious interaction techniques are more appropriate for intimate works, while more exploratory, less obvious techniques distract viewers and promote exploration of the interaction itself rather than of the portrayed personality. Many factors influence the viewer's experience. Some shift the experience towards a more "subject" one, increasing the viewer's awareness to the sitter's inner personality, while other factors shift the experience towards a more "object" one, increasing the viewer's awareness of the artist's message, away from the sitter's individual personality. In my design process, two factors seemed to be more influential than others: (1) the style of the interaction and (2) the viewer's expectations.

In the evaluation chapter I report on two exploratory studies I have conducted to better understand the influence these design factors might have on the viewer's experience. My observations and findings suggest that designing the style interaction and the viewer's expectations are important design factors that clearly influence the way viewers experience an interactive portrait. In the "Style of interaction" study I have shown that "guided interaction" (simple, rather obvious interaction) is more appropriate for works that strive to focus on engaging the viewer with the sitter's personality (a "subject" style), while "exploratory interaction" (a rich, more exploratory, less obvious interaction) promotes investigation and exploration and is less appropriate for "subject" style works. In the "viewer's expectations" study I showed that setting clear expectations for the viewer prior to the interaction is a key factor that influences the way viewers experience the work. I demonstrated that an interactive portrait with "explicit visual expectations" would increase the chances that viewers create a meaningful connection with a portrait's sitter, leading to a more "subject style" portrait experience. While an interactive portrait with "obscure visual expectations" decreases the chances that viewers create a meaningful connection with the portrait's subject, leading to a more "object style" portrait experience. My findings are based on exploratory studies with a small sample size, and many factors could bias the results. Nevertheless, these observations can be meaningful to designers and artists that create interactive experiences.

In the design guidelines chapter I frame what I learned, giving examples from my evaluations as well as my own design process. I hope these guidelines can serve designers and artists of interactive experiences, specifically, to help them better match their intended experience with the appropriate interaction technique.

In conclusion, this thesis demonstrates how a theoretical framework created for portraiture art is still relevant for interactive portraiture; documents an iterative design process of interactive portrait prototypes; and presents a set of design guidelines that inform designers & artists how to influence the viewer's experience.

BACKGROUND & RELATED WORK

In every portrait there is the person whose portrait is being created, the person who creates the portrait and the people who view the creation. These roles are described in different names in different periods, for consistency reasons I will use the following:

The Sitter: The person who's portrait is being created
The Artist: The person taking the portrait
The Viewers: The people viewing the portrait

Brief history of portraiture

Portraiture as a medium can be traced to the Egyptian empire and maybe even before. Initially, portraiture served as a way of documenting someone's existence and recording it for next generations. Even though it was a documentation tool, sitters, throughout history, were presented as possessing ideal beauty and success and represent the highest social standards; these ideals sometimes compromised the true representation of the sitter. The historian and art critic Richard Brilliant illustrates this idea using a portrait of Aristotle by Rembrandt (Brilliant 1987).

Figure 1: Aristotle contemplating a bust of Homer by Rembrandt, 1653

Before photography, portraiture was a complex and expensive skill and therefore a privilege of the wealthy. Some portraiture artists were able to create art that conveyed their own artistic message through the portrait, however, most of the times portraiture artists were commissioned to create a portrait, and naturally created portraits that were flattering rather than conveying their own artistic message or representing the true personality of the sitter.

Portraiture as an art form representing real people holds an internal paradox. The sitter desires to be represented in a certain way that might conflict with the artist's intentions. In his book "portraiture", Richard Brilliant writes:

> "The oscillation between art object and human subject, represented so personally, is what gives portraits their extraordinary grasp on our imagination. Fundamental to portraits is the necessity of expressing this intended relationship between the portrait image and the human original." (Brilliant 1987)

Photography was an evolution of the "camera obscura". In the 17th and 18th century the camera obscura was a popular technique painters used to create realistic paintings with ease <ref camera obscura and painting (Laggat 2001). In those days, the camera obscura was a big black tent with a pinhole & lens in one side and canvas on the other. The pinhole and lens created an upside-down image of the reality outside the tent and enabled the painter to trace the two-dimensional representation and create a more accurate painting. In 1839 a French man by the name of Daguerre invented a way to record the camera obscura image on a glass-plate covered with light-sensitive copper-based emulsion. He termed it "daguerreotype", and the medium of photography was born. The new medium was accepted with amazement:

> "People were afraid at first to look for any length of time at the pictures he produced. They were embarrassed by the clarity of these figures and believed that the little, tiny faces of the people in the pictures could see out at them, so amazing did the unaccustomed detail and the unaccustomed truth to nature of the first daguerreotypes appear to everyone". (Laggat 2001)

Photography marked the beginning of a new era in portraiture and art. The nature of the photography medium made it harder to beautify the sitter. People accepted the notion that the camera cannot lie and what you see on the plate is as real as it can be and that there is no artistic interpretation of the image. In addition, portraits were no longer the privilege of the wealthy. Portraiture artists became less dependent on few commissioned art works, which

increased their artistic freedom. Portraiture artists started to create art that is driven by their artistic expression, and gradually started to drift away from realism.

Photography as an art form has an inherent tension - is it an art form or journalism? Richard Avedon, one of the greatest photography portraiture artists of the 20th century has said:

> "We need a new vocabulary to talk about photography. Not 'art' versus 'reality,' 'artifice' versus 'candor,' 'subjective' versus 'objective' - photography falls in between these classifications, and that's why it's so impossible to answer questions like 'Is photography really art?' and 'Is this an accurate picture of your friend?' As I have said on other occasions, 'All photographs are accurate. None is the truth.' I don't think pictures have to justify their existence by calling themselves works of art or photographic portraits. They are memories of a man; they are contradictory facets of an instant of his life as a subject - and of our lives as viewers. They are, as Barthes said, texts, and as such they exist to be read, interpreted, and argued over - not categorized and judged." (Avedon, Henry Kissinger's portrait)

Throughout the 20th century, as more and more portraiture artists adopted photography as their artistic medium, it became clear that portraiture is not an objective process. A portrait represents the relationship between the artist and the sitter, which is interpreted in the mind of the viewer.

Richard Avedon beautifully describes this unique relationship:

> "...A photographic portrait is a picture of someone who knows he's being photographed, and what he does with this knowledge is as much a part of the photograph as what he's wearing or how he looks. He's implicated in what's happening, and he has a certain real power over the result. The way someone who's being photographed presents himself to the camera and the effect of the photographer's response on that presence is what the making of a portrait is about... A portrait photographer depends upon another person to complete his picture... We have separate ambitions for the image. His need to plead his case probably goes as deep as my need to plead mine, but the control is with me. A portrait is not a likeness. The moment an emotion or fact

is transformed into a photograph it is no longer a fact but an opinion." (Avedon, Henry Kissinger's portrait)

Avedon continues and describes the artistic process, and the level of control a portraiture artist has on the outcome:

"The first part of the sitting is a learning process for the subject and for me. I have to decide upon the correct placement of the camera, its precise distance from the subject, the distribution of the space around the figure, and the height of the lens. At the same time, I am observing how he moves, reacts, expressions that cross his face so that, in making the portrait, I can heighten through instruction what he does naturally, how he is… portraiture is performance, and like any performance, in the balance of its effects it is good or bad, not natural or unnatural. I can understand being troubled by this idea-that all portraits are performances-because it seems to imply some kind of artifice that conceals the truth about the sitter. But that's not it at all. The point is that you can't get at the thing itself, the real nature of the sitter, by stripping away the surface. The surface is all you've got. You can only get beyond the surface by working with the surface. All that you can do is to manipulate that surface-gesture, costume, expression-radically and correctly." (Avedon, 1970)

The Subject-Object Continuum in Portraiture Art

In this section I classify the works of well-known 20th-century portraiture artists along a single dimension, which is instrumental to my own work, called the "subject-object continuum". Clearly, classification can be limiting and simplistic. Nevertheless, it is a useful tool to observe and analyze portraiture art, and helped me understand the artistic intention of portraiture artists.

The "subject-object continuum" distinguishes between the sitter's personality and the artist's message. A "subject" portrait is one that focus on the sitter's individual's true character, trying to highlight its inner personality. An "object" portrait is one that focuses on the artist's message, using the sitter as an object, a means to a goal. Clearly, this is not a dichotomy, but rather a continuum. Portraiture artists are working within this continuum, developing their personal portraiture style. Some consistently create "subject" or "object" portraits, while

others move along the continuum, exploring the tension between "subject" and "object" portraits, usually by combining both aspects.

In the next section I will map photography portraiture artists along the "subject-object continuum", giving many visual examples, and explaining the differences in their portraiture style. Following that I will present selected video and interactive art works, analyzing them using the "subject-object continuum" as a guiding principle.

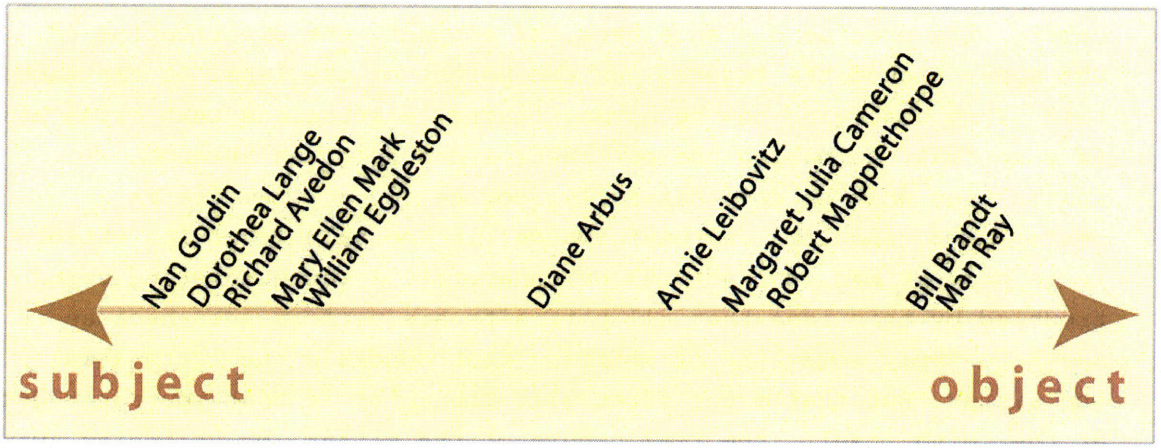


Figure 2: 20th century photographers mapped along the subject-object continuum

Photography Portraiture Artists

During the 20th century there were many active portraiture artists, each with their own unique style to portray people. Some of the most eminent ones are: Margaret Julia Cameron, Bill Brandt, William Eggleston, Dorothea Lange, Robert Mapplethorpe, Man Ray, Richard Avedon, Mary Ellen Mark, Diane Arbus, Annie Leibovitz, and Nan Goldin.

Figure 1 above maps some of these photographers along the subject-object continuum. Below are examples of portraits along the subject-object continuum, starting with two prototypical examples of "subject" (Dorothea Lange) and "object" (Man Ray) portraits, followed by an overview of artists along the continuum, from the "object" ones towards the "subject" ones.

Dorothea Lange (1895-1965)

Dorothea Lange was an American photographer who became famous for her portraits of the people who migrated to the west, looking for jobs in the depression period in the 1930's. Her portraits have a distinctive "subject" style, portraying poor people in their own environment, showing compassion, sensitivity and deep understanding of the people she photographed. Lange was the first photographer who made journalist style portraits. Before her, portraits were almost always set in studio or studio like setting while journalism photography was focused on capturing news events. In Lange's work the focus is on the people and their character in their own location.

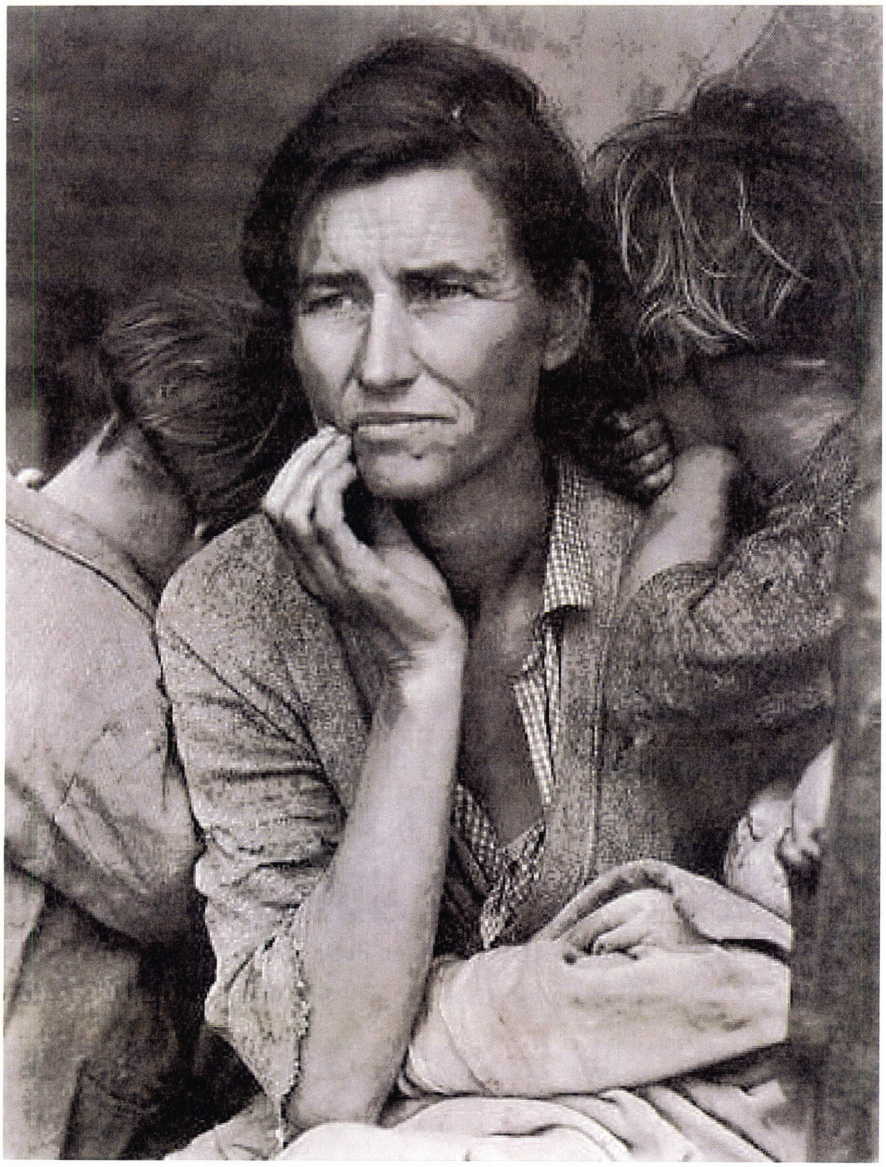


Figure 3: Migrant Mother, 1936

Man Ray (1890-1976)

Man Ray was an American Surrealist & Dada artist. Man Ray liked to experiment with photography techniques including solarization, collage etc. His portraits have a distinctive "object" style, staging people as a means of conveying his artistic expression. When photographing famous people, Man Ray created iconic images which conveyed his message about contemporary culture and the essence of art, rather than trying to highlight the sitter's individual personality.

Figure 4: Marcel Duchamp as Rose S'lavy, 1920

Bill Brandt (1904-1983)

A British photographer; known for his high contrast and extreme perspective nude photographs. Bill Brandt moved along the continuum of subject-object in different periods of his life. During the 1920's fascinated by the extreme social contrasts of London of that time Brandt did a lot of photojournalism portraits of the different classes. In the 1940's he was commissioned by various publishing houses and magazines to take portraits of famous artists:

> "I always take portraits in my sitter's own surroundings. I concentrate very much on the picture as a whole and leave the sitter rather to himself. I hardly talk and barely look at him."

Later on in his life he started experimenting with nude pictures, he had acquired a camera with an extreme wide angle lens and started experimenting with compositions and perspectives. He used professional models as well as family and friends. These portraits were more about Brandt's exploration than the sitters' representations.

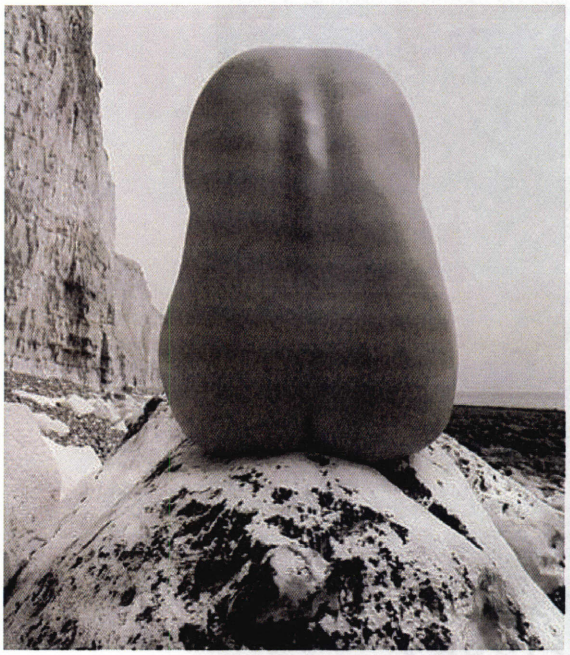


Figure 5: East Essex, 1977

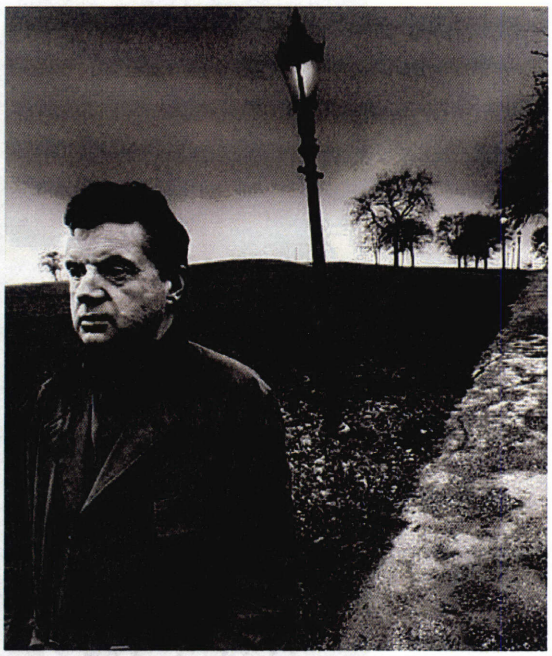
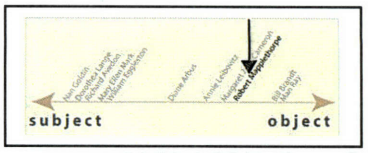


Figure 6: Francis Bacon, 1963



Robert Mapplethorpe (1946-1989)

Robert Mapplethorpe is known for his aesthetically amazing portraits, male nudes and flower images. Coming from the gay scene in NY, some of his images were borderline pornography that stirred controversy around his art and the public funding of art. Mapplethorpe was always obsessed with form and composition. He used his skills as a classic high quality photographer to portray problematic issues such as male nude and gay sexuality as a beautiful thing. Mapplethorpe's work functions in a postmodern sense on many levels and raises a variety of questions regarding the role and/or construction of gender and sexuality in our society, the role of form and content in traditional and contemporary art, the communicative aspect of imagery, and censorship issues regarding museum space, tax dollars, and, in a general sense, all imagery. As such his work has a distinctive "object" style. Although he used real people and mentioned their names, his work is about the message, the sexual icons his sitters come to represent.

Figure 7: Lisa Lyon, 1981

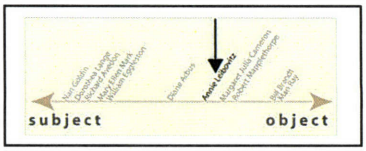
Margaret Julia Cameron (1815-1879)

Margaret Julia Cameron was a British photographer who started photographing at the age of 49, after she received a camera as a present from her daughter. She started taking pictures of the people around her, and soon after started to photograph the celebrities of that period. Cameron's works strive to match the qualities of medieval time paintings (she is heavily influenced by the Pre-Raphaelites' school).

Figure 8: Henry Tyler, 1864

Even though she photographed real people and was trying to convey their character in some way, she was always telling a story through the picture and would try to create a scene for the viewer. She used techniques such as composition, low lighting and blurry images to convey her message, rather then beautify the sitter. In that time this was considered almost unprofessional and she was looked at as an eccentric. When she died the Times wrote about her:

> "Mrs. Cameron appealed to a wide public by her perfectly original and unique photographic work and subject pictures in which, after a daring fashion of her own, forfeiting the sharpness of definition which ordinary photographers strive for, and which is one of the things artists most dislike in photographic portraiture...she produced a series of heads and groups... unique in their suggestiveness...



Annie Leibovitz (1949 -)

Annie Leibovitz is probably the most popular portraiture photographer today. She focuses on celebrities and is known for her close collaboration with her subjects. She directs the subject very meticulously to the extent that they represent more of the viewers' pre-perception than their real character. In the John and Yoko example below, Leibovitz directed john to be naked and "hanging" on to the somewhat distant Yoko, a staging that represented the public opinion about their relationship.

> "Sometimes I enjoy just photographing the surface because I think it can be as revealing as going to the heart of the matter." (Annie Leibovitz)

Leibovitz' work is an interesting combination of the object and subject as the focus is on the shallow appearance and the public views of the famous sitters, nevertheless, because of the cooperation and the intimacy between Leibovitz and her sitters there is also a "subject" dimension to the portraits.

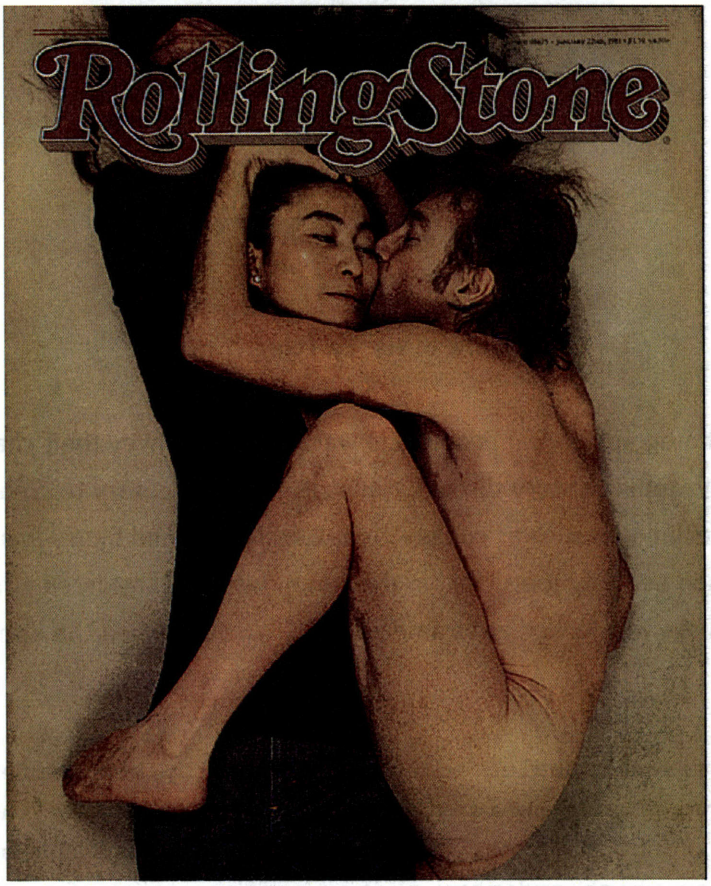
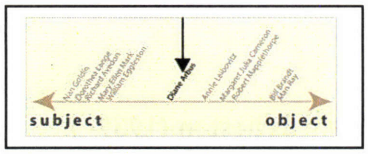


Figure 9: John Lennon and Yoko Ono, 1980



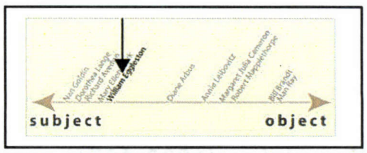
Diane Arbus (1923-1971)

Arbus was an American photographer who was famous for photographing portraits of people on the fringe of life, such as transvestites, dwarves, giants, prostitutes, and ordinary citizens in poses and settings conveying a disturbing uncanniness. Arbus liked to show non-ordinary as well as ordinary people as different, showing a sense of otherness. Her portraits were very much about the sitters, but her own opinion was apparent and she used her subjects to convey a message about preconception, social standards and hypocrisy. She used to find her subjects in streets and pubs, go up to them and ask them to be photographed. She would usually photograph them on the spot, using a flash to separate them from the background. She used a medium size camera that was held at waist-level so as to impose a different relationship with the sitter, because she would not hide behind the camera and was free to talk to the sitter while looking for the right moment to take the picture. Some critics claimed Arbus exploited her subjects. Others claim that all portraits exploit their subjects. Like many other portraiture photographers at that time, Arbus started out in the fashion world, where she worked as a stylist in her husband's studio. That clearly affected her artistic work, as she was appalled by the shallowness and deception of the luxurious fashion world. She had a deep need to show what she thought was true about people.

Figure 10: Identical twins, 1967

Figure 11: Brooklyn Family, 1962

"We thought it was the worst likeness of the twins we'd ever seen," whispers Bob Wade, the girls' father. I mean it resembles them," Wade continues. "But we've always been baffled that she made them look ghostly. None of the other pictures we have of them looks anything like this."

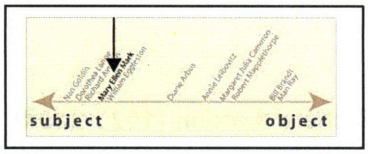


William Eggleston (1939-)

In turning to color as an artistic expression, William Eggleston, a native of Mississippi, established his reputation as the pioneer of modern color photography with his one person exhibition at New York City's Museum of Modern Art in 1976. Curated by John Szarkowski, then curator of photography at MOMA, this show of large-format prints that monumentalize everyday subjects and its accompanying book/catalog entitled "William Eggleston's Guide" ran counter to the then prevailing idea that art photography was black and white by definition. Eggleston sought to create prints in which the human eye could see all colors. His images are of a mundane world, yet he had a talent in exposing the extraordinary in a mundane world. Mark Holborn, in his introduction to "Ancient and Modern" writes about the dark undercurrent of these mundane scenes as viewed through Eggleston's lens:

> "[Eggleston's] subjects are, on the surface, the ordinary inhabitants and environs of suburban Memphis and Mississippi--friends, family, barbecues, back yards, a tricycle and the clutter of the mundane. The normality of these subjects is deceptive, for behind the images there is a sense of lurking danger."

Figure 12: Ackson, Mississippi, Not dated



Mary Ellen Mark (1940-)

A photojournalist and a portraiture artist, Mary Ellen Mark is known for her selection of subjects that allowed her exploring difficult social issues like homelessness, loneliness, drug addiction and prostitution. She has talent portraying the most emotional aspects of her subjects and bringing the viewers into their world. She used to spend a lot of time with her subjects and sometimes would revisit them after several years. Her images display a strong empathy with the subjects. Ellen Mark uses her sitters to show a world not known to the average viewer, even though she shows very specific people her focus is to show their world and poor life and not their personality. Ellen Mark's work tells us a story about people's life in different places through her eyes and interpretation.

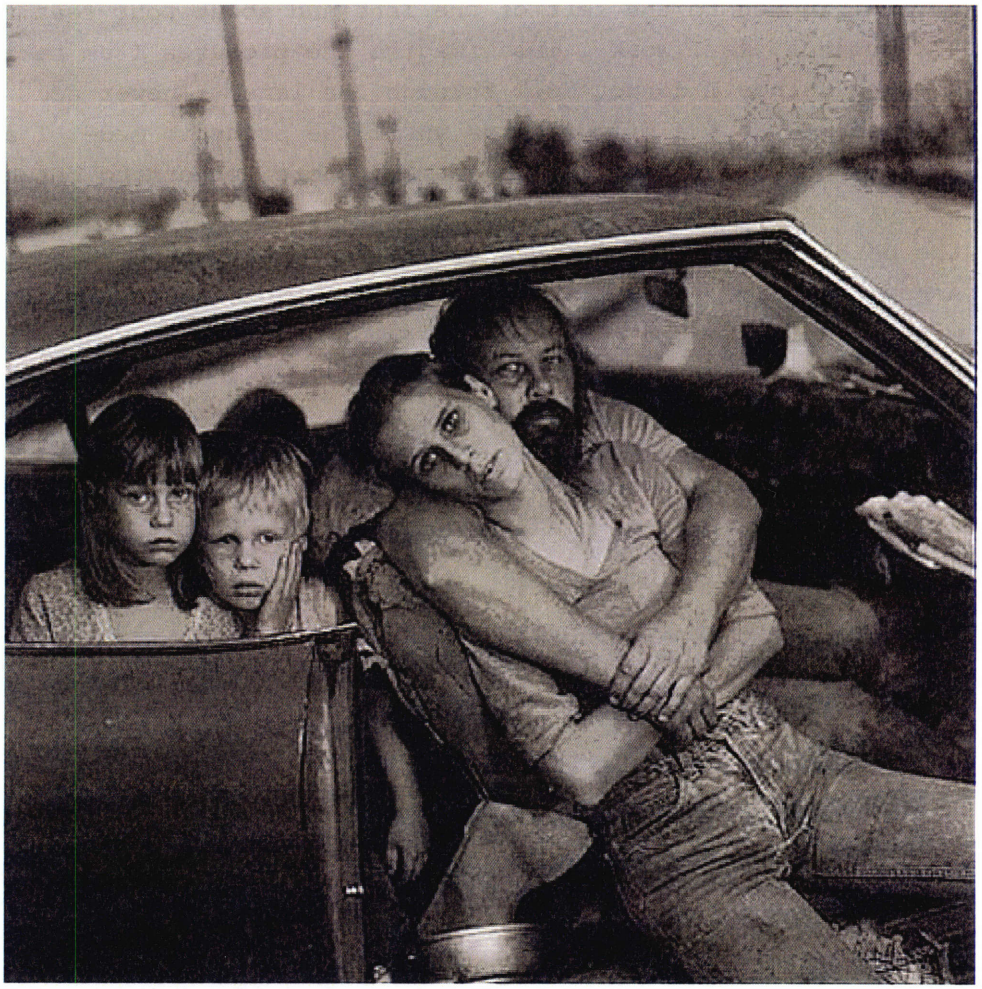


Figure 13: The Damm family in their car, LA 1987.

Richard Avedon (1923-2004)

Richard Avedon was an American fashion photographer who developed a unique artistic portraiture style as he began by portraying the celebrities of the time and followed by portraying the simple people in the American west. Similar to Arbus, his work with the fashion world affected his artistic work in that he was interested in exposing the "real" essence of his subjects. His philosophy was to give the stage to the sitter and not interfere:

> "I've worked out of a series of no's. No to exquisite light, no to apparent compositions, no to the seduction of poses or narrative. And all these "no's" force me to the "yes." I have a white background. I have the person I'm interested in and the thing that happens between us. ...I stand next to the camera, not behind it, several inches to the left of the lens and about four feet from the subject. As I work I must imagine the pictures I am taking because, since I do not look through the lens, I never see precisely what the film records until the print is made. I am close enough to touch the subject and there is nothing between us except what happens as we observe one another during the making of the portrait. This exchange involves manipulations, submissions. Assumptions are reached and acted upon that could seldom be made with impunity in ordinary life."

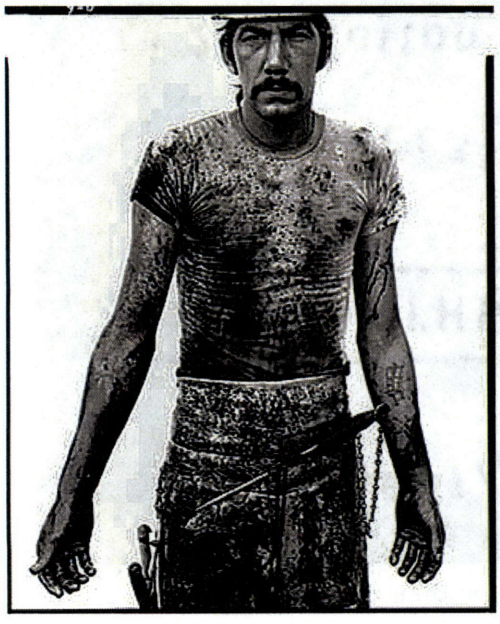


Figure 14: Blue Cloud Wright. Slaughterhouse Worker, 1979

Figure 15: Marilyn Monroe, 1957

Nan Goldin (1953 -)

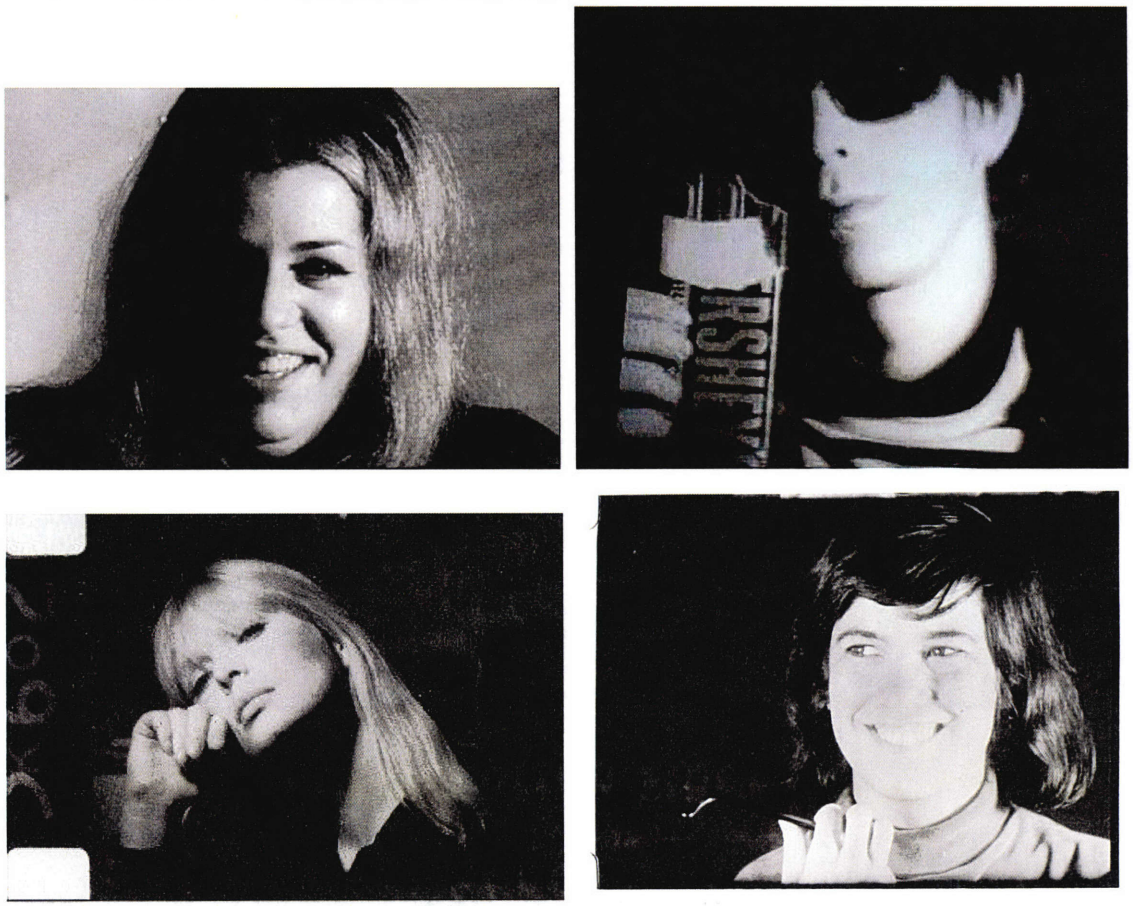
Nan Goldin started her career by photographing her friends at the fringe of society. In New York she concentrated on the post-punk community and eventually photographed the drug addiction subculture of that time. Being part of these people's life she showed the harsh reality of drug use, violence, and the very intimate moments that are not seen by the public's eyes. Most of her subjects were dead by 1990 and Nan claimed to have done the photographs in an attempt to hold to the memory of the living. In a way, Goldin's involvement in the life of her subjects makes her work a self-portrait more than anything else.

> "My work originally came from the snapshot aesthetic . . . Snapshots are taken out of love and to remember people, places, and shared times. They're about creating a history by recording a history." (Nan Goldin)

Figure 16: Cookie at Tin Pan Alley, 1983

Video Portraiture

In the 60's artists began to explore video art, including video portraiture. One of the most influential works in the video portraiture field is Andy Warhol's "screen tests". In his tests Warhol examines the relationship between a portrait's viewers and sitter. During a period of several months, every visitor to the Warhol's factory would be invited to sit for a screen test. The screen test would be a 3 min "one shot" of someone standing in front of the camera until the end of the cartridge (3 min in 24 frames per second). The sitters were ordered not to move, blink or swallow, while Warhol left the room, but almost none of them complied. The tests were shot in 24 frames per second but were projected in 16 frames per second, which creates a slow motion effect (4.5 min viewing time). This work is considered Warhol's greatest work of minimalism and conceptual art. Warhol pushes the viewers to a point of an uncomfortable voyeurism. He wanted to create a photographic portrait that is taken over time and therefore capture the sitter's motion and change of movement. On the other hand he instructed the sitters to not move, which is of course impossible to do for 3 minutes of time. The result is very subtle changes and small nuances that surface the sitter inner personality. He made over 500 of these movie portraits of which 277 survived.



Figures 16, 17, 18, 19: screen tests of (clockwise) Mama Cass, Lou Reed, Nico, and Susan Sontag , 1960-1966

Motion is an essential component to understand a face or a character. The fact that physical movements embodied in gait and gesture, are characteristic to a particular individual, has long been recognized. Quoting his father, the great 17th century sculptor Gian Lorenzo Bernini, Domenico Bernini observed that:

> "If a man stands still and immobile, he is never much like himself as when he moves about. His movement reveals all those personal qualities which are his and his alone". (Brilliant 1987)

This information is lost in a still image (not enough information) or in a narrative (too much information). In "screen tests" Warhol forces the viewers to look at the gestures, gaits and minimal movements of his sitters. There is no narrative, no development just a sitter doing nothing for a long time which make the viewers focus on subtleties, nuances, and bring in their own interpretation and emotional experience.

Wayne Koestenbaum writes the following about Warhol's screen tests:

> "Watching the screen tests, we're being tested: Will we, the viewers, comprehend what we see, or will we scoff, walk away, give up this chance for vision? The screen tests test the subject's emotional immunity. Ann Buchanan, in her screen test, is crying. Because I don't know who she is? Because Warhol humiliated her? And yet her tears seem unemotional, Nico-esque. Pain, in Warhol's work, is sourceless; one is never sure who caused it or whether the person supposedly experiencing it (in this case, Ann) is fully aware of her suffering. Warhol gives us pain without awareness: Ann's test sells anesthesia. ...If two people are framed identically, then we are allowed to tease out equivalences--symbolic affiliations--between them. ...He allows us to exercise our analogy-seeking capabilities to the full; he suggests that every individual is an arena for likenesses to germinate. ...The screen tests permit but also punish individuality; and the copresence of anarchic and carceral vibes is an American conundrum that Warhol fastidiously chronicled. Warhol points out celebrity's paradox: Is the star a punished or a privileged site? Is notoriety--being-known, being-seen--torture or delight? Warhol is (if you wish him to be) a minimalist, whose morphemes are not shapes or colors but personalities.
>
> A face is interesting, but so is the time we spend looking at it. Seeing a Warhol screen test, we compose a conceptual sculpture: an empty box, containing our time-of-beholding. Face equals duration: Warhol leaves us contemplating formal equations that contain more gaiety than we could ever guess." (Koestenbaum 2003)

Analyzing Warhol's screen tests using the "subject-object continuum" point of view we learn that the limitations he set, the private experience for the sitters, the length of the filming - together create a space that "forced" sitters to expose their inner personalities, even if they try to avoid it. His minimalistic and "objective" structure created an extreme "subject" experience for viewers. In comparison to still photograph portraits, the longer duration of the visual experience imposes self-reflection on the viewer much more than in a traditional portrait. The viewers question their patience, their uneasiness and interest in the long observation into the sitter's situation.

Since the screen tests were made, many artists repeated the technique - shooting a person doing nothing for a relatively long time, in a way that force both the sitter (in the shooting phase) and the viewer (in the viewing phase) to deal with no narrative, no goal, just a person for 4.5 min. Using a comparison method to highlight the individuals difference is another technique that was copied by many others. Artists like Bill Eggleston, and Marty St. James are among those who used those techniques.

Digital and Computer-Based Portraiture

The 60's and 70's also mark the beginning of computer art exploration. A lot of these explorations started in science labs by engineers that had personal interest in art. Unlike early years where artists were on the fore front of technology, being the first to develop and use it, with computers there seem to be a divide between artists and technologists that grew wider over the years. Photography expanded art creation into a larger scale by enabling people who are not skilled with drawing or painting to express themselves in an artistic way. Computers had the same effect to even a greater extent, and people that never thought about visually expressing themselves started exploring digital and computer technology as an artistic expression tool. The first attempts in computer art were about transformations. Computer art enabled showing people in ways you couldn't see in real life (different age, different sex, merge them with another person etc.) Since real was not real anymore, it challenged the audience perception of art objects, their knowledge of art history and the traditional relationship of passive art object and passive viewer. (Reichardt, 2000) The boundaries between the subject, the artist and the viewer were blurred and therefore created a new experience of art. In traditional portraiture there was a large effort to expose the inner personality through likeness to the superficial appearance. In digital portraiture in the 90's, that was no longer the case. The sitters were manipulated, deformed and most of the time not even visible to the viewers and the art pieces were more about conceptual representation of someone, and in most cases a general cultural representation through an individual case. The

only exceptions were self-portraits of artists where real face or likeness to the sitter (in this case the artist) was used but still in a more general conceptual message. Some examples to self-portraits in the 90's are:

- **Gary hill** - "Inasmuch as It Is Always Already Taking Place" (1990) - 16 screens close up of different parts of the body of Hill. Each part moves and breathes. Each part is displayed on a screen in the size of the body part in a random order that doesn't correspond with the human skeleton. A wire connects the screens like a spinal cord.

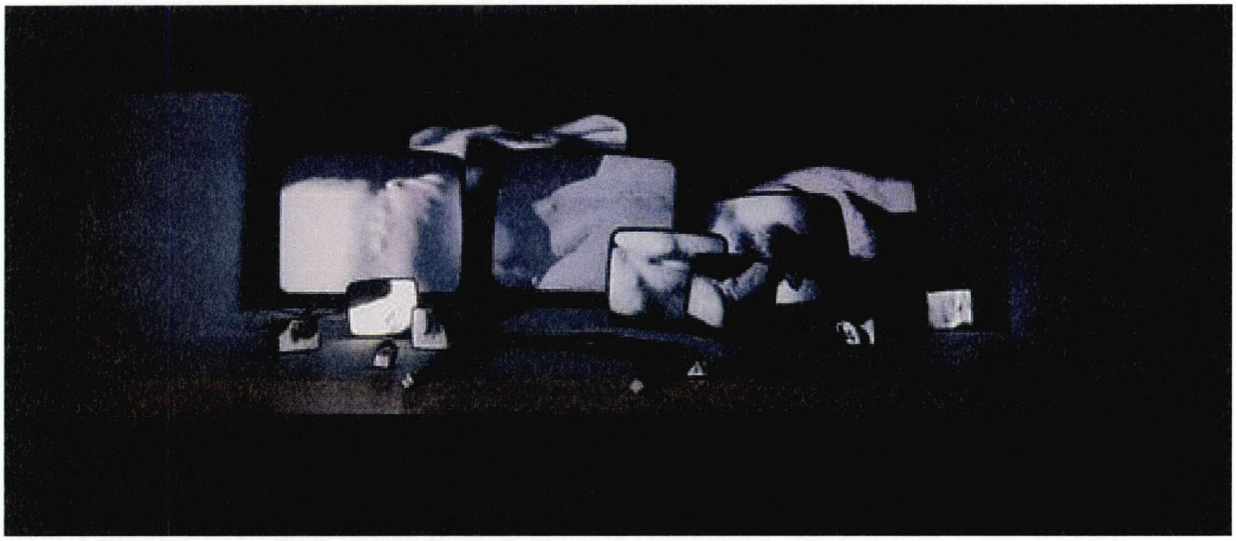


Figure 20: Inasmuch as It Is Always Already Taking Place , Gary Hill, 1990

- **Mona Hatoum** - "Corps Étranger" (1994) - The video maps an internal and external self-portrait of the artist through such complex medical procedures as endoscopy, colonoscopy, and echography.

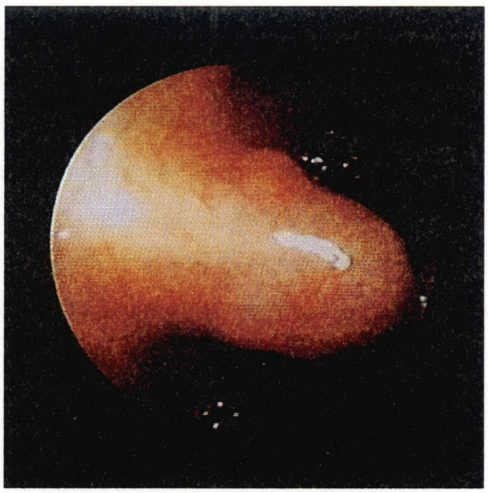


Figure 21: Corpse Etranger , Mona Hatum, 1994

- **Yasumasa Morimura** - making new portraits of himself in famous traditional portraiture works.

Figures 22, 23, 24: Mona Lisa in pregnancy (1998), Frida Kahlo (2001) and Van Gogh (1985), Yasumasa Morimura.

In the 90's the aesthetics became less relevant to the art works. Artists were interested in creating new realities and conceptual messages. From the subject-object continuum point of view the works were much more on the object end of the continuum than the subject one. Since concept and criticism were the main goals of these works, the subject was used to convey a bigger message about the state of society, culture, human kind, politics or any topic that was dealt with at the time. The subject personality becomes the means rather than the end.

Interactive Portraiture

Myron Krueger created the first interactive art experience where the viewers are part of the creation and responsible for their own experience. He created, back in 1969, interactive experiences that would sense the viewers and change the visuals and audio according to the viewer's physical movement. In the late 90's the underlying technologies for interactive art became more advanced as well as easier to use. Sensors enable the artwork to sense viewer's physical behavior, in a general or individual way. Artificial intelligence and machine learning enable creation of autonomous creatures that develop a life of their own. Communication and networks enable examinations of collaborative and remotely located scenes and behavior. All contributing to a completely different experience and provoking deeper thinking about philosophy, aesthetics, relationships, history and art.

Within the interactive art field, some artists focus on portraiture. The following interactive portraiture works are the most relevant to my research: Luc Courchesne's "Portrait one" (1990), Gary Hill's "Tall Ships" (1992), Flavia Sparacino's "responsive portraits" (2001), Stefan Agamanolis's "portrait of Cati" (2002), and Rafael lozano-hemmer's "Under scan"(2006).

Luc Courchesne's "Portrait one", (1990)

Luc Courchesne created Portrait one in 1990, a work in which the viewer interacts with a woman actor by selecting questions to ask her. The questions are presented on a screen and when the viewer selects a question the portrait loads a movie with an answer for that question.

Jean Gagnon writes about Portrait one in his "Portraits of dialogue" article:

> "Whether fictional or documentary, individual or collective, all of Courchesne's video portraits share one common quality: their "interactivity" manifests itself in the form of dialogue... dialogue opens us up to intersubjectivity, which is the foundation of subjectivity. In other words: if I do not speak to the Other, then I do not exist. Language is of course the foundation of this dialectic between Self and Other. This gives rise to an ethics of reciprocity toward the Other - whether I speak with him or her, or become the subject of their address. This equation is particularly present in Portrait One... the important role that language plays in our attempts to break the endemic solitude that surrounds us, and also reveals the ways in which speech addressed to another constitutes a gesture toward them, an attempt to reach out, uniting us and committing both parties to responsibility and action... for me, Courchesne's interactive portraits allow us to question the condition of sociability itself, by leading us to recognize that part of ourselves which is based upon the Other. Courchesne's portraits invite us to pass through dialogue in order to awaken this responsibility toward the Self which requires the Other; an experience that signifies our individual Self's responsibility toward the Other in return. (Gagnon, 1995)

Figure 25: Portrait one, Luc Courchesne, 1990

Gary Hill's "Tall Ships" (1992)

In their 1993 book "Gary Hill's projective installations", Quasha and Stein describes the viewer experience in Tall Ships:

> "...the viewers Enter a long dark corridor, like a narrow harbor, and encounter a fleet of twelve human figures like tall ships adrift in space. They are the only source of light, their faces like white sails in the moonlight. Like the spectral figures in Dante's Purgatorio, or the sirens in Homer's Odyssey, these phantoms stand silently, waiting, until you enter and disturb the fragile peace. As you journey into the stillness of this space, sensors are triggered and the nearest figure will move closer. Each apparition, whether man, woman or child, offers itself to you as if about to speak. Yet they stand, shimmering and silent, until they turn away, unable to unburden the secrets hidden behind their eyes. This fleeting moment leaves an unearthly, haunting sensation. Do we ever really connect, or are we just passing ships in the night?" (Quasha, 1993)

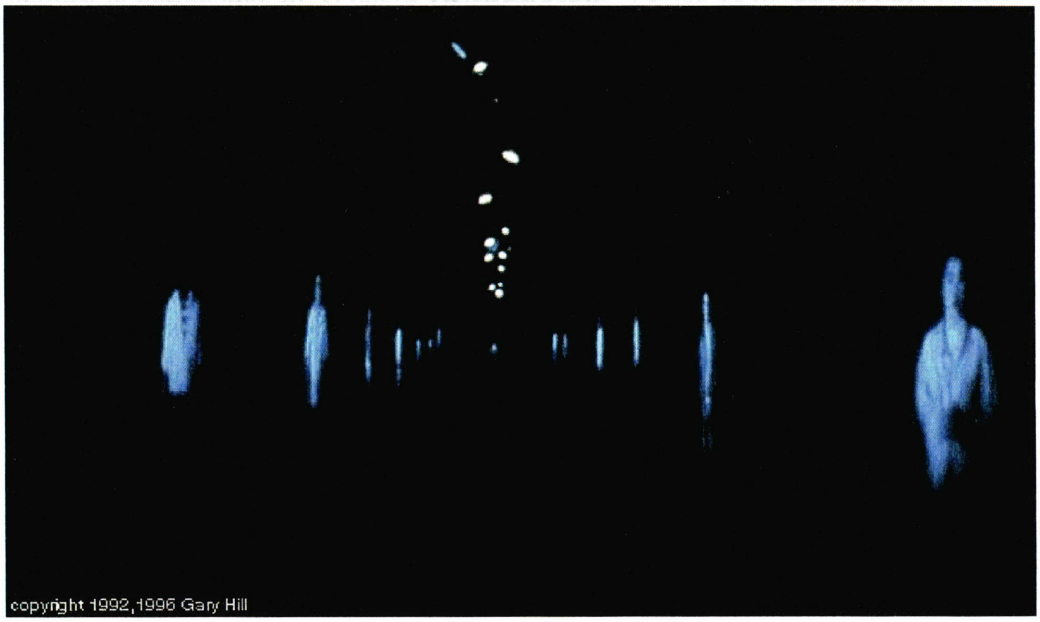


Figure 25: Tall Ships, Gary Hill, 1992

Gary Hill discusses his work in an Interview conducted by Regina Cornwell:

> "Tall Ships is simply the idea of a person coming up to you and asking 'Who are you?' by kind of mirroring you and at the same time illuminating a space of possibility for that very question to arise. Basically I wanted to create an open experience that was a deliberate and at the same time would disarm whatever particular constructs one might arrive with, especially in a museum." (Hill, not dated)

In Tall ships Gary Hill blurred the boundaries of sitter-viewer, and created an immersive experience where the viewers start to question his own being as a human. The ghost-like actors and the subtle interaction create an immediate engagement.

Flavia Sparacino's "responsive portraits"(2001)

Sparacino's responsive portraits try to challenge the notion of static photographic portraiture as the unique, ideal visual representation of its subject.

Figure 26: Responsive portraits, Flavia Sparacino, 2001

It consists of a multiplicity of views: digital photographs and holographic 3D images, accompanied by sounds and recorded voices, whose dynamic presentation results from the interaction between the viewer and the image. The viewer's proximity to the image, head and upper body movement's illicit dynamic responses from the portrait, driven by the portrait's own set of autonomous behaviors. This type of interaction reproduces an encounter between two people: the viewer and the character portrayed. The sensing technology used is a computer vision system which tracks the viewer's head movements and facial expressions as she interacts with the digital portrait; therefore, the whole notion of "who is watching who" is reversed: the object becomes the subject, the subject is observed.

Stefan Agamanolis's "portrait of Cati"(2002)

Agamanolis's "portrait of Cati" was created for the "Id/Entity" exhibition (curator Judith Donath, 2002). In "Id/Entity" artists and technologists were paired to create works of art about portraiture in the new millennium.

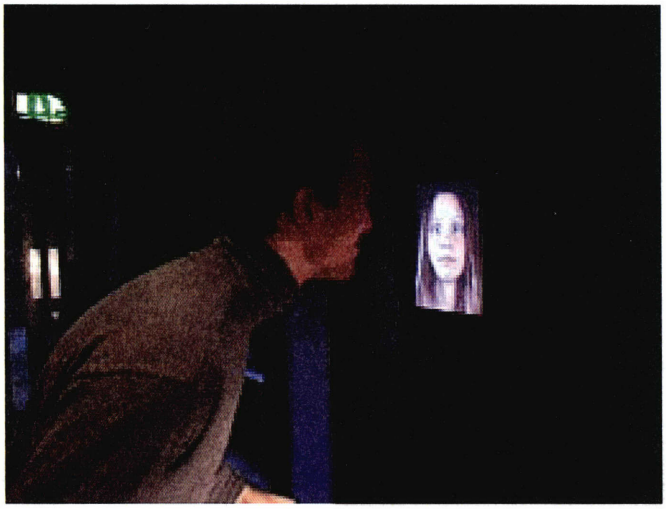


Figure 27: Portrait of Cati, Stefan Agamanolis, 2002

Agamanolis combined roles and was the artist as well as the technologist. Agamanolis based the portrait on his previous work, "Magic Windows" (2001), in collaboration with Barbara Barry. In Magic windows the viewer controls the progress of the movie by coming closer to the screen. There are different movies, one showing a man blowing a balloon, another showing a man picking up a heavy box and a third showing a man blowing a bubble gum. The closer the viewer, the more the movie progresses, until - if too close, the balloons pop and the man with the box breaks his back. When the viewer steps back, the movie plays back. In "portrait of Cati" Agamanolis used the same proximity technique to create a personal space for the portrait. When viewers approach the portrait, they invade the personal space of the portrait, and the subject reacts with random facial expressions that are more extreme the closer the viewer gets.

For this thesis, I conducted an email interview with Agamanolis, where he explains his motivation:

> "I was thinking that enhancing a portrait with technology could be a means to conveying the personality/quirks of the subject in a different or stronger way than is possible with a conventional portrait. In "Portrait of Cati", Cati's expression changes as the spectator gets closer -- the spectator is potentially more personally involved with the subject in this way and also gets to glimpse aspects of Cati's personality that you wouldn't have seen in a traditional portrait (the kinds of expressions she made, the way she expressed emotions, etc). The idea is simply that the spectator should be able to "build a relationship" with the subject in the portrait in a richer way, even if the emotions are somewhat superficially or artificially induced by the interaction. In the piece the expression Cati makes are random,

maybe it gives an impression that Cati was more of an emotional changeable person that she was in real life but that could be certainly an aspect of ones personality that could be expressed with this kind of portrait"

Rafael lozano-hemmer's "Under Scan" (2006)

Under Scan is a large-scale public art project. Eight video crews shot 1000 portraits of local people in different cities in the UK (Derby, Leicester, Lincoln, Northampton and Nottingham). The portraits where then projected on the ground of the main squares of each city. At first, the portraits are not visible to pedestrians because the space is flooded with white light coming from a projector. As people walk around the area, their shadows cast on the ground, revealing the projected video-portraits. The short video sequences begin with the subjects in a still position turned away from the camera. As they appear inside pedestrians' shadows, they start to move and their heads turn to look straight at the pedestrian, potentially giving rise to an interesting range of interactions. When a shadow moves away from a portrait, the portrait likewise reacts by losing interest and looking away.

Figure 28: Under Scan, Rafael Lozano-Hemmer, 2006

Lozano-Hemmer intension was to expose the city inhabitants to other city inhabitants and let them experience each other in a deeper way. He instructed the sitters to do whatever they want, but to look at the camera. If we compare "under scan" to "screen tests" of Warhol, in both cases the sitters are in an awkward situation. In "screen tests" they are supposed to not

move for 3 min while looking at the camera, in "under scan" the sitters have to lie down for a few minutes and look at the camera. Looking at the "under scan" portraits, it seems that without the limitations from the artist the awkwardness of the situation led them to over act out a scene, such as throwing something on the viewer, making funny movements, flashing a flashlight in the viewer's face. It is clear from the footage that the sitter are relating to the fact that the viewer is going to watch them and in return they are focused on acting out, or being funny rather than exposing themselves. In "screen test" the sitters are very much occupied with their own feeling and thoughts and they don't try to appeal to the viewer, the awkwardness and length of time in front of the camera makes them become unaware to the fact they are being watched and as such they reveal more of their inner personalities.

In the next chapter I describe the interactive portraiture prototypes I have created during my Masters research.

DESIGN AND IMPLEMENTATION: THE INTERACTIVE PROTOTYPES

Representation of human emotions has always fascinated me. Over the years, as a professional photographer, I have taken hundreds of portraits. This process helped me develop my own aesthetics and portraiture style, as I explored the tension between portraying the personality of the sitter and conveying my own artistic message.

In my Masters' research at the Media Lab I have extended this process in several ways. I added motion and interaction to my portraits. I realized how revealing a short motion sequence could be, how it exposes the inner personality of the sitter. Then, when I added interaction, I learned how it could be used as a tool in the hands of the portraiture artist.

During this process I have created a variety of interactive prototypes. I used a variety of sensing techniques, such as presence-detection, gender-detection, or user viewing-time measurement, as well as different interaction techniques, such as viewer-portrait interaction and portrait-to-portrait interaction.

In this section I present these prototypes in detail. For each prototype I describe the concept, the design and production process, the technical implementation (including software, hardware, and sensors), the portrait presentation, and my reflections on that work, what I learned and how it lead me to the next prototype.

Prototype 1: Moving Portraits I. October 2003
Three portraits on three individual screens.

Figure 29: Moving Portraits I, Pattie Maes, David Cavallo, Ted Selker, 2003

Description

I asked three Media Lab faculty members to pose for me. The sitters were Prof. Pattie Maes, Prof. David Cavallo and Prof. Ted Selker.

In this work I created a studio with a black background to isolate the people from the environment and in that way help the viewer focus on the sitter's expression. I asked each person to look away from the camera and when I gave the cue, to look into the camera.

I hung the three portraits on a wall, side by side and framed the screens with a real wooden picture frame, so that at first they look like a real picture hanging on the wall. When the viewer stood in front of one of the portraits, the person in the portrait looked at the viewer. As long as the viewer stood in front of the portrait, the person in the portrait looked back at the viewer. As soon as the viewer left, the portrait returned to its initial state (not looking at the viewer).

Concept

In this first prototype I wanted to explore the idea that an emotion could be revealed by a short gesture in a short motion sequence. I wanted to see if it creates a different viewing experience, and if it gives me, the artist, more tools to convey both the sitter personality and my message. I also added viewer-portrait interaction, by using a simple "presence sensor". With the sensor, the portraits reacted only if someone was looking at the portrait, which created a more personal experience for the viewer.

Design and production

As a visual artist it was crucial for me to maintain the photographic of my previous work in still image portraiture. I decided to use a sequence of still frames (rather than video) to get the highest resolution possible into the motion sequence. In order to capture the motion sequence I used the "continuous" or "burst" mode in a digital camera, which enables capturing of multiple images in one burst. I used the Canon G2 semi-professional digital camera, which captures 12 images at a rate of one frame-per-second. I captured the images in black and white, which maintained my portraiture style and minimized the visual overload on the viewer, thus making it more likely that the viewer will focus on the expressive gesture.

I told each subject to sit on a chair in front of the camera and look away from the camera. On my cue they looked into the camera. The effect of a portrait "following with his/her eyes" wherever the viewer is standing can be achieved by having the subject look directly into a camera. Subjects chose in what way they look away and into the camera, revealing their own character in their personal gesture.

Technical implementation

For editing and controlling the images and interaction I used Macromedia Director. I created a movie out of the image sequences and marked the points of looking away and looking at the viewer. Whenever there was an input from the sensor that someone is viewing the portrait it played the movie to the end and stop. When the viewer left and the sensor sent the relevant message and the movie played backwards.
For the interaction input (proximity) I used Sharp infrared sensors controlled by a PIC microcontroller.
Each portrait was presented on a 19" screen and was controlled by an individual computer. The sensor communicated with the PC through the serial port and the software controlled the interaction. The portraits were in a "not looking" mode when people passed by or when there were no people around. If someone stood in front of one of the portraits (about 3 feet away) for more than two seconds the portrait reacted and "looked" at the viewer. When the viewer left, the portrait played back to the starting position.

Presentation and feedback

Moving Portraits I was presented in the media lab in the fall 2003 sponsor week event.

People liked the aesthetics and presentation of the work that made it look like a real photographic portraits on a wall and therefore set a certain expectation. People observed the portrait for a few seconds and when they realized it was moving they either enjoyed the surprise or they tried to explore additional interaction, by making faces, hand-waving or sound-making. Many people were inspired by the work and came up with many ideas of what they would like to do with such installation (make it react to faces, make it know who I am, make it indicate availability status of the person in the portrait).

People who knew the subjects were amazed by the accuracy of the depiction of the subject's character. Even though the gestures of each sitter were similar they looked very different in

the context of each portrait. For people who did not know the subjects, the comparison helped them notice the different characteristics of each subject.

Reflection

- The aesthetics and production quality of the work is key. The high resolution, black & white style was the first thing that grabbed viewers' attention.
- Having several subjects portrayed in the same way and doing the same gesture helped viewers focus on the subtle differences between the portraits, which was determined only by the subject's characteristics and thus brings forward their inner personality.
- The surprise of a motion sequence out of a still image increased the expectations from the work immediately and since it did not "do" more some people felt disappointed that they couldn't "play" more with the portrait. I felt there was a need to further research this balance by playing with either the level of expectation or the level of complexity of the interaction.
- I decided to try and do a much more sophisticated portrait that would offer a much more complex interaction.
- Several design factors in the prototype enhanced the "subject" style of the portrait.
    - Minimal visual presentation of headshot on a black background in black and white contributed to the attention viewers gave the sitter.
    - Short sequence of a moving gesture exposed more of the sitter's personality to the viewer.
    - Simple interaction that was based on the natural behavior of viewer in front of a picture (stand in front of it and look at it) didn't promote exploration of the interaction and enabled viewers to focus on the content. Since some of the viewers did try to explore the interaction a better design for guided interaction will help the experience to match the expectations.
    - Presentation in a wooden picture frame to make it look like a "real" picture set an expectation of the visual content (a picture of a person) and the interaction (to stand and look at it).
    - Comparing the three portraits that were doing the same gesture highlighted the differences between them that was a result of their personality.

Prototype 2: Charlie. March 2004

One portrait on one screen.

A collaboration with David Gatenby.

Figure 30: Charlie, 2004

Description

Charlie was a character that "lived" in the hallway. He had his own personality and reacted to the people that walked through the hallway. He reacted differently to different people but also changed his reaction based on the interactions with previous viewers.

David Gatenby acted as Charlie.
When a viewer stopped to look at the portrait, Charlie "woke up" and looked at the viewer with an expression that was happy, natural or annoyed. The expression was determined by the previous interaction Charlie had with other (or same) viewers. Then the viewer would be encouraged to come closer by a gesture from Charlie. Based on how fast and how close the viewer came to the portrait Charlie would react. All the interactions were registered in a "mood" variable which affected future interactions with viewers.

Concept

In this prototype we tried to create an autonomous character that has a life of its own and is affected by the things that happens around him. We wanted to build a system that will build a character based on the environment and this way resemble real human behavior, more diverse personality and less predicted behavior.

We divided it to two stages. First we built a system that had a complex reaction mechanism and had memory of interactions for future reaction. For second stage we created a learning system that changed the character's basic behavior based on interactions over time.

Design and production

First we defined the factors Charlie was sensitive to. We decided he would react to three combined parameters:

1. Number of people looking at the portrait.
2. How fast people approach the portrait.
3. Noise level in the environment.

We scripted out 22 different reactions to the viewer based on the combined parameters plus the initial state Charlie was in, which was based on the previous interaction. I filmed the 22 different reactions using a high-resolution 3ccd Canon video camera that captures 30 fps in 720x320 resolution. I decided to explore video as a capture device because the gestures were more complex and couldn't be captured in a 12 frames sequence.

Technical implementation

After capturing the gestures I edited the clips and key-framed them for the interaction. For this prototype I used Max/MSP/Jitter, which is a visual programming language that was developed for sound editing in real time. It enabled the creation of a complex interaction script in a pretty simple interface. As sensor we used an ultrasonic sensor more accurate than the Infrared sensor to detect proximity and approach-speed. David Gatenby adapted the open CV vision system by Intel to detect number of people in front of the portrait. We used a USB webcam as the face detection sensor.

When the viewer stood in front of the portrait the proximity sensor sent the input, and the webcam +vision system reported how many people are present. The input evoked the "wake up" sequence. Before playing the movie the software checked in what "mood" Charlie went to sleep and based on that factor selected the appropriate "wake-up" sequence (e.g. if he went to sleep happy he will wake up happy). Then the software waited for the next event, which could have been viewer stepped forward, no change or viewer left. If the viewer stepped forward, the ultrasonic sensor measured the approach-speed and the software selected the appropriate sequence as Charlie's reaction. If the viewer didn't move, the software played the "come closer" sequence, once again, based on Charlie's current mood. When the user left Charlie waved bye-bye, based on his current mood. Charlie's mood changed based on the approach-speed. For instance, if he woke up in an indifferent mood and the viewer approached in a medium pace it changed Charlie's mood from indifferent to happy.

Charlie was presented on an individual screen with a wooden picture frame. Two computers processed the portrait, a PC the vision system face detection, and a Mac for the portrait motion sequences and the interaction control.

Presentation and feedback

Charlie was presented at the Imagina 2004 show, Monaco, Europe.

Since there was an immediate reaction to the viewer, people stayed and played with the portrait. Charlie's reactions amused people and they focused on trying to control Charlie.

Reflection

- The complexity of the interaction made it impossible for viewers to understand in what way their behavior controlled the portrait's reaction. Most people thought Charlie's reaction was random.
- Selecting speed-of-approach as the main variable for the mood change was not effective, since most people just stood in front of the portrait and look at it. It was un-natural for people to accept their approach as interaction.
- Viewers focused on the interaction, sometimes even more than on the portrayed person. As such it became more of a game than a work of art or even a portrait of someone.
- The starting point of this prototype was the technology and not the content or concept. I started with different sensing techniques and created the content around that. I think that an interactive work should come out of a concept and content and use technology to enhance that and not the other way around.
- MAX/MSP/Jitter is a great software for quick prototyping, but you pay a high price in run-time performance. Overall, MAX was too slow to handle the interaction and refresh rates I needed.
- I decided to take a step back and rethink my approach. In my next prototype I wanted to:
    - Maintain my photographic portraiture aesthetics.
    - Go back to simple interaction. Interaction that is connected to the content and is simple for the viewer to understand. For example, proximity, face detection, facial expression detection, gender detection etc.
    - Think more about the viewer expectations from the subject of the portrait and the portrait as a work of art.
    - Return to portraying people instead of using an actor.
    - Change the underlying technology from MAX/MSP/JITTER to Java.

- Several design factors in the prototype enhanced the "object" style of the portrait.
    - David acting out rather than being himself to portray a certain character.
    - Exploratory interaction - the viewer had to explore different behaviors to promote various reactions from the portrait
    - The work was about a creature that lives in an environment rather than the personality of the sitter.

      Since I was not aware at the time of the subject-object framework and was in an exploration stage, some of the design decision made here didn't work well to convey the meaning of the work. For example, focusing on the exploratory interaction could have resulted in a more structured interaction built on giving the right feedbacks to the viewer for him to move forward.

Prototype 3: Moving Portraits II. October 2004
Two portraits on individual screens.
A collaboration with David Gatenby.

Figure 31: Portrait of Gaia, 2004

Figure 32: Portrait of Pattie, 2004

Description

This prototype consisted of two independent portraits. The first portrait was of a 2.5-year-old girl (Gaia), and the second one was of Prof. Pattie Maes. In the first portrait I wanted to show

the girl's character and the way young children are very shy around new people, especially if there is more than one person present. When the viewers looked at the girl's portrait, they saw her covering her face with her hands. If they stood long enough (>5 seconds) the girl "came to life" and slowly removed her hands from her face and looked ahead, at the viewers. If more than one viewer was watching her she quickly hid again behind her hands. If there was only one viewer, and the viewer focused on the girl ("giving her attention"), her expression gradually changed from a protective/suspicious expression to a happy, relaxed, open one.

The second portrait was of Pattie and her family. I wanted to show Pattie on a more personal level, exposing her inner personality, but in all of our previous photo sessions she only revealed her "official" self. The "problem" also made me think about the amount of time we spend with people and that it takes time to get to know people's private life. When a viewer stood in front of Pattie's portrait, nothing happened for some time (10 seconds), and then slowly her family started to join her. First her husband appeared in the portrait and stoos behind her, while her image was static, then her eldest son joined in followed by her younger son. Eventually the family "warmth" around Pattie "defrosted" her from her static state and Pattie's inner personality was revealed to the patient viewer.

Concept

These prototypes were about using technology to extend the portraying of a persona. The content and interaction were designed specifically for the character of the subject. In these portraits I was trying to explore if a gesture or temporal scene (gesture in a movie sequence) revealed more of the sitter's persona and if the specific interaction and sensing technique could engage the viewer with the personas. I chose the interaction to fit the personality trait of the sitter in order to enhance it. In the girl portrait the number of people changed the experience. In the Pattie portrait the length of viewing built a story about the person's personal life.

Design and production

In these prototypes I used the Canon 3ccd high-resolution digital video camera. I brought the equipment, including background and light to the homes of the sitters in order to document them at a comfortable, natural environment for them.

In the girl portrait, I asked her to sit in front of the camera and hide her face. To my cue she opened her hands and looked suspiciously at the camera and then laughed in delight.

In the Pattie portrait I placed Pattie in a chair at the front of the scene and asked her to stay still. On my cue her husband came in and stood behind her, then her eldest son came in and stood next to his dad and last came in the youngest son who also leaned on Pattie's shoulder and made her laugh. I edited this movie in a way that Pattie is actually still (one frame) all along while the rest of the family is active and moving behind her, until her youngest son breaks the ice and her still image dissolves into a live natural smile.

Technical implementation

Both of these portraits are about intimacy. Therefore I decided to use presence and length-of-presence sensing techniques, so the more time passes more is revealed to the viewer and thus a more intimate connection might occur between the viewer and the portrait.

In Pattie's portrait I used an ultrasonic proximity sensor to sense the viewer presence and length-of-time spent in front of the portrait. In Gaia's portrait, in addition to the timing measurement, I wanted to distinguish between one or more viewers. Using a vision system with face-detection algorithms based on the open CV by Intel, we sensed if there were one or more people viewing the portrait.

Since the Max/MSP/Jitter was not a successful choice for the previous portrait, David Gatenby used the Java programming language to control the sensor, vision system, and QuickTime movies.

The face detection software kept looking for faces. Whenever it found one or more faces it sent an event to the Java controller. When there was one face looking at the portrait the software played the movie forward. If the viewer left or looked away, the software immediately reset the movie to the beginning - Gaia covering her face. If the sensor detected two or more faces, the software ran the movie 60 frames forward and then played the sequence backwards to the beginning. The result was Gaia opening her hands a little bit and closes them right back.

The portraits were displayed on 19-inch monitors with a wooden picture frame.

Presentation and feedback

Moving Portraits II was presented at the DIS 2004 conference and was nominated for "Best Design" award.

The interaction was intuitive and therefore did not need explanations. When people stood in front of the portraits they got an immediate reaction and were engaged with the sitters rather than the interaction itself.

Reflection

- The connection between the sitter's personality, the particular gesture, the sensing technique, and the interaction technique - proved to be an essential factor in the success of these interactive portraits. Each individual factor in the design supported the overall concept, which is to expose the inner personality of a persona and engage the viewer with that persona to create an intimate experience.
- Human personality is intriguing and engaging at such a deep level, so it is better to keep the interaction technique as simple as possible, to enable viewers to focus on the persona rather than the interaction.
- Using people in their natural setting rather than an actor (in the case of Charlie), and connecting with the people's true personalities, proved to be much more engaging for viewers.
- I felt I reached my goal of creating an intimate, meaningful experience for viewers, and proceeded to explore the concept of a group portrait, where a group of networked portraits interact with each other, not only with the viewer.
- The Canon video camera produced reasonable results, but I wanted to explore higher resolutions.

Prototype 4: Influence. April 2005

Sixteen networked portraits, projected on one piece of laminated glass.

Collaboration with Sajid Sadi.

Figure 33: Influence, 2005

Description

This prototype consisted of 16 individual portraits of Media Lab students, networked and arranged in a 4x4 layout. The interactive group portrait had two states: (1) in the autonomous state one of the portraits starts to yawn. At some probability, some of the portraits around that yawning portrait will look at the yawning portrait and will get infected by it and will start to yawn too. Each portrait had a predefined threshold level for "catching the yawn virus" from a neighbor portrait. Very soon the yawn spreads through the networked portraits, and eventually all portraits fall asleep. 30 seconds after all the portraits were asleep, they were initialized, and another one randomly started the yawning "virus" again.

Concept

This prototype was my first prototype for a group of networked portraits, and I wanted to visualize a classic network concept. I chose the "social epidemic" concept - how collective behavior emerges from individual decentralized interactions in a small social group. Individual people are unconsciously influenced by their peers, and in turn, they influence the people around them, and so on, until the whole social group is "infected".

We are all unique individuals. There are no two people alike. Nevertheless, we have no control over the influence of people around us, we all affect each other's behavior, if we like it or not.

Design and production

I conducted a search for the best camera for the job. Commercial video cameras went up to 720x420 dpi resolution, which was not enough for my needs. Digital SLR cameras could not grab too many frames in one burst. I decided to use a custom camera board made by Point Grey Research® Inc. (PGR). PGR developed advanced digital camera modules. Their cameras modules came with an open API, and the camera was operated by a PC computer through a firewire connection. I worked with PGR's DragonFly camera module that grabs black & white images at a rate of 15 fps in a resolution of 1024x768. The camera produced an AVI RAW movie.

In the production of this portrait, I asked the sitters to look at the camera, yawn, look in 8 different directions around them, and then fall asleep. Then I key-framed the sequence and separated it in ten clips, which made is easier to control by the Java runtime software.

Technical implementation

Prototype 4 (Influence) is a system of 16 portrait agents that operate as a distributed master-slave cluster over TCP/IP. Each portrait agent consists of a set of nine gestures, each gesture a sequence of 40 photographic-quality black-and-white frames, packaged as a QuickTime movie.

There are 16 LCD screens operated by 3 PC computers, each with several graphics cards. Each portrait agent is able to communicate with the others and display a portrait clip on the appropriate LCD screen. At startup, one agent is arbitrarily designated as the master, and all slave nodes are directed to connect to the master node to form the array. Once connected, each agent declares its configuration. The agents exist on the server only, but are synchronized with their respective portraits over the network. This design simplifies the communication between nodes, while retaining synchronous, millisecond scale control over the video playback.

Presentation and feedback

Influence was presented at the Art Interactive Gallery (Cambridge MA) and at the Cyber Arts Festival (Cambridge MA) as part of the Collision 7 group show, 2005.

In both events the group portrait was presented in a portrait-to-portrait interaction mode, with no user interaction.

When people looked at the portrait at first it looked like nothing was happening. Then all portraits opened their eyes at once, and a randomly assigned portrait agent started yawning. Viewers stayed between 1-5 minutes to observe the whole spread cycle of the "yawning virus". Some viewers continued to observe for several cycles times to try and figure out a pattern, until they realized there is no fixed pattern, rather the group of portraits is simulating a probabilistic, unpredictable spread.

Reflection

- The collective behavior of the group portrait was engaging and created an effect of group dynamics.
- Viewers tended to project their own thoughts and assumptions on the nature of the group dynamics.
- The group dynamics was completely detached from the individual personalities of the sitters, and the result was a more "object" style portrait. As the artist, the interaction technique was another tool for me to use the individual portraits to convey my own artistic message (in this case - our individual behavior is unconsciously influenced by our peers).
- The small size of the group (16 individuals) was not very effective at visualizing a system phenomenon. To make the portrait experience more effective it should be displayed with a group of >50 individual portraits. We have simulated several larger scale group portrait, up to 100 portraits in a 10x10 layout. The visual effect of the "yawning virus" spread was much more effective at that scale.
- In the next prototype I decided to further explore the tension between the "object" style and the "subject" style. The goal was to create a group portrait that highlights the inner personality of the each of the individual sitters, while at the same time convey my artistic message about the individual/collective behavior.
- Several design factors in the prototype enhanced the "object" style of the portrait.
    - The use of many portraits focused the viewer on the group activity more than the personality of the sitters.
    - The spread of the yawn happened in many places at once, which focused the viewers on the spread of the virus rather than the person who is yawning.
    - This prototype was about a message from the artist about group behavior and not about the personality of the sitters
    - The sitters were acting out a script to convey a bigger message.

Prototype 5: Spotlight. October 2005

A group portrait of 16 networked portraits, displayed on 16 individual screens in a 4x4 layout. Collaboration with Sajid Sadi.

Figure 34: spotlight, 2005

Description

Spotlight was my second group portrait - a set of 16 interactive portraits displayed on individual framed screens in a 4x4 layout. Each portrait had a set of 9 "temporal gestures" - photographic-quality sequences of human gestures such as "looking up", "looking to the right", or "being at the center of attention". The portrait agents are networked, and run by several computers.

Every few seconds, a randomly selected portrait is looking towards a randomly selected neighboring portrait. In turn, the neighboring portrait is looking back. Then both portraits stay in that position, of "looking at each other" for a few seconds, until they return to their idle position. To the viewer of the installation, these "looking at each other" events seem like

"discussions" between people who know each other, and create a sense of a group of people, engaged in their "group dynamics". At any time, the viewer can interrupt the group dynamics by selecting one of the 16 portraits. When a portrait is selected, the remaining 15 portraits automatically react and look at the selected portrait. In turn, the selected portrait reacts with a special gesture - "whatever that person feels like when they are the center of attention".

Concept

Spotlight is about an artist's ability to create new collective meaning from individual portraits while keeping a strong connection between the viewer and the individual portrait. The mere placement of two or more portraits near each other is a known technique to create a new meaning in the viewer's mind. Spotlight takes this concept into the interactive domain, creating interactive portraits that are aware of each other's state and gesture. So not only the visual layout, but also the interaction with others creates a new meaning for the viewer. Using a combination of interaction techniques, Spotlight engages the viewer at two levels. At the group level, the viewer influences the portraits' "social dynamics". At the individual level, a portrait's "temporal gestures" expose much about the subject's personality. Spotlight achieved a seamless blending of "subject" and "object" portraiture styles.

Design and production

As my capture device I used the PGR Dragonfly digital camera module. I created a photographic studio in one of the Media Lab rooms, and asked the Media Lab professors (my subjects) to look around in 8 directions, as well as doing whatever they do when they are aware they are the center of attention. I didn't tell the subjects who they were going to look at, in an effort to have their inner personality control their gesture. For the "being at the center of attention" gesture I allowed them to react in any way they wish, to give even more space for their personality to come out.

Technical implementation

Spotlight is a system of 16 portrait agents that operate as a distributed master-slave cluster over TCP/IP. Each portrait agent is a set of nine gestures, each a sequence of 40 photographic-quality black-and-white frames, packaged as a QuickTime movie.

There are 16 LCD screens controlled by a set of PC computers. Each node is able to communicate with the others and display a portrait clip. At startup, one node is arbitrarily designated as the master, and all slave nodes are directed to connect to the master node to form the array. Once connected, each node declares its own configuration. The agents exist on the server only, but are synchronized with their respective portraits over the network. This design simplifies the communication between nodes, while retaining synchronous, millisecond scale control over the video playback.

In idle mode, each agent may randomly choose a neighbor to "converse with." When the user initiates an interaction, the agents all "look" at the agent the user selected. The target agent then plays its gesture action, while at the same time the other agents play a gesture of looking towards the selected agent. The entire array is then reset, and if no further interactions take place, the agents eventually return to the idle "random conversation" mode.

A wall of 16 screens in a 4x4 layout was built for this prototype. Each screen is covered with a black mat.

Presentation and feedback

Spotlight was presented at the "Moda Technologia" fashion show in Milan, Italy, 2005.

Spotlight will also be presented at SIGGRAPH 2006 conference in Boston MA, at the Art Gallery program.

The layout and presentation of the work was an effective way to convey the "group dynamics" message. Viewers were immediately aware of the subtle meaning that emerges from the interaction of the individual portraits. The portrait-to-portrait interaction technique was effective and engaging for people to observe. The user-portrait interaction was effective in getting viewers to be involved in the piece and control the "center of attention" behavior. The choice of a standard button-based remote control gave the viewers a familiar interface with clear limits, so the expectation were set at the right level, and viewers did not try to explore different interactions like waving in front of the portraits.

Reflection

- The presentation of the piece, as 16 individual screens was a very effective way to communicate a group portrait. Each portrait had a presence of its own, and at the same time each portrait had an integral part in the whole.

- Viewers tended to quickly imagine social relationships between portraits, based on subtle cues from the portraits' interactions and facial expressions. For example, when two portraits turned to each other and froze for a few second, viewers easily imagined a discussion between the portraits. In the next cycle, if one of these portraits engaged in another "discussion", viewers assumed s/he was passing a message from the previous portrait to the new one. Also, viewers created assumptions about the relationship between the personas, which ones were more popular etc.
- It was interesting to see the difference of the impact of the work between people who knew the subjects vs. people who didn't. People who knew the subjects engaged first with the character of each portrait, usually comparing them to the real people, and only then paid attention to the group dynamics. People who didn't know the subjects engaged first with the group dynamics, probably using their own group experiences as a reference, and only then paid attention to the individuals.

Prototype 6: Faculty series November 2005
A set of individual portraits, each displayed separately on a single screen.
In collaboration with Sajid Sadi.

Description

Faculty series was a series of Media Lab faculty members' individual portraits. It consisted of 16 individual portraits, each doing the exact same gesture. The viewer was viewing each portrait separately. The dynamic gesture had the potential of bringing out the inner personality of the sitter. The interaction was designed in the same way as with portrait #2 (Portrait of Gaia), based on viewer's presence detection. When no one was looking at the portrait, the portrait was a static frame, showing the sitter in an official pose. When a viewer approached the portrait, the portrait "became alive" and the sitter quickly covered his/her face. Then, the sitter peeked out carefully to "see who is out there". After a few more seconds the sitter became relaxed, and smiled naturally. The interaction and gestures were the same for all portraits, so a series is created that highlights the individual personality of each sitter.

Concept

This prototype is about the subtlety of human character. The dynamic gesture brings out the person's personality in a natural way, and the subtle differences between the different people are more apparent when presented as a series.

Design and production

I used the PGR Dragonfly camera in a studio I have built in the lab. I asked the sitters to do one continuous gesture, starting with "looking ahead" regularly, continuing with "cover you face with your hands", "peek out cautiously", "check who is out there", and then "smile naturally".

Technical implementation

As in the previous portraits, we used Java to control to portraits' movies play back. We used the same face detection system to detect viewers facing the portrait. All the portraits were displayed on a 19" LCD screen mounted in a wooden picture frame.

Presentation and feedback

This work was never properly presented. I did not have the opportunity to set up a series of 16 screens in a line layout, so viewers could experience the portraits one after the other by walking from one to another. As an interim solution, I displayed the portraits on the same screen, with a software-based controller that allows viewers to switch between the 16 portraits.

Prototype 7: Portrait of Cati II. May 2006
Individual portrait on a single screen.
In collaboration with Benjamin D Bau.

Figure 35: Portrait of Cati II, 2006

Description

In "Portrait of Cati II", a young woman named Cati reacted to viewers approaching her portrait. She reacted with a different gesture if the viewer is a man or a woman (based on a custom-made gender detection system).
The name "Portrait of Cati II" is homage to Stefan Agmanolis's interactive portrait, done in 2002, named "Portrait of Cati". A more detailed description of Agmanolis's work, including a personal interview with him about his interactive portrait can be found at the Background & related work section of this thesis.

Concept

In this portrait I wanted to expose different aspects of Cati's personality as I experienced them. Cati has a very feminine appearance, and in my opinion men interpret her appearance differently then a women. When I made this portrait, I wanted to deliberately use both "subject" and "object" styles. On one hand, I wanted to highlight Cati's inner personality, how she is when she is open and relaxed ("subject"). On the other hand, I wanted to use this portrait to convey a more general message, about Women's tendency to behave differently around men than around women, and Men's tendency to view beautiful women as sex symbols ("object").

Design and production

I used the same equipment I used in my previous portraits - the PGR Dragonfly and the studio environment. I asked Cati to act out a seductive gesture and then surprised her with something embarrassingly funny to expose her natural laugh and help her open up, which was the sequence used for the female viewers.

Technical implementation

For this portrait Benjamin D Bau (an undergrad student at MIT who worked with me through MIT's UROP program) created custom-made gender detection. The system used a standard face-detection algorithm to detect faces and then analyzed the face structure to identify if the person is a man or a woman. The system has 80% accuracy, and is based on a learning algorithm that was tuned using 250,000 pictures of people's faces. (Bau, 2006. See appendix for full paper)

Presentation and feedback

Portrait of Cati II was presented in the media lab during spring 2006.

When I presented it to Media Lab visitors, I tried two different approaches to explore the difference in the viewers' experience. For some viewers I explained that the portrait reacts differently for either a man or a woman, while for others I just said it reacts differently to different people without explaining why. I saw that people experience the portrait differently based on my explanation. The people who knew it used a gender-detection system were focused on Cati's reaction, on the subtleties of her gestures, and tried to define her character, and why she reacts in that specific way to men and women. The people who did not know the nature of the detection were more focused on the interaction, trying to get Cati to react in a different way, making different gestures themselves, trying to control her. They missed the opportunity to explore the subtleties in her gesture or her personality.

Reflection

- The different ways I presented the work to viewers made a clear difference in their experience. One experience was not better than the other, but it clearly made a difference. I think these factors should be thoroughly explored to inform artists and designers of the implication of their design decisions. For me it was more important to increase viewers' awareness to Cati's personality rather than to the interaction, so I preferred the more informative presentation where the viewers know the nature of the different reactions.
- The portrait seemed to work as a "subject" portrait - most viewers engaged with Cati's personality immediately and felt connected to her. People who knew Cati said the different reactions were like Cati when they just met her vs. Cati as a close friend.
- The gender-detection system's inaccuracies (it is accurate only 80% of the time) makes viewers react in a very protective way. When viewers are recognized as the wrong gender, they take it very personally and immediately try to fix something in their looks in an effort to make themselves look more feminine/masculine. On the other hand, when viewers are recognized as the right gender, they feel very proud.

EVALUATION

I have designed and conducted two small-sample exploratory studies in an effort to better understand two design factors that in my opinion had a strong influence on the viewer's experience. These factors are: (1) the style of interaction and (2) the viewer's expectations.

Exploratory study one: style of interaction

The first evaluation was about the style of interaction. By "style of interaction" I mean how much control the viewer has in the interactive experience. An interactive work with guided interaction would limit the interaction, giving the viewer very little control, with a clearly defined interaction. An interactive work with exploratory interaction would provide a rich interaction, giving the viewer multiple options to control the work, inviting the viewer to explore different ways to interact with the work.

My hypothesis was that the "guided interaction" (simple, rather obvious interaction) is more appropriate for "subject" style works where the goal is to create engagement between the viewer and the sitter's personality, while "exploratory interaction" (a rich, less obvious interaction) is less appropriate for such works. I based this hypothesis on my experience with my early prototypes. For example, the "Charlie" prototype (prototype 2) had exploratory interaction, giving viewers many ways of controlling the portraits' reaction. The viewer's presence triggered one reaction; the viewer's speed of approach to the portrait triggered another reaction; if the viewer pointed up, down, or to the sides, different reactions were triggered. After people interacted with the "Charlie" portrait, many had ideas for new types of interaction I should implement and new ways for the portrait to react. Only rarely did people related to Charlie's personality. On the other hand, I designed "Moving Portraits II" portraits (prototype 3) to have very limited interaction, using the viewer's presence as the only way to control a portrait's reaction. After people interacted with the "Moving Portraits II" portraits, many related to the portrayed personalities, and rarely have people suggested ideas for new interaction techniques.

To further explore this observation, I have designed a rather informal evaluation around portrait 7 - "portrait of Cati II". Portrait 7 involves gender-detection as its interaction technique: the portrait reacts with a different gesture if the viewer is a man or a woman, based on a custom-made gender detection algorithm. The informal evaluation was conducted with 20 Media Lab visitors. I used two different methods to introduce the portrait to each of the viewers. For half of the viewers ("group A", about 10 people) I introduced the work as a portrait that reacts with a different gesture for a man or a woman. For the other half ("group

B", also about 10 people) I introduced the work as a portrait that reacts differently to different people, without specifying how the different gestures are being triggered.

When people from group A (the ones that know about the gender detection) experienced portrait 7, they were more focused on the portrayed woman's reaction, on the subtleties of her gestures. After viewing the portrait the viewers were discussing her personality, trying to define her character, and contemplating why she reacts in that specific way to men and in a separate way to women.
When people from group B (the ones that did not know about the gender detection) experienced portrait 7, they were more focused on the interaction, trying to get the portrayed woman to react in a different gesture than the one they saw initially. Viewers tried to make different facial expressions in an effort to trigger a new gesture, some even tried to wave their hands.

My evaluation was very informal and based on a small sample; nevertheless the informal results are surprising. There was a clear difference in viewers' reaction between the different introduction methods. Viewers from group A seized the opportunity to explore the portrayed personality, creating a rather personal connection between themselves and the portrait. Viewers from group B missed the opportunity to explore the subtleties in the portrayed personality and focused on exploring the interaction itself.

My informal findings confirmed my hypothesis. A "guided interaction" helps the viewer ignore the interaction and focus on the subtleties of the portrayed personality. "Exploratory interaction" promotes focus on the interaction as a novel experience, promoting experimentation rather than deep observation, taking the focus away from the subtleties of the portrayed personality.
Clearly, my findings are informal and based on an exploratory, small-sample study. A more comprehensive study should be conducted to further explore this direction.

Exploratory study two: viewer's expectations

The second evaluation was about designing the viewer's expectations. I wanted to evaluate how visual expectations influence the relationship formed between a viewer and the subject in an interactive portrait. In what way the viewer's initial visual experience influences his/her expectations of the interactive experience?

For that purpose, I designed two portrait experiences. Portrait A: a viewer sees a still photograph of a woman, placed in a picture frame. When the viewer approaches the frame, the portrait "becomes alive" and the woman makes a gesture. Portrait B: a viewer sees a black screen placed inside a picture frame. When the viewer approaches the frame, a portrait of a woman suddenly appears, and the woman makes a gesture. The two portrait experiences are completely identical, except for the initial frame. In Portrait A the frame is the first frame of the women's gesture, while in Portrait B the frame is black.

I conducted the exploratory evaluation with 10 individual viewers. The viewers were members of the MIT community that have never seen any of my portraits before. I asked the viewers to approach the picture frame slowly while observing it, stop right before the picture frame, and observe it until it's done. The viewers did not know what was going to happen, how long it would take or what it was about. Five viewers saw Portrait A, with the woman's still image as the first frame, and the other five viewers saw Portrait B, with the black screen as the first frame. The woman's gesture was identical in both portraits, the only difference was the first static frame (woman's still frame in A, a black frame in B). After the portrait experience was done, I asked the viewers to fill out a short questionnaire. The questionnaire was designed to promote self-expression and reflections on the portrait experience. The questionnaire was identical for both portrait experiences (A and B).

My hypothesis was that portrait A, with the woman's static frame, would create a deeper connection between the viewer and the subject in the portrait, because the viewer develops expectations of a human portrait while approaching the picture frame, and has time to look at the woman and observe her. Then when the moving gesture starts, the viewer of portrait A receives more information on the woman through her gesture, which deepens the connection and ultimately creates an intimate, more "subject style" portrait experience. I thought that Portrait B, with the black frame, would create a connection between the viewer and the portrait technology or concept in general, rather than the specific subject in that particular portrait experience. I assumed viewers of Portrait B would focus more on the interaction itself and interactive portrait concept, because they do not develop any specific expectations while they approach the portrait. They see a black picture in a picture frame, they are not sure if it is a portrait, a landscape picture, maybe a new concept for TV screens, or a live camera feed. When viewers of portrait B see the moving gesture, they are surprised; they do not necessarily focus on the portrayed woman, but rather on their control over the experience, the point when they triggered it.

The study's participant's gender distribution was 60% Females and 40% Males, three females and 2 males for each of the portrait experiences. In table 1 below I present the gender distribution using coded names for the viewers: A.F1 means portrait experience A, Female viewer number 1. In the same way B.M2 means portrait experience B, Male viewer number 2. Later on when I detail my observations, I will use these coded names to present quotes from the questionnaire the viewers filled out.

Portrait A Woman's frame condition	A.F1, A.F2, A.F3 A.M4, A.M5
Portrait B Black frame condition	B.F1, B.F2, B.F3 B.M4, B.M5

Table 1: The participant's gender distribution

Table 2 below lists the nine questions in the questionnaire the viewers filled out immediately after the portrait experience:

1. What are your thoughts about the experience you just had? (Please try to write at least 2 paragraphs).
2. How long did you look at the portrait?
3. What did you think was going to happen when you approached the portrait?
4. What was the mood of the woman in the portrait?
5. Why do you think the woman in the portrait reacted the way she did?
6. Do you feel you "know" this person from the portrait?
7. Can you write a short paragraph about the women's personality?
8. Was there something you expected the portrait to do and it didn't do?
9. Do you have any other comments you want to share?

Table 2: The study's questionnaire

Below are the answers each of the 10 participants gave to questions 1 and question 7.

Portrait A viewers' answers to the 1st question:

"What are your thoughts about the experience you just had?"

A.F1: "I did not know what to expect when I came here - only that I would be seeing something on a screen. I did not expect to view a photograph - and one that moved, moreover! The

photo first looked like simply that - a photo of a young woman. I was surprised when it began to move - and it was actually a short video activated by my own movement"

A.F2: "My first impression was feeling surprised and amazed at the first glance of this picture frame. Later that I realized it was not just a picture but it actually moved, it was much more interesting and made me more curious to observe. It actually reflects a lot of emotion. Made me wonder what this girl was doing. I figured she was shy and even made me feel a little shy for a moment. It definitely left me with a bunch of questions in my mind. Like: Maybe she was subject like me? or Why is she shy? It was definitely a very moving short experience."

A.F3: "it was interesting...i was expecting the level of lighting to change...i was not expecting to be watching a giggling woman on the wall--i wondered who she was and what she was going to start doing...but she didn't do anything very interesting except giggle...she reminded me of myself when someone tells me to 'pose' for the camera or says, 'say something in the video camera!' and i feel really shy or silly about it."

A.M4: "This is an experience which I have never experienced before. Usually, the portraits that I look/glance at are stills which show one mood that the photographer had captured or is trying to portray to the audience. However, this portrait was different as it involved movement. The portrait tried to connect and show affection with the individual standing before it by her head movement, eye contact, little hand gestures, and facial expressions."

A.M5: "You expect a picture to be static, and suddenly the person moves. At first you think it's just a twitch, but then it becomes a more sustained and interactive movement. You wonder whether she's programmed to do the same routine with all viewers, or if something you're doing is eliciting a particular response from her. It's also not completely clear whether she's repeating behavior on a loop, or if the whole protocol is a series of unique steps. In other words, you're not quite sure when the experiment is over. (I turned round and asked, is she done). Then, when she becomes static, it's clear she's done. She seems very seductive. The facial language is flirtatious, and the blouse off the shoulders compounds the effect. Is something I'm doing eliciting this seductive behavior, or is this the way she is with everyone? And why does she look a little familiar?"

Portrait B viewers' answers to the 1st question:
"What are your thoughts about the experience you just had?"

B.F1: "I'm not sure if there is something in the system that responds to me. Am I being filmed here? Is there a computer connecting the image on the screen and my own expressions? I felt a little self-conscious looking at the image. I was tempted to experiment with my own expressions to see if I could see a connection between what I did and what the image did."

B.F2: "It was a positive experience and the photography subject seemed happy, yet a little uncomfortable. It was neat to have an interactive photography and I know personally I would value having one of a family member who lives quite a distance away or for a loved one who passed away. It makes it more personal and you feel more of a connection with the subject and it is more meaningful if you have a personal, close relationship with the subject as you can draw from personal memories and experiences to get more of a feeling than from still photographs...at first the portrait was blank and black and I was unsure. Once it came on I was not sure if the subject was going to speak to me. After initial experience I began to wonder if she was going to react to my facial expressions."

B.F3: "I expected that I would see something gradually appear and was surprised when the woman all of the sudden appeared. I thought the woman was a happy person and her happiness made me smile and laugh a little. Watching her react to something that seemed to make her happy made me feel happy too. It was almost as if her happiness was contagious. At the very least she was smiling a lot, which also made me smile too. I think that I laughed because she was making funny looks as she was smiling--almost in a mischievous way. This doesn't come as a surprise to me; people who look directly at me/make eye contact with me and smile almost always receive a smile back--it's almost a reflex."

B.M4: "I didn't experience any strong emotions as I watched this sequence. I was trying to carefully observe the image and remember what I saw so that I'd be able to answer questions afterwards. The person in the image was an attractive, young woman. I noticed that her hair was long and dark, and that she was white skinned. In the initial frame she was looking off to her right. She made intermittent eye contact with the camera. Something seemed to amuse her. When she smiled or laughed she dropped eye contact. There was something about the way she was acting that seemed to me to be kind of flirtatious. She was wearing some sort of loose fitting garment, which at the end of the sequence she seemed to be trying to get more firmly back on her shoulders. In the final frames she was making direct eye contact with the camera,

and was not smiling. This image was in black and white. The person was framed from about the shoulders up. The lighting looked like studio, rather than natural or room lighting."

B.M5: "The video shown on the picture frame is not something I have expected. I noticed that there was a camera under the picture frame, so I assumed that the video shown is likely of another test subject much like myself. I am actually somewhat confused by what I am supposed to respond to the video. Perhaps I am supposed to react the way the person in the video did, or perhaps that person was just over-reacting to whatever she was watching. Overall, the video seems too short for me to conclude much from. There is basically just a face of a person laughing (while trying not to)... It was somewhat interesting I suppose, to be seeing a video in a picture frame, certainly not something I was expecting... I was expecting something like a slideshow I suppose. I also noticed the camera under the portrait, so I thought it may just be a streaming video of myself in there."

Portrait A viewers' answers to the 7th question:
"Can you write a short paragraph about the women's personality?"

A.F1: "I don't really know her, but at that moment she seemed happy. She reminded me of someone I know who is happy when you talk to her but I think actually in most of her life she is depressed."

A.F2: "This person is a young sweet and shy personality. She reflects certain 'womanhood' in which women are sometimes considered 'sweet' and 'shy'."

A.F3: "Happy reserved doesn't tell people a lot about herself unless they get to know her she doesn't think she is gorgeous but she thinks she is decently attractive. She seems like she's into the arts--maybe writing books/poetry/playing the guitar at a coffee shop"

A.M4: "Based on the portrait and what I have observed, I think the woman's personality is friendly, caring, and genuine. The way her head swayed, made eye contact, and hand gestures felt that she was showing her true feelings for someone that she cared for or is fond of. She was definitely giving off more than a friendly vibe that someone would show to another when meeting for the first time."

A.M5: "A little narcissistic (she knows she's attractive, but is also insecure and needs reassurance). Outgoing. A party girl, but a slightly unstable one."

Portrait B viewers' answers to the 7th question:
"Can you write a short paragraph about the women's personality?"

B.F1: "She is shy, sensitive, low key"

B.F2: "The woman seems happy with her current situation. She appeared at first appearance to be laughing at a private joke or situation. As time elapsed I felt she was beginning to feel uncomfortable with the sitting and unsure of how to react or respond. As more time progressed and she was the center of attention she appeared to be more uncomfortable and adjusting her clothing by pulling her shirt over her shoulders. She seems slightly shy as she did not maintain eye contact and kept looking away and laughing as in discomfort."

B.F3: "I think the woman's personality is outgoing. Since she was constantly smiling and laughing, I think that she is one that connects well with people. In other words, based on what I saw, she looked like a nice person (since she was smiling and laughing) and is thus probably well-liked by people in general."

B.M4: "The woman in the picture is shy, reticent, but basically confident in her own powers. She is pleasant to be around - not the sort of person to start an argument. She likes to be entertained and is somewhat flirtatious. She is very intelligent and creative, but not sure what she wants to do with those traits. She likes music and other artistic expression. Though she is neither a musician or an artist at present, she is considering exploring those avenues."

B.M5: "She seems to be an optimistic person, or perhaps just someone who gets excited easily. She is likely the type who laughs or is happy all the time."

Summary of findings - viewer's expectations study

Looking at the answers the study participants' filled in, there are clear differences in the type of connection created between the viewers and the subject.

Here are some of the differences in the answers to the 1st questions:

> Portrait A viewers used sentences that reflect a special connection with the subject, a deeper, more intimate connection:
>
> "It actually reflects a lot of emotion"

"It was definitely a very moving short experience"
"The portrait tried to connect and show affection"
"She seems very seductive. The facial language is flirtatious, and the blouse off the shoulders compounds the effect... and why does she look a little familiar?"

While Portrait B viewers used sentences that showed interest in the concept of an interactive portrait rather than the specific subject in the portrait, as well as puzzle about the nature of the interaction and their wish to further explore it.

"Is there a computer connecting the image on the screen and my own expressions?... I was tempted to experiment with my own expressions to see if I could see a connection between what I did and what the image did"
"It was neat to have an interactive photography and I know personally I would value having one of a family member who lives quite a distance away or for a loved one who passed away"
"After initial experience I began to wonder if she was going to react to my facial expressions"
"I didn't experience any strong emotions as I watched this sequence."
"This image was in black and white. The person was framed from about the shoulders up. The lighting looked like studio, rather than natural or room lighting."
"Overall, the video seems too short for me to conclude much from. There is basically just a face of a person laughing (while trying not to)..."

Here are some of the differences in the answers to the 7th questions:

When Portrait A viewers described the subject's personality, they went beyond the surface features (happy, shy, uncomfortable etc.):

"She reminded me of someone I know who is happy when you talk to her but I think actually in most of her life she is depressed."
"She reflects certain 'womanhood' in which women are sometimes considered 'sweet' and 'shy'."
"...she doesn't think she is gorgeous but she thinks she is decently attractive."
"...friendly, caring, and genuine. The way her head swayed, made eye contact, and hand gestures felt that she was showing her true feelings for someone that she cared for or is fond of."

"she knows she's attractive, but is also insecure and needs reassurance"

When Portrait B viewers described the subject's personality they rarely reached beyong the surface features:

"She is shy, sensitive, low key"
"The woman seems happy with her current situation... She seems slightly shy as she did not maintain eye contact and kept looking away and laughing as in discomfort."
"she looked like a nice person (since she was smiling and laughing) and is thus probably well-liked by people in general."
"She is likely the type who laughs or is happy all the time."

There was one exception with viewer B.M4, who reached a little deeper than the others: "The woman in the picture is shy, reticent, but basically confident in her own powers...she is very intelligent and creative, but not sure what she wants to do with those traits."

Evaluation Summary

In the evaluation chapter I have described the two exploratory studies I have conducted, the "Style of interaction" informal study, and the "viewer's expectations" study. My observations and findings show that designing the style interaction and the viewer's expectation are important design factors that clearly influence the way viewers experience an interactive portrait.

In the "Style of interaction" study I have shown that "guided interaction" (simple, rather obvious interaction) is more appropriate for works that strive to focus on engaging the viewer with the sitter's personality, while "exploratory interaction" (a rich, more exploratory, less obvious interaction) promotes investigation and exploration and is less appropriate for "subject" style interaction.

In the "viewer's expectations" study I showed that setting clear expectations for the viewer prior to the interaction is a key factor that influences the way viewers experience the work. I demonstrated that an interactive portrait with "explicit visual expectations" (such as the static portrait frame) would increase the chances that viewers create a meaningful connection with a portrait's sitter, leading to a more "subject style" portrait experience. While an interactive portrait with "obscure visual expectations" (such as the black screen) decreases the chances

that viewers create a meaningful connection with the portrait's subject, leading to a more "object style" portrait experience.

My findings are based on exploratory studies with a small sample size, and many factors could bias the results. Nevertheless, these observations can inform designers and artists that create interactive portraiture experiences to better achieve their artistic goal. Future studies should be conducted to explore these design factors further.

In the next section I present my design guidelines for the design of interactive portraiture, with special focus on factors that influence the "Subject-Object" style of a portrait.

DESIGN GUIDELINES

In this chapter I will lay out my design guidelines for the development of interactive portraiture experience. I developed these guidelines in an effort to inform designers and artists who work in the field of interactive portraiture how different design decisions influence the viewer experience, sometimes in unexpected ways. The guidelines do not cover all aspects of designing interactive portraiture, but rather focus on design factors that influence the intimacy of an interactive experience, ones that can influence the "subject-ness" or the "object-ness" of an interactive portrait. In addition, the guidelines are limited to design factors I have dealt with in my design process.

The design guidelines are designed with interactive portraits in mind, but can be applied to the design of interactive experiences in general.

Design Guideline 1: **Content, Media, and Presentation**

The content and media of any artistic expression are subjective, resting with the particular desires and goals of the particular artist. Interactive expression is no different. Therefore in this section, I select two guidelines that are particularly relevant to my own interactive work and that I feel can be applied by other artists to their work.

Guideline 1.1: **"Being yourself Vs. Acting out"**

When filming a subject, a portraiture artist faces several key design decisions. One of them is the way the subject behaves in front of the camera. Some portraits bring out the inner personality of the subject, a "being yourself" portrait, while others are portraying people as actors, either "acting out" a gesture or scene, or playing a directed role.

Most people can not "be themselves" in front of a camera. Artists that want to surface the inner personality of their subjects have to make a conscious effort to help them "open up", loose their "masks", and unwillingly expose their fragile side.

Richard Avedon was a master of this technique, and used to ask his subjects very personal questions in an unexpected way to surprise them and help them open up. Then he quickly captured their expressions on film. Andy Warhol used a different technique in his Screen Tests project; he positioned people in front of a video camera for three minutes and asked them not to move or even blink for the whole time. Something in that technique caused people to face themselves, and for many of the subjects it surfaced their inner personality in a very honest way.

Designers/Artists of interactive portraits need to make a conscious decision what type of portrait they want to create. If it is a "being yourself" portrait, they must prepare a technique to help their subjects open up. If it is an "acting out" portrait, they must plan the act. If an artist does not prepare a technique ahead of time, subjects will probably "act out" a representation of themselves, hiding their fragile side.

Both types of portraits can create an intimate experience; it all depends on the artist's meaning and the conscious planning. For example in Gary Hill's Tall Ships the subjects are acting out a carefully planned scenario. They walk back and forth, away from the viewer and back closer to the viewer. The effect of a series of subjects acting the exact same scene brings out the subtle differences between them and creates a very powerful and moving experience.

Guideline 1.2: **"Visual Information: Minimal Vs. Rich"**
The visual information in a portrait can be minimal or rich. "Minimal" would be a portrait that minimizes all visual information except the subject, for example using solid-color background or black-and-white photography. Minimizing visual information helps the viewers focus on the subject. "Rich" would be a portrait that adds additional visual information on top of the subject, such as color, moving items in the background etc. A "Rich" interactive portrait can create a visually engaging experience, but runs the risk that viewers will pay too much attention to the background and less attention to the subtleties in the subject's expressions and gestures.

Andy Warhol's Screen Tests can serve as an example for "Minimal" visual information portrait work. Warhol placed a neutral paper-based background behind his subjects, and the composition was a close-up of the subject's face.

Bill Viola's The Greeting can serve as an example for "Rich" visual information work. Viola portrayed a brief social exchange between three subjects-actors. Inspired by Pontormo's painting The Visitation (1528-29), Viola's subjects are filmed in long-shot style, dressed with costumes inspired by the painting. To enable viewers to focus their attention, Viola leveraged his famous styled, using high-speed camera to prolong the social interaction moment. The work surfaces the subjects' body language rather than their facial expressions.

Figure 36: Bill Viola's "The Greeting", 1995

Design Guideline 2: **Design the style of interaction**

The style of interaction in an interactive experience can strongly influence the viewer's actual experience. Some works can have a guided interaction, where the user is directed with limited control over the portrait's reaction. Other works can have an exploratory interaction, where the user can explore a variety of ways to control the portrait's reaction.

For example, the "Charlie" prototype (prototype 2) had an exploratory interaction style, giving viewers many ways of controlling the portrait's reaction. The viewer's presence triggered one reaction; the viewer's speed of approach to the portrait triggered another reaction; if the viewer pointed up, down, or to the sides, different reactions were triggered. After people interacted with the "Charlie" portrait, many had ideas for new types of interaction I should implement and new ways for the portrait to react. Rarely have people related to Charlie's personality. On the other hand, the "Moving Portraits II" portraits (prototype 3) had "guided interaction" style, with limited viewer's control over the portrait's reaction: the viewer's presence triggered the moving portrait. After people interacted with the "Moving Portraits II" portraits, many related to the portrayed personalities, and rarely have people suggested ideas for new interaction techniques.

In my evaluation section I reported on an informal study I have conducted to learn more about the "style of interaction" design factor, using an interactive portrait with gender-detection interaction technique. My findings informed me that "Guided Interaction" style helps the viewer ignore the interaction technique and promote focus on the subtleties of the portrayed

personality, while an "Exploratory Interaction" style promotes focus on the interaction itself as a novel experience, promoting experimentation rather than deep observation, taking the focus away from the subtleties of the portrayed personality.

Guideline 2.1: **"Guided Interaction"**

An interactive work with Guided Interaction is one with simple, limited, rather obvious control over the portrait's reaction. To design a Guided Interaction work one must limit the interaction, giving the viewer very little control, with a clearly defined interaction limits. Guided Interaction works allow viewers to focus their attention on the experience rather than the interaction itself. In an interactive portrait experience, Guided Interaction design helps the viewer ignore the interaction technique and promote focus on the subtleties of the portrayed personality, promoting a "Subject" style experience. In a general interactive experience, Guided Interaction design has a better chance to create an intimate experience for the viewers, because the viewer is not distracted by the interaction itself.

Luc Courchesne's "Portrait one" can serve as an example for interactive portrait work with Guided Interaction. At every session, the viewers only interaction is to choose one of three available questions for the portrait to react to, then the viewer watch the portrait's answer.

Guideline 2.2: **"Exploratory Interaction"**

An interactive work with Exploratory Interaction design is one that gives viewers a variety of ways to control the portrait's reaction.

To design an Exploratory Interaction work one must provide a multifaceted interaction, giving the viewer multiple options to control the work, inviting the viewer to explore different ways to interact with the work. Exploratory Interaction directs viewer's attention to the interaction itself, promoting investigation, exploration, and experimentation. These types of works promote playful experiences and might increase engagement in longer experiences, but for intimate experiences, Exploratory Interaction might not be the appropriate technique.

Stefan Agamanolis's "portrait of Cati" can serve as an example for exploratory interaction. When a viewer approach the portrait, a random gesture is selected and displayed, so the user is encouraged to explore additional gestures by re-approaching the portrait. In addition, when a gesture is selected, the viewer's distance is mapped to the movie's progress (as the viewer approach the movie progress), encouraging viewers to "play" with the portrait's gesture by moving back-and-forth.

Design Guideline 3: **Frame the viewer's visual expectations**

The viewer's expectations about an interactive experience can strongly influence the viewer's actual experience. The factors that influence the viewers' expectations vary. It starts with the prior information the viewer has about the work, such as the name of the work or previous works of that artist. It continues with the environment the work is presented at, the location, the space, the lighting, and the ambient sound/noise. Finally, and maybe the most influential factor, is the visual expectations - what viewers see when they approach the work.

Some works can have "Explicit Visual Expectations", where the viewer's expectations are quickly set by an explicit visual experience, such as an image with relevant content. Other works can have "Obscure Visual Expectations", where the viewer's expectation are not set by specific visual experience. In that case, the viewer can expect anything from the interactive experience, no image/sound/movie or other information explicitly sets the expectations. IN "Obscure Visual Expectations" works viewer will probably develop some expectations from the environment surrounding the interactive experience.

In my evaluation I reported on an exploratory study I conducted to learn more how framing the viewer's expectations can influence the viewer's experience. I designed one interactive portrait that started with a static frame of a woman, and another portrait that started with a black frame. In both portraits the interaction and content was identical, when the viewers reached the portrait they saw a short movie of the woman making a gesture. The findings were surprising. The viewers that saw the black frame when they approached the portrait did not define the experience as an emotional one, and were able to describe the woman's personality using surface features only. In contrary, the viewers that saw the woman's first frame when they approached the portrait did define the experience as an emotional one, and were able to describe the woman's personality in a deeper way (for more details and excerpts from viewer's remarks see the evaluation section).

Guideline 3.1: **"Explicit Visual Expectations"**

An interactive work designed with Explicit Visual Expectations is a work that presents the essence of the experience up front, in a way that the viewer can start thinking about it while approaching the work, before the interaction occurs. Design with Explicit Visual Expectations helps the viewers know what to expect. There can be surprises, but they should extend the current expectations rather than create a totally new, unexpected experience. In my opinion, design with Explicit Expectation has a better chance to create an intimate experience for the viewers, because the viewers have time connect with the work while they approach it. In an

interactive portrait experience, Explicit Visual Expectations encourage focus on the subtleties of the portrayed personality, promoting a "Subject" style experience.

Gary Hill's "Tall Ships" can serve as an example for interactive work with Explicit Visual Expectations. When viewers enter the dark corridor they see the projected portraits walking back-and-forth. The viewer is free to choose a person to approach to, and while approaching there is plenty of time to observe the portrayed person, learn more about it from it's walking style and appearance, forming an ephemeral relationship between them.

Guideline 3.2: **"Obscure Visual Expectations"**
An interactive work designed with Obscure Visual Expectations is a work that does not present any clues about the essence of the experience while viewers approach the work. The essence of the experience is revealed only after the viewer interacts with the work. Design with Obscure Visual Expectations surprises the user, and the artist/designer has limited control over the expectations viewer develop about the work. While the viewers approach the work they can think about anything and expect for anything. In my opinion, design with Obscure Visual Expectations has a lower chance to create an intimate experience for the viewers. It can be useful for non-intimate works.

Rafael Lozano-Hemmer's "Under Scan" can serve as an example for interactive work with Obscure Visual Expectations. When viewers approach the city square and step into the projection space, they suddenly see a random portrait projected inside their shadow. The projected portrait is selected in random, and the viewers have no opportunity to create a relationship with the portrait while approaching it.

CONCLUSION

In this Thesis I have thoroughly explored the interactive portraiture field. I have presented the theoretical framework for my work: the "subject-object continuum" in portraiture art, and demonstrated that the framework is relevant for photography portraiture, video portraiture, and interactive portraiture.

I described my iterative design process, presenting and reflecting on the interactive portrait prototypes I have created throughout my Masters research. I have highlighted the design factors that seemed meaningful to the viewer's experience, and explored these factors using various prototypes.

I reported on two studies I conducted to further explore two design factors, the "style of interaction" and the "viewer's expectations". I summarized the findings from these studies, including many quotes from the study's participants. My findings suggest that designing the style of interaction and framing the viewer's expectations are important design factors that clearly influence the way viewers experience an interactive portrait. I have shown that "guided interaction" (simple, rather obvious interaction) is more appropriate for works that strive to focus on engaging the viewer with the sitter's personality (a "subject" style), while "exploratory interaction" (a rich, less obvious interaction) promotes investigation and exploration and is less appropriate for "subject" style works. In addition, I have demonstrated that an interactive portrait with "explicit visual expectations" increases the chances that viewers create a meaningful connection with a portrait's sitter, leading to a more "subject style" portrait or "intimate" interactive experiences. In a similar way, an interactive portrait with "obscure visual expectations" decreases the chances that viewers create a meaningful connection with the portrait's subject, and therefore is less appropriate for "subject" style portraits or "intimate" interactive experiences.

I framed my observations into a set of design guidelines. I developed these guidelines in an effort to inform designers and artists who work in the field of interactive portraiture, how different design decisions influence the viewer experience, sometimes in unexpected ways. Designers and artists follow (or consciously break) design guidelines when creating visual experiences. For example, photographers train themselves to understand how light and composition impact the viewing experience of their portraits. In this Thesis I presented three design guidelines for interactive portraiture: (1) Designing the Content, Media, and Presentation; (2) Designing the style of interaction; and (3) Framing the viewer's expectations. These design guidelines are designed with interactive portraits in mind, but can be applied to the design of interactive experiences in general.

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A Machine Vision System for Interactive Portraits

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Abstract

This paper presents a new system for the real-time identification of gender from a person's face that achieves 80% accuracy. It further presents an application for this system, interactive portraits, where the image displayed changes based on its viewers.

Key words: gender-recognition, pattern-recognition, interactive-portraits, machine-vision, machine-learning.

1. Introduction:

This paper describes the development of a new method for identifying a person's gender from his/her face and how this technique can be applied to enhance a common form of art, the photographic portrait. The picture in the interactive portrait "behaves" differently when the viewer is observed to be female than when the viewer is observed to be male. The key to making this form of artwork interactive, and the focus of this paper, is enabling the computer to observe the portrait's audience so that the portrait can exhibit a range of meaningful behaviors.

The system is composed of three parts: (1) identifying and obtaining images of the faces of the viewers; (2) creating a real-time pattern-recognition system via machine-learning to identify the gender of the viewer's faces; and (3) using this information as an input to a rule based system that determines how the portrait will react to its viewers.

The first part, obtaining images of the faces of the viewers, is accomplished via simple modifications to the Intel OpenCV project's face detection/tracking system (Intel Open Source Computer Vision Library). The main component of this research consists of the second part, the design and development of a classifier system that, when given an image of the viewer's face, accurately determines his/her gender with a high degree of accuracy in real time. The final component of this system consists of sending the information collected on the viewer to a rule-based system that determines how the portrait responds.

The gender classifier presented in this paper achieves a high-degree of accuracy, better than 80%, while still maintaining the capacity to do several classifications per second. Ultimately, the machine vision techniques developed for this gender classifier may be extendable to classifications of age, ethnicity, or facial expression. Furthermore, using the architecture developed and presented, it may even be feasible to do several of these classifications at once.

2. Previous Work:

2.1 Previous Work on Gender Classification of Faces:

Techniques for the gender classification of faces fall into two broad categories. The first category attempts gender recognition using a series of measurements of easily identifiable features such as the facial shape, jaw, lips, nose, eyes, etc... An example of this more intuitive method is described in the paper "A Comparison of the Gender Differentiation Capability between Facial Parts" (Kawano et al. 2004). This research discovered that comparing measurements of the facial shape and the jaw to those of an average/template face produced a good gender classifier. However, a weakness in this study was that the images used to create and test the classifier were front-facing, expression-less males and females of the same ethnicity that were pre-processed to achieve a high-degree of normalization (i.e. all faces are exactly upright). Moreover, the time to identify and measure specific facial parts becomes prohibitive for a real-time application. Even if this method could be easily expanded to meet our needs, a fast gender-classifier that works well across ethnicities and facial expressions and can handle some degree of head-tilting, this strategy has traditionally performed worse than the second method of gender-detection.

This second category of gender classifiers consists of those that seek to select the relevant features automatically. This category has succeeded in achieving lower error rates than when humans try to select the relevant features themselves. Exemplary of this category of gender classifiers is the classifier described in "Learning Gender with Support Faces" (Moghaddam and Yang, 2002). This paper describes how a support vector machine (SVM) can be trained to detect a face's gender with error rates as low as 3.4% simply by being fed faces that were pre-processed to eliminate differences in position, size, and angle (head tilt). In short, under this method, what

to look at is chosen without regard to traditionally identifiable features. However, SVM's are slower than many other classifier methods, and, for real-time purposes, we do not have the time to do the necessary normalization of faces.

"Real-time Gender Classification" (Wu et al. 2003) outlines another method of the second category that is closer in nature to the one that we developed. Ultimately, the technique outlined in that paper produced 80% accuracy on video. Given a face, the gender classifier, like the SVM, selected which features of the face to look at rather than having them selected for it by a human. However, instead of support vector machines, this group used classifier cascades (Wu et al. 2003). An example of how this cascade might work is that one takes an input and at each stage the classifier "guesses" whether the input is positive (female) or negative (male). If the result for that stage is negative then "male" is returned (the face is "definitely" not female). If the result is positive, then the input continues to the next stage where the process repeats itself. At the final stage, if the result is still positive, female is returned as the answer. Interestingly, the gender classifier produced by this method performed better on video, where it viewed the average of multiple frames, than it did on individual frames (images). As we too were interested in real-time gender detection from video, the method developed is inspired by the one used in "Real-time Gender Classification" (Wu et al. 2003).

2.2 Previous Work on Face Detection:

Rather than developing our own face-detector for the web-cam's live-video, this project relied on the work available in the open-source Intel OpenCV library (Intel Open Source Computer Vision Library). This library includes facedetect.c, which uses a classifier cascade (same idea as the architecture described for "Real-time Gender Classification" (Wu et al. 2003))

to identify whether there is a face in an image and, if so, gives the dimensions of a square encapsulating the face.

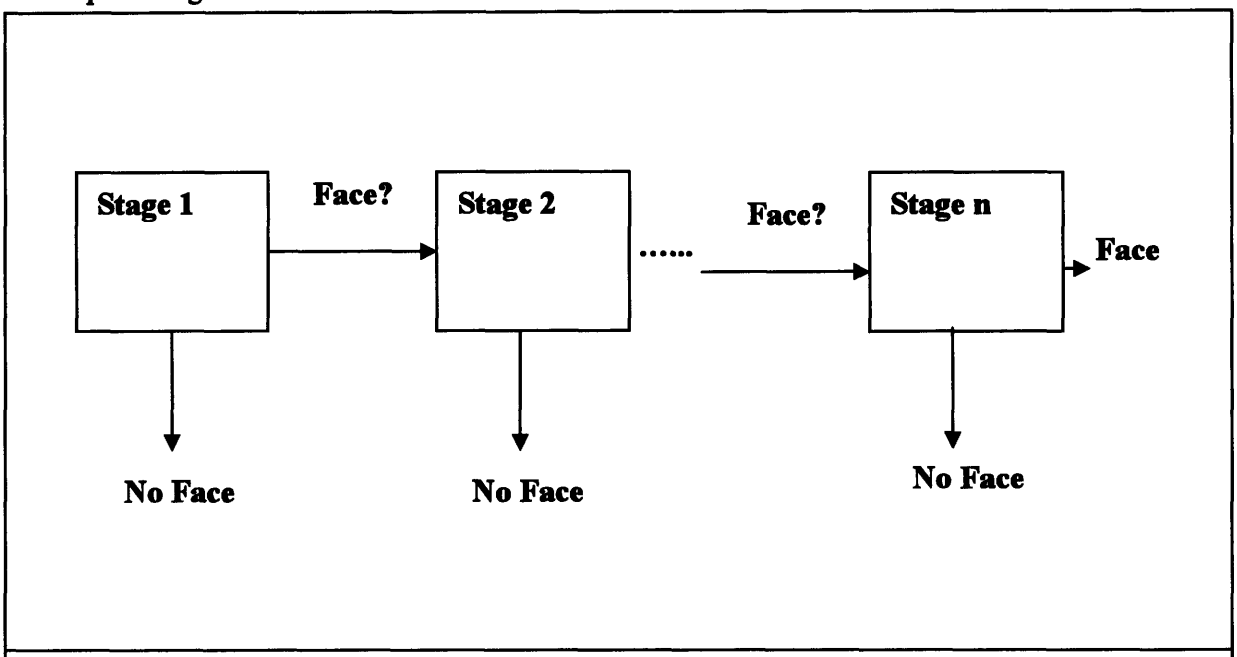

Figure 1: Simplified diagram of a classifier cascade like the one used in Intel OpenCV face detection (Intel Open Source Computer Vision Library). Either selects definitely no face (and is done) or guesses that there might be a face and goes on to the next stage (Shakhnarovich et al. 2002).

2.3 Previous Work on Interactive Portraits:

The concept of interactive portraits that respond in some way to the portrait's viewers has been a project developed by Orit Zuckerman at the MIT Media Laboratory and has been in progress since 2003 (Zuckerman, Interactive Portraiture Installations). To date, the portraits have mostly relied on the presence and number of viewers in order to determine the behavior of the portrait. This paper describes a logical next step-expanding the capability of the interactive portrait to observe its viewers' genders.

3. Work Accomplished:

The work in this project falls under three categories: (1) the training of a sufficiently accurate gender classifier; (2) the integration of that classifier with the Intel OpenCV face-

detection program (Intel Open Source Computer Vision Library); (3) and the use of the output of the classifier (in conjunction with a webcam) to provide input to a rule-based system that controls the images appearing in the portrait frame. The end result is a real-time system that feeds the portrait's software a list of observations about the portrait's audience which are then used to modify the portrait's behavior.

3.1 Training of a Gender Classifier:

The Intel OpenCV facedetect program (Intel Open Source Computer Vision Library) gives the dimensions of a square surrounding an image of a face within the video frame captured by the web-cam. Therefore, when we crop the face out of the image, there is some degree of standardization. Namely, the space between the eyes is horizontally centered, and the face precisely fits the vertical.

The only modifications done to the image after it is cropped out in the box specified by the face-detector and before being inserted into the gender classifier was to convert it to grayscale and to resize it to 100*100 pixels.

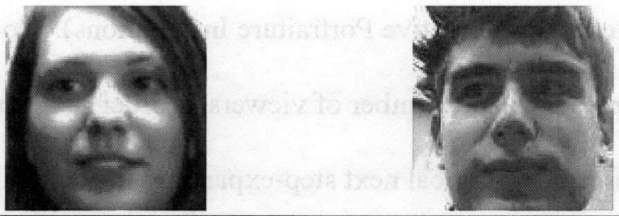

Figure 2: Samples of the format of images that would be sent to the gender classifier.

3.1.1 Gender Classifier Architecture: The Classifier Tree

In section 2.2, the classifier cascade was described (the idea of using classifier cascades for object detection was presented in "Robust Real-time Object Detection" (Viola and Jones,

2001)). The idea in the classifier cascade is that at each level you attempt to make very sure that a face is not something (i.e. male). For a system dealing with people of the same ethnicity and maintaining expressionless faces, this is sufficient. However, when dealing with all sorts of ethnicities and facial expressions, the classifier cascade is as likely to push out all or some of the people of a certain race or facial expression by mistaking them as people of a certain gender. To avoid this problem, I extended the classifier cascade to become a classifier tree. At every branch, the classifier makes a "guess" as to the gender of the test image (as with the classifier cascade). However, rather than discard the image if it is classified as male, the image being classified simply advances along a different path than if the "guess" at that stage was female. Only when the test image reaches a leaf of the tree designated as male or female does the designation become the final answer.

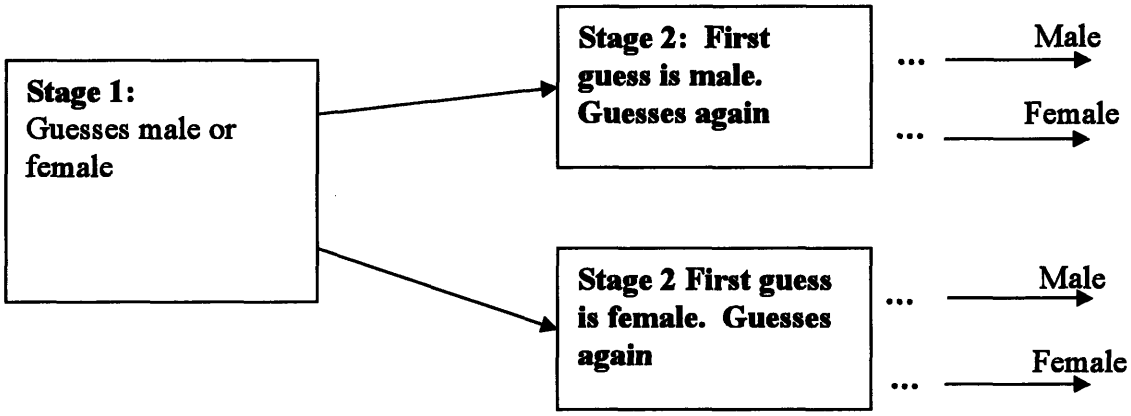

Figure 3: Shows the structure of a 2 stage classifier tree. The full classifier tree has many more middle stages. The right-most labels signify leaves of the classifier tree. An image ending up in a leaf is classified as what the leaf is marked.

The theory behind this method is that, at any given stage, the classifier could make a mistake completely unrelated to gender. For example, it might separate out smiling people or

people of a certain ethnicity (especially if the training set is not perfectly balanced between smiling males and smiling females). The classifier tree allows such separations to occur but is not impaired by them because eventually a certain node of the tree is reached where a group of smiling faces, a group of a single ethnicity, people holding their heads at a certain angle, or people with long hair becomes completely separated out. Once this has occurred, classifications on subsequent branches will be more strongly based on gender and not on those other features (which the images in question would then all share).

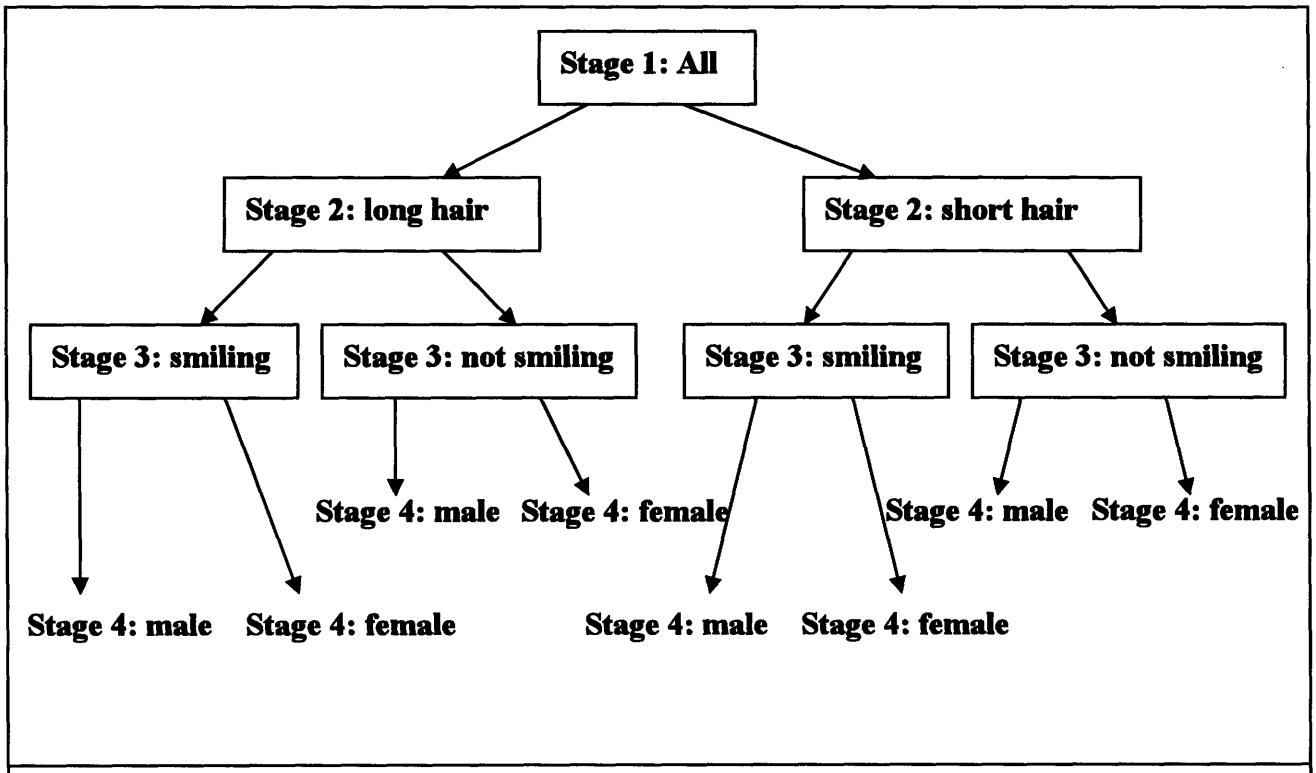

Figure 4: Idealized version of the classifier. The images are first divided by a variety of factors (i.e. hair length, and facial expression) before finally being divided based on gender at/near the final stage so that the classifier's final response is based on gender and not on other factors. This also shows the potential for getting more information out of the system than just gender.

An interesting side-effect of this method, which has not been tested, is that a whole series of characteristics could emerge from a single pass through a classifier tree of the type described

above. For example, one could potentially get results like smiling, long-haired, Asian female. Although, this effect is, to an extent, implicit in our strategy, the classifier tree was not explicitly trained or tested for such a result.

3.1.2 Traversing the Classifier Tree

At each level, the classifier must determine whether an image should take the male or female branch to the next level of the classifier tree. In order to do this, the distance (sum of squares of the differences in each pixel value) between the image and a template (average) male face image and template female face image for that level is calculated. If the distance between the female template image and the test image is smaller than that between the test image and the male template, then the test image is sent down the female branch.

Ultimately, we did not rely on the raw distance calculated. The following two steps were taken to obtain a more accurate computation: (1) the average shade of the test image's face is determined by getting the average pixel value of pixels close to the center of the image. The test images is then switched to the skin shade of the template image by subtracting out the shade (pixel number) found and adding in the template face's shade (found by the same computation on the template image) for all pixel values; and, (2) differences between the horizontal center of the image and the template are more heavily weighted than the difference between pixels closer to the sides.

The reason for the first modification was to minimize errors due to slight variations in skin color (or lighting). The average of pixels close to the center of the image gives a good approximation of facial coloring because observation of the face-detector shows that a correctly identified face will be approximately centered. The reason for weighting differences near the

center more heavily is that it minimizes the effects of background on the difference computation. The human face tends to be taller than wide, and it is delivered to the classifier in a square of 100*100 pixels. Therefore, background tends to appear at the horizontal fringes of the image because face detect (Intel Open Source Computer Vision Library) attempts to provide horizontal centering.

Although, raw pixel data was used to perform difference calculations, another possible measurement common in machine vision research that would have fit in just as easily is the comparison of eigenvectors between the template faces and the test image. For example, in "Neural-Network-Based Gender Classification Using Genetic Search for Eigen-Feature Selection" (Sun et al. 2002), a subset of the eigenvectors of the image were used in a neural network. As in that paper, we could have used a subset of the eigenvectors for computing the difference between the test image and the templates.

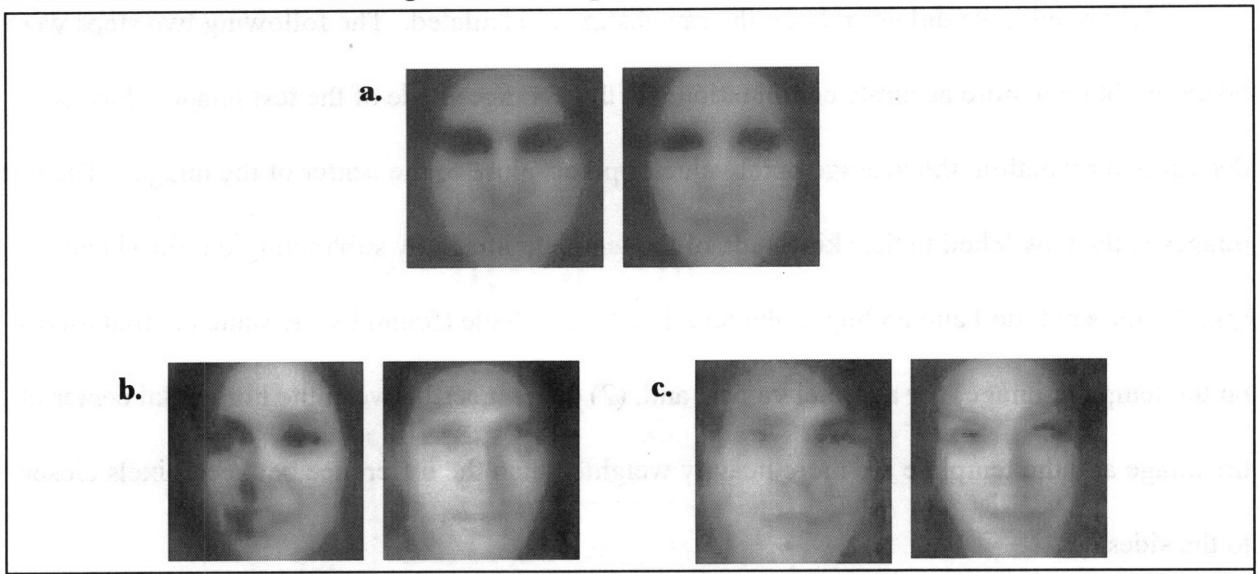

Figure 5: Above are pictured 3 pairs of templates for deciding which branch an image should take. (a) is the pair of templates at the root of the tree, (b) is a pair of templates near the middle of the tree, and (c) is a pair of templates near the leaf of the tree. As can be seen, the closer to the leaves of the tree the templates are, the less generic they become.

$$\frac{2500-(x-50)^2}{1000}$$

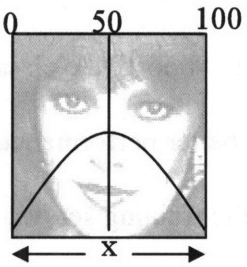

Figure 6: Shows why differences in pixels are weighted more heavily towards the horizontal center of the image.

3.1.3 Training the Classifier

In order to train the classifier described above, we collected a large database of male and female images (~3000 each, not all of different people, spanning a wide-range of facial expressions) and cropped out the faces using the dimensions given by Intel OpenCV facedetect (Intel Open Source Computer Vision Library). For the best results, we used faces collected by the webcam used for the interactive portrait at the same approximate angle and lighting as it would need to make a correct identification on a viewer of the interactive portrait. The training process is simple: (1) create the first male template by taking the average (pixel-values) over all the faces (the female template is created in the same fashion); (2) divide the testing set into four groups: female images that are closer to the female template, male images that are closer to the female template, male images that are closer to the male template, female images that are closer to the male template; (3) recurse on two groups-one made up of correctly identified female images and incorrectly identified male images making up the "female" branch, and the other, "male" branch, made up of correctly identified males and incorrectly identified females; (4) stop when a branch contains less than 10 images (below this number the template face will not be sufficiently generic causing over-fitting).

Once a basic classifier is created, it is strengthened over a series of tests by adding images it gets wrong to the training set (and if it still gets them wrong-their weight in the training

set is increased). Although, we did not do it, future efforts could take advantage of the AdaBoost algorithm (Freund and Schapire, 1996) to "boost" the classifier to much higher degrees of accuracy. As expected, testing showed better performance using images from the web-cam under the same conditions from which the training set was collected than on generic images collected from the internet.

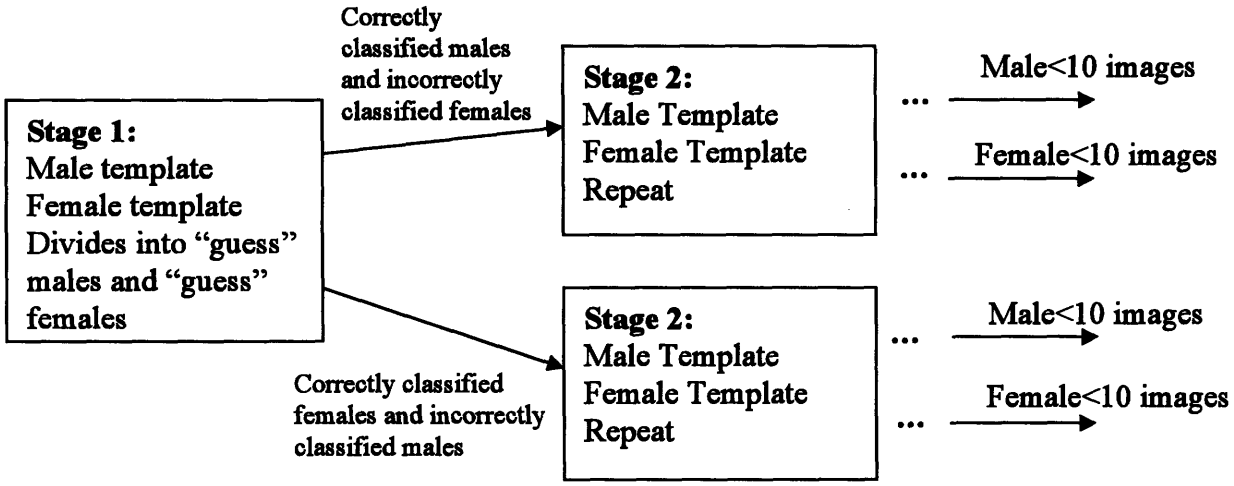

Figure 7: Shows the training structure of the classifier tree. At each stage an average male and average female face is created, and the training images are divided into two groups based on these average faces. This process is then repeated on each group until there are less than 10 images in each group.

3.2 Connecting Intel FaceDetect to GenderClassifier:

The facedetect.c program provided in the Intel OpenCV (Intel Open Source Computer Vision Library) open source software is modified to crop out the image of a single face (the last one identified in the image). This face is then converted to gray-scale and run through the classifier cascade. This cascade is maintained as a file-system structure in Windows. The top folder contains the two templates and a male and female folder. Each folder represents a branch and to classify an image, the classifier traces down the file-structure till it reaches a leaf (a folder

with no templates or further branches). In short, if the system "guesses" female then it looks in the female folder and vice versa, choosing one branch and recursing down the tree. The connected system produces several results per second at better than 80% accuracy.

3.3 Interactive Portrait:

The final step in the system is to convey the output of the gender-classifier to the portrait's controller so that the portrait can modify its behavior based on the viewer. At this time, the portrait controller gets two pieces of information: (1) the number of people facing the portrait, and (2) the gender of one of the viewers (specifically the last one picked up by the face-detect). Currently, more complex problems, such as determining the gender of multiple viewers, are not dealt with. Based on this information the portrait runs a different series of frames when the viewer is found to be male than if he/she is found to be female. This extends the powers of the portrait which previously only reacted to the presence of 0, 1, or 2 or more viewers to also reacting to a viewer's gender (Zuckerman, 2004). The new completed interactive portrait was exhibited in the MIT Media Laboratory in May of 2006 (Zuckerman, 2006).

Figure 8: Sequence of frames played when Gaia is viewed by only one person (Zuckerman, 2004).

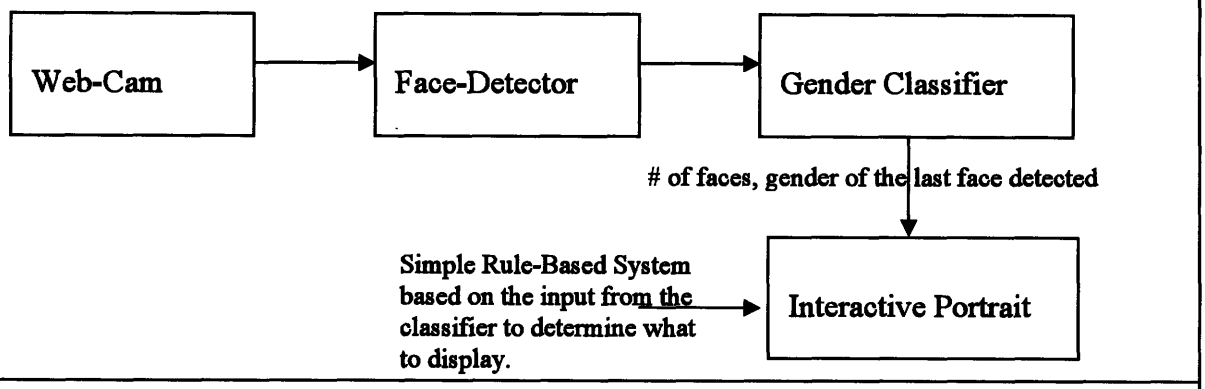

Figure 9: Depicts the components of the whole system.

significant further experimentation with this approach. The accuracy of the classifier may be improved by using eigenfaces (Sun et al. 2002) rather than simple pixel differences (mentioned in section 3.1.2). Furthermore, there is room, provided that efficiency is maintained, to try to normalize the images (i.e. by rotating tilted heads such that the eyes are always on a horizontal). Further experimentation with AdaBoost in the training phase (Freund and Schapire, 1996) could also raise accuracy. In addition to these possible techniques for improving accuracy, a fruitful avenue for research (as suggested in section 3.1.1) would be to see if this classifier architecture can be extended/trained to provide data on such subjects as ethnicity, facial expression, etc... Observation has also shown that it has potential for facial recognition because different images of the same person tend to follow a small subset of the paths down the classifier-tree.

The potential for extending the interactive portrait itself is essentially limit-less. It would be simple at this point to extend the system to determine how many males and females appear in a group. Furthermore, provided the classifier can be extended to provide further observations of the portrait's viewers, such observations can be added to the portrait's rule-based system in order to display a wider range of behavior that simultaneously remains intuitive.

5. Conclusion:

This paper has outlined a new architecture for real-time gender classification that is competitive with the currently best known methods and is extendable to other forms of machine-vision classification. As such, this portion of the research has relevance to a broad range of other applications including targeted advertising, security, robotics, etc... Furthermore, this research adds a new dimension to artwork by giving the creator of a portrait the power to have his/her art adapt based on the number, identities, moods, and reactions of its viewers moving from a passive form of art to a more active one.

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