

Understanding the Work of Ceramic Artists



Ease tension by taking up a new hobby.
You might want to try throwing pottery.



UNC CHARLOTTE

Principles of Human Computer Interaction
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1. Overview

The word "ceramics" comes from the Greek *keramikos*, meaning "pottery." which in turn comes from *keramos*, meaning "potter's clay" [5]. Most traditional ceramic products were made from clay, shaped and subjected to heat. Modern ceramic artists often introduce or embed original, natural elements (such as features from animals, plants, or water flow) into their works, to fight against seriously industrialized, formatted stiff environment. Most ceramic works are unique pieces, either thrown on the wheel, hand built, or a combination of the two. Some modern pieces are created with slip casting, in which molds are used to create identical forms.

Often the final product will turn out differently than intended, taking a different shape or achieving a different effect. Occasionally, features may even be unintentionally forgotten during the working process. While ceramic artists are as a group fiercely creative, able to inspire and be inspired, modern computers have the strengths of stable mass memory and accurate calculation. Thus, modern HCI technologies which allow ceramic artists to take advantage of computers' benefits could facilitate the work of ceramic artists as they form art from the creative sketches in their heads.

2. Data Gathering

Ceramic artists as expert users was the unanimous choice of our team, as the amount of creativity involved in the field fascinated us and we believed the field had a high potential for inspiring novel ideas for the project.

We defined an "expert" as someone who has an extensive knowledge in the ceramics field based on experience, occupation, research or involvement in major shows. As most ceramic artists are either self-employed or teach at various colleges or universities, we narrowed our domain to local self-employed ceramic artists and fine art professors.

One of our team members had previous experience in ceramics and knew some local ceramic artists, which provided us access to the experts in the field. We contacted various experts and shortlisted the ones who were available for interviews and agreed to be a part of the project.

Our first expert is Ms. Janet Williams, who is an area coordinator for ceramics and teaches ceramics at UNC Charlotte. Our second expert is Ms. Shelley Lineberger, an adjunct professor at Queens University of Charlotte and manager of a local art gallery. Our experts are further described in section 3 below.

In order to learn more about the ceramics field, we visited the Ceramic Art Studio at UNC Charlotte's College of Arts, where we received a tour which helped familiarize us with various techniques involved in ceramics, including wheel throwing, pinching, coiling and slab building. The studio space is composed of classrooms, an advanced studio, inventory and an outside kiln area. We were also exposed to various tools and equipment used by ceramic artists, including dust collectors, electric wheels, extruders, scales, slab rollers, brick kilns and electric kilns.

Once we were familiar with the domain, we brainstormed various interview questions that would help us gather information for our analysis. As there were many open ended questions in the interview, we opted for in-person interviews with the experts to encourage discussion and feedback. Ms. Lineberger was not available for an in-person interview, however, so our interview with her was conducted via telephone. Both interviews were recorded for later analysis. The interview questions asked are found in the Appendix.

More information regarding ceramic artists was collected from online resources including artists' blogs and websites. These supplemented our data gathering process and are listed as resources.

3. User Characteristics

General Characteristics

The following data collected from Occupational Employment Statistics (2010) gives some insight on some of the generic characteristics of fine artists, including ceramic artists [1].

Most fine artists develop their skills through a bachelor's degree program or other postsecondary training in art or design. Around 60% of fine artists are self employed, with the next most common employers being newspaper/periodical/book publishers, and academic institutions (around 9% each).

The annual wage for fine artists in 2010 ranged from \$29,230 to \$83,410, with a median of \$42,650. The middle 50% earned between \$29,230 and \$60,650. Earnings for self-employed artists vary widely based on their experience and reputation. Some well-established artists earn more than salaried artists, while others find it difficult to depend solely on the income earned from selling art.

Many artists work in commercial studios located in offices, warehouses, lofts or in personal private studios. Some artists share studio space, where they may exhibit their work. Employed artists generally follow a standard workweek and may work overtime during busy periods, whereas self-employed artists set their own working hours.

Ceramic artists are exposed to many hazardous materials [2] including lead, silica dust, heat and toxic emissions from kilns than can adversely impact their health. Some muscle injuries can also take place while carrying heavy articles, having poor posture at potter's wheel or while handling clay. Hence, they need to take necessary precautions at work.

Specific Characteristics (of first interviewed subject):

Ms. Janet Williams is a white female between the ages of 55 and 65. She graduated with a bachelors' degree in fine art in the 70s from Middlesex Polytechnic in London, and describes her work there as "sculpturally oriented," but she did not focus on ceramics until receiving a post-graduate diploma in the field. She then went on to complete a graduate program in ceramics at Cranbrook in Michigan in 1989. As the holder of both a bachelor's and a graduate degree, Ms. Williams' cognitive ability is presumably above average. She currently teaches ceramics at UNC Charlotte, and is also self-employed, producing work for her own shows and for public displays.

Ms. Williams is very well traveled, having spent 18 months traveling throughout Europe and Asia. She has been a resident artist in numerous countries and at various industrial companies, such as Kohler. She also spent several years running an international artist residency program. She enjoys being a resident artist, stating that she does her best work at those times, as they remove her from the tedium of everyday activities, allowing her to focus exclusively on her art.

Ms. Williams is passionate about and dedicated to her art. She is very patient, regularly spending six to eight days on a single aspect of a project, such as cutting materials into specific shapes. She states that she does not usually mind the repetitive nature of such tasks, enjoying the labor involved and finding it meditative. Her work is mostly solitary, although she employs students or other helpers for some of the most physically demanding or

repetitive work. She does perform numerous physically demanding tasks herself, such as mixing multiple 200 pound batches of clay and transporting them, indicating that she is in good physical shape.

Specific Characteristics (of second interviewed subject):

Ms. Shelley Lineberger is a 42 year old white female who has been working with ceramics since 2004. She received her bachelor of fine arts from UNC Charlotte with a double major in painting and ceramics, and then went on to graduate school in 2006 at the Rhode Island School of Art and Design. Ms. Lineberger currently works as an adjunct instructor at Queens University of Charlotte, and also has maintained an art gallery in Charlotte since 2009.

Ms. Lineberger is passionate about teaching, having originally intended to pursue licensure and teach art in middle schools. She believes that a good instructor should spend more time with his or her hands on the clay, giving students a point of reference with demonstrations. She finds joy in inspiring students, but with a heavy teaching load, wishes she had more time for her own artwork. Ms. Lineberger is a “night owl” and self-confessed procrastinator. Her two current lines of work are slab based sculptures, and porcelain aprons made of clay mixed with dryer lint and rolled very thinly.

Personas:

Public Art Patricia

- applies for grants and produces unique pieces for public art installations
- spends a several months a year traveling and participating in residential artist programs
- is extremely dedicated to her work, does not like being distracted from it
- does not create traditional, functional pieces; her works are for display, like museum art, and often take up an entire wall, floor or table
- teaches at a public university, but spends the majority of her time on her own artwork

Teaching Terry

- teaches Introduction to Ceramics and two other art classes at the local university
- when not teaching, produces art for shows, and volunteers once a month at the local gallery
- balances her time spent creating art with time spent teaching and raising her children
- is a passionate instructor who enjoys teaching as much as making artwork
- wishes the school had better equipment for her students

Freelance Fran

- lives outside the city
- sells ceramics on Etsy and in two gift shops in Charlotte
- makes lots of “stock” pieces similar to those that have sold well before
- travels to festivals four times a year to promote her artwork
- has three “lines” of pottery, featuring a unique glazes and/or design details
- spends a lot of time photographing and advertising her work on her website

4. Stakeholder Analysis

Primary stakeholders (targeted end users)

Our primary stakeholders are professional ceramic artists, those who make their living through forming clay. This includes ceramic artists who produce many traditional pieces for

commercial sale in shops and festivals, artists who receive grants to create unique pieces for public display, and artists who make a living teaching others how to sculpt.

Secondary stakeholders (receive output or provide input to system)

Organizations and governments provide the input of funding and receive the output of a finished sculpture for public display. Individual consumers, gift shops and other purchasers of ceramics are secondary stakeholders, as they provide input by paying for a piece, and receive the piece as output. Universities are also secondary stakeholders, as the university provides funding for ceramic art instructors.

Tertiary stakeholders (others directly receiving benefits from system success or failure)

Tertiary stakeholders include the manufacturers and suppliers of raw materials for ceramics, such as glaze manufacturers, who benefit when their supplies are purchased. Pottery festival organizers are also tertiary stakeholders, as they benefit when artists succeed, either by receiving a percentage of the profit or by receiving payment from artists who wish to display their work during the festival. Students taking ceramics courses are also tertiary stakeholders, as they are likely to learn more from more experienced artists, but do not directly impact the artwork produced by their instructors.

Facilitating stakeholders (design, development, maintenance)

The facilitating stakeholders are the project team, who are responsible for designing and developing the device. Should it continue to be implemented, those assigned to maintain the device (likely student employees) would also be facilitating stakeholders.

5. Environment

Physical

The physical environment of a ceramics studio varies depending upon the tasks being conducted. During wet-throwing or handbuilding tasks the environment is moist and potentially covered with clay dust, slurry or clay shavings. Throwing generates a large quantity of slurry, whereas trimming generates shavings and dust. During glazing and other “materials” work, there is the potential for dust from clay bodies as well as chemicals used in mixing glazes. The glazing process also includes the use of liquids, often in large quantities, making spills and drips a hazard in the environment. Ms. Lineberger states that the studio she works in is usually dusty, damp and smells like mold.

The physical space of a ceramics studio often involves tables, equipment for pressing clay (such as slab rollers and extruders), ceramic wheels, storage spaces for work such as shelving, storage containers for clay and a sink for cleanup. Glazing spaces are filled with materials needed for glazing, making glazes and for preparing specialty clay bodies.

As a result of the potential for the interaction between materials, the overall nature of ceramics to be adverse to cleanliness and for the productivity of workflow, ceramic studio spaces tend to be very orderly. There are separate spaces for throwing, glazing and firing. Tools are stored where they can be accessed easily without spreading clay residue, such as in open-air cabinets or on hooks on a wall. Materials are stored in an organized fashion, in labeled bottles or boxes, and reference charts often hang on the walls of studio classrooms. These charts list information such as which cones melt at which temperatures, or which glazes in which bottles produce which colors.

There are often physical obstructions in a ceramics studio that are out of the control of the artist. In the case of the university ceramics studio, our experts have to deal with a situation where the main studio and the kiln room are separated by a staircase. It is difficult to

transport materials and finished work into and out of the main studio due to this limiting factor. The UNC Charlotte ceramic studio is divided into separate spaces for throwing, glazing, firing and for advanced students to work and learn.

Further, not all studios are traditional rooms in a building. The UNC Charlotte studio contains a non-heated area in which the kilns, pug machines and other large machines are kept and clay is stored. This area extends outside, where specialty kilns are located. Ms. Williams has a private studio in her back garden; it is located in a Quonset building measuring approximately 30' x 40'. One section is heated and cooled, and this is where Ms. Williams does most of her work; the remaining section is used for storage, photography, to lay out work and explore ways of installing it.



The UNC Charlotte ceramics studio; using a router

Technical

A survey of public information from local artists about their personal studios reveals that the use of computers or other technology in the ceramic process is rare. In the case of the students studying ceramics at UNC Charlotte, the technical environment is limited to a Windows-based PC running glaze recipe catalog software. Kilns are often computer controlled, or computer monitored, and ceramic wheels have electronic controls, but outside of those scopes, the use of electronics is limited. Mechanical technologies, such as slip mixers and pug mills, are much more common.

The UNC Charlotte ceramics studio has access to a wireless network, projectors and smart-classroom technology. Even with the availability of technology, ceramic artists seem adverse to it in their working environment. Ms. Williams states that her studio is far enough from her house that there is no internet signal, and she purposefully leaves her computer (and often her phone) in the house so that she will not be distracted when working. However, another factor besides personal preference influences the availability of technology in ceramic artists' working areas, and that is the messiness, as described in greater detail in Section 7.

Social

The social environment in ceramic art is somewhat relaxed. Everyone wears extremely casual or messy clothing, as it is likely to be ruined by clay, glaze or other materials. The social environment of ceramics is somewhat technologically adverse. Ms. Williams indicated that among her students, there is resistance to using the available glaze software, with students preferring paper glaze recipe books.

We observed an interesting gender disparity, as the vast majority of ceramic artists we have been in contact with are female, and all the students present when we observed the studios were female as well. However, Ms. Williams stated that in some of her classes, such as sculpture, the students were overwhelmingly male.

There is a lot of interaction between ceramic artists, as they share their knowledge with each other freely and often attempt to assist each other with problems. To an outsider, the jargon used between ceramic artists is unique and requires time to learn. There are elements of chemistry, specialized techniques and procedures that cannot be conveyed efficiently through lay language and as such specialized terms are used to convey meaning.

Ceramic artists and students who work in a common environment do not function in isolation. There is collaboration on ideas and projects in many instances. Some aspects of the ceramic process are repetitive or monotonous, and during such times ceramic artists opt to listen to music or interact verbally with each other. Music tastes can generate conflict in the ceramic environment, and as such can be disruptive to the work flow. Nevertheless, there is usually a music player in every studio.

Outside the studio, ceramic artists socialize at workshops, when attending shows or presenting work at the same festival or gallery. Ms. Lineberger stated that in Seagrove, an area approximately an hour from Charlotte with a large concentration of ceramic artists, artists commonly throw kiln-opening parties, in which everyone gathers to be surprised (whether elated or dismayed) by the final results.

6. Task Analysis

Ceramic artists perform a number of tasks in a rotating cycle. Many tasks require days to complete, as the clay needs time to age, dry, heat, or cool, necessitating a good understanding of time and a great deal of patience on the part of the artist. Ceramic artists are involved in every step of the process; many dig their own clay out of the ground, and even those who buy clay in bags must prepare it, often mixing a custom blend of ingredients. This process is physically exhausting and time consuming, as the clay is made in large batches, must be transported to the desired location, and there is a great deal of cleanup to perform when the task is complete (wiping off machines, mopping the floor, etc).

The actual creation of a piece of ceramic art can take a long time as well. As long as the clay is kept moist by covering it with a plastic bag, it can be worked for weeks at a time. Ms. Lineberger spoke of one piece she had worked on for months that was still incomplete. This allows artists to work on multiple pieces at a time if they wish. After the clay has hardened, it is fired for the first time in the kiln. This first firing is called a bisque firing. Loading the kiln, depending on the kiln's size, the type of kiln, and the number and consistency of pieces to be fired, can be a difficult, time-consuming process, taking up to a day. We expand upon the kiln-loading process further in Scenarios 2 and 4 below, and in Section 7. Firing the kiln can take another day, and many kilns must be monitored to ensure they are at the correct temperature. It may take up to another day to wait for the kiln to cool, as kilns can reach temperatures of over 2000 degrees Fahrenheit.

Afterwards, the kiln is opened and must be unloaded. If any pieces have broken, there may be shards to clean up. Intact pieces are ready to be glazed. Ceramic artists may first test glaze combinations on small clay tiles to get an idea of what the final result may look like, as colored glazes look extremely different before and after being fired. After a piece is glazed, it is ready to be fired again, and the kiln loading, firing and cooling process repeats. The kiln is then opened, often with some ceremony, as no artist is ever certain of what the final result will be – an uncertainty that both our interviewed experts stated keeps them coming back.

Scenario 1: Preparing a proposal

Linda receives an email from her newsgroup, announcing that proposals should be submitted to the University of Waterland, which recently opened a new engineering building, for a sculpture to decorate the main lobby. The university wants the sculpture to have a “water” theme. Linda researches multiple aspects of water and engineering on her laptop, while sketching half-formed ideas in her sketchbook. She hits upon one idea she really likes, for a large series of structures, suspended from the ceiling. She fleshes out her sketch, draws two more versions, than does some calculations on the side of her notebook to see whether the concepts she is imagining would fit in her studio. They will, so she puts away her notebook and prepares to type the proposal. She knows that if her proposal is accepted, she will need to consult with the university building’s architects to see if the building can support the weight of her work. She will also need to hire Sam, a former ceramics student who spends a lot of time at the gym, to help her with the heaviest lifting, so she pencils in a note to email him and ask about his availability this summer.

Scenario 2: Preparing to fire pottery in the kiln

Tom is preparing for an upcoming art show, and his latest pieces are ready to be fired in the kiln. He carefully carries his pieces from the shelves in his workshop to the kiln area, where he sets them on a wooden table covered in newspaper. Tom places organic materials, such as minerals or animal hair, inside the abstract bowls to see what effect they will have. After distributing the organic materials, Tom decides which pieces will be placed on the first layer, at the bottom of the kiln. He builds a wall of bricks large enough to surround the first piece, and then fills the area inside the bricks with a layer of sand before resting the piece inside. He pours more sand on top to prevent the bricks from sticking to the piece, or any cross-contamination of materials. He continues to build walls around his pieces until the first layer is complete, and then places a kiln shelf on top of the bricks. He repeats this process until the kiln is full.

Scenario 3: Creating a sculpture

Mia spent the last week creating clay, and it is now old enough to begin working with. She rolls a large amount of clay out over her worktable, creating a slab 4’ x 3’. She then cuts the slab into three sections, and drapes each over a variety of objects to observe the ensuing shapes. She works not from a sketch, but from spontaneous inspiration regarding what she sees in front of her. After it has dried somewhat, she paints under glazes onto the clay in response to the form it has taken. Where the clay has cracked, she “scores” the area, using a tool to mark up the problem area, and then “slips” it, covering it with slip (liquid clay). As the slip dries to match the moisture content of the surrounding clay, the slip shrinks; therefore Mia puts extra slip on to prevent further cracking. When this area dries, the excess slip sticks out, and Mia carves it off.

Scenario 4: Firing student sculptures in the kiln

Julie has opened the kiln, and calls out into the studios that the kiln is ready for glaze firing. She looks at the work on the shelf designated for this kiln, calculating how much space each will require, while students from two classes begin carrying work into the kiln area. Julie helps a student slide an exceptionally large piece into the kiln first. The large sculpture is placed on cardboard, and Julie cuts away the excess. She then goes to the end of the shelves where the “kiln furniture”—kiln shelves and supports—are stored, and retrieves six supports and two shelves. She places the supports around the large sculpture so they form two triangles, to support the two shelves. She then looks through the student work for any small pieces which can fit on the lowest shelf with the large sculpture, and finding two, places them

in the kiln. She then places the shelves on top of the supports, each covering half the kiln. Julie repeats the process, arranging and rearranging the student artwork in the kiln as she adds more shelves. In the end, everything just barely fits, and Julie is pleased. She closes the kiln, chooses several cones of appropriate temperatures, and places them in the kiln where they can be monitored for bending (which indicates the appropriate temperature has been reached).

Scenario 5: Teaching a class

Rachel's class is beginning a new unit. She begins her class by showing a PowerPoint presentation projected from her laptop, featuring several famous and several not-so-famous ceramic artists. She lectures about the artists, and then turns the overhead light back on and instructs everyone to gather around the front table for a demonstration. Her 19 students put their notebooks away and move forward while she retrieves clay from the clay barrel. She demonstrates the technique of coiling, taking questions as she works. After the demonstration, she has a student pass out information sheets regarding the next assignment, and discusses the project in broad terms before instructing the students to begin work. She walks around the classroom, reminding two of the students that they are in charge of clean up this week, demonstrating the technique again for one student, and telling another to turn down the volume on his headphones.

Scenario 6: Creating test tiles

Alex wishes to determine the baseline results of a new glaze. He collects small pieces of clay, both red and white, some that have under glaze, and some that do not. He then paints some of the tiles with the new glaze. He paints other tiles with other glazes he commonly uses, to see how they will impact the new glaze (and vice versa) when placed next to each other in the kiln. He places half of his test tiles at a time in the small "test" kiln at the back of the studio. After the firing, he observes the results, knowing that the effects will be different on his finished pieces depending on variables such as what kiln he uses and what other pieces are fired simultaneously.

7. Problems

1. Clay is heavy.

The weight of clay makes it physically exhausting to work with. Ms. Williams, for instance, mixes 200 pounds of clay at a time, and her completed pieces have weighed as much as four tons, requiring her to consult with architects to reinforce display walls. The weight of clay makes it difficult to move into and out of kilns. Ceramics students do not always anticipate how heavy their final result will be, making it more difficult for teachers to assist them in firing their pieces.

In the ceramics studios at UNC Charlotte, students are encouraged to work on cardboard, which is itself on a wooden board. This makes the work easier to move, as it can be slid into the kiln from the board, and the cardboard will disintegrate during the firing process. However, the problem of weight is compounded by the presence of stairs in the UNC Charlotte studios, which has required the installation of a scissor lift elevator for the movement of clay buckets and other heavy equipment.

2. Working with clay is messy.

The materials that ceramic artists work with are almost uniformly messy. Clay sticks to hands, while slip (liquid clay) and glaze stain, spill and splatter like any other liquid. When touring the ceramics studio at UNC Charlotte, we observed that even opening a jar of glaze

for demonstration purposes required hand washing afterwards. This necessitates cleanup before transitioning activities. For example, one would not use a computer or other electronic device with hands sticky from clay; in fact one would not want expensive electronics anywhere near the process, as they could be ruined by a spill.

3. Temperature

The workspaces of ceramic artists are often partially heated and cooled, but partially not, particularly in areas for storage and where kilns are located. This necessitates working in an environment that is too hot or too cold, depending on the season.

4. Health hazards

Certain art materials pose health risks to ceramic artists. They can be broadly categorized as follows:

Dusts: Clays and glazes used in ceramics are made from minerals that can pose a respiratory risk. Artists have a high chance of inhaling them while mixing dry clay, which can cause silicosis.

Toxic Materials: Some of the ceramic colorants and glazes contain lead that is toxic in nature. Artists are exposed to these toxins while preparing or applying glazes. Kiln firing also emits some toxic fumes that can cause bone and teeth problems after prolonged exposure.

Heat: Kilns are used to harden the clay and melt the glazes in ceramic artwork. The temperature of the kilns can range from 1600° F. to 2400° F. Improper handling can cause burns.

Weight: Clay comes in bags weighing 50lb to 100lb and at times they need to be moved from one place to another. Lifting such heavy weights can cause injuries or muscle strain.

Ceramic artists are aware of these risks and develop their own precautions. For instance, Ms. Lineberger minimizes her exposure to clay dust by not working at home and wearing designated “studio clothes and shoes,” which she washes immediately on returning home. Ms. Williams works to minimize her handling of the clay while it is in its driest stage. Additional information regarding these health risks was found online [4][5]. Some other general precautions are as follows:

Artists usually wear masks and gloves while mixing clays in order to avoid inhalation of dust.

A scissor lift or wheeled carts are commonly used for lifting and transporting heavy objects.

The work area is cleaned and mopped after use to avoid exposure to dusts and other toxic materials.

Less harmful, lead-free glazes have been developed and are generally used by most artists.

Artists wear heat-protective gear while working with kilns.

Proper ventilation is available in the areas where kilns are present and high chimneys are made for fuel-fired kilns.



Dry clay pots in the kiln room at UNC Charlotte

5. Tasks are often repetitive.

Depending on the piece being produced, the process involved can be repetitive. Some ceramic artists create displays that contain repeated elements, for which the process to create each must be repeated up to hundreds of times. Other artists create many similar variations of their best-selling pieces; coffee mugs are one example of a commonly made item. In the former case, labor saving methods are not practical to implement, as one would need to design a new method for each new repetitive project. In the latter case, where the repetitive work is perpetual, there is more opportunity to make changes which may have long-term benefits to ceramic artists. Also, some ceramic artists like the repetitive nature of some tasks, making it difficult to distinguish between labor-reducing and enjoyment-reducing methods.

6. Reference materials in classroom settings are not easily usable.

There are a number of reference materials on the walls in the UNC Charlotte ceramics studios, which are meant to indicate what materials are needed and where they are kept. These references are needed to help organize the many hundreds of materials available, but the location of these references is not always convenient for users. For instance, there is a chart that displays how glazes appear on tiles and lists the glaze number, which corresponds to the bottles stored on the wall. This chart is stored in a corner, however, making it difficult for more than one or two people to view at a time. Another example is the chart in the kiln room that lists the burning temperature of cones, which are used to gauge the temperature at which a kiln is firing. The chart is kept two or three yards from where the boxes of cones are stored, in the middle of a narrow walkway between a row of kilns and a line of shelves upon which students place their artwork. This location is only mildly inconvenient when the room is empty, but would be both more inconvenient and potentially hazardous when the room is full of people loading kilns and transporting heavy pottery to and from the shelves.

7. Kilns are difficult and time-consuming to load.

This problem is closely related to the first, that of clay being heavy. However, loading kilns presents a number of other challenges as well. One problem is how to optimally arrange pieces so as many as possible will fit in a kiln for firing. Experienced artists who routinely create similarly shaped pieces can plan their load in advance, mitigating the problem. For instance, Judy Abdelaziz writes that she always makes extra-tall vases in multiples of three, to take up one half of a kiln [3]. However, this remains a problem for artists who craft sculptures, and for instructors who must determine how to load their students' work. In a

university setting, with deadlines at the end of the semester and a corresponding increase in the number of pieces produced, this is a particularly challenging problem. When announcing that a kiln is ready to fire, instructors do not know in advance which pieces, or how many, the students have prepared, and must determine the best way to load the kiln as they go.

Another difficulty in loading kilns is that they reach such high temperatures that many substances will melt and stick to each other inside. For this reason, elaborate preparations must sometimes be made, depending on the materials being fired. For instance, the soda-ash kiln at UNC Charlotte does not have a door. When fired, it produces a mixture of sodium bicarbonate and water, which vaporizes instantly, but leaves behind a residue which would seal the door shut. Therefore, those who wish to use this kiln must build the kiln's fourth wall with individual bricks before every use. Projects may also require the use of a specialized sand called wading as a barrier between the bricks and the clay, to prevent them from melting together.

8. Existing Systems

Ceramics is usually classified as a branch of fine arts. Since modeling or graphics software (Maya, 3dMAX, AutoCAD, SolidWorks) is already widely used in other areas of fine arts such as sculpture, interior design, and Visual Art; and other image processing software programs (such as Photoshop, ACDSee, Corel Paint Shop) are also used in feature enhancement, graphic design, they could also be applicable for ceramic arts.

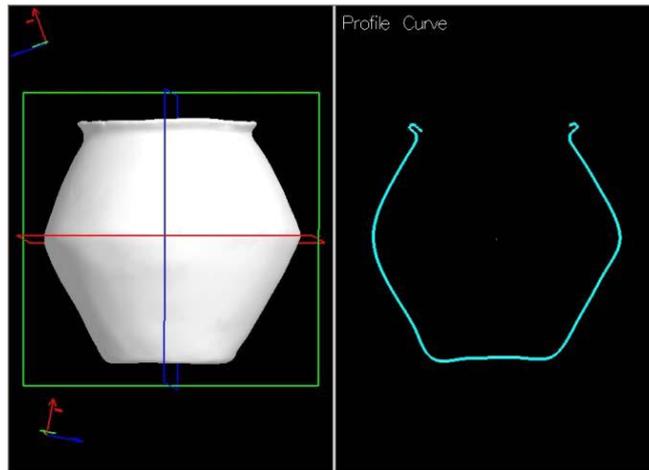


3D models by 3DMAX

However, students in ceramics rarely use these programs, and some students only use Photoshop for 2D texture design. It may be impractical for ceramic students who spend most of their time working by hand to master complex software like 3DMax or AutoCAD.

However, some more experienced artists learn and use these programs. For complex or precise ceramic product design, experts in 3D modeling or other specialized software must work with ceramic artists as needed. For instance, Ms. Williams uses CNC routers and laser cutters with the assistance of those in the architecture building.

Computer engineers have developed some software for ceramic studies. For instance, The Ceramic Technologies Digital Library (CTDL) uses a proprietary program developed at PRISM by Myungsoo Bae. It is called Ceramic Vessel Analysis Software (CVAS), and is used to obtain precise measurements about the vessel's construction.



CVAS screenshot

The UNCC VisionLab in the electrical engineering department also has a project regarding ancient ceramic reconstruction. However, these studies are not for the ceramic building process, but for analysis of pottery construction.

Recently, there has emerged a unique software program that mimics the ceramic building process, also an excellent HCI program for simulating the whole procedure of ceramic production. It is an iPad application called Let's create! Pottery, produced by Infinite Dreams.



The Let's Create! Pottery iPad application

The program interface provides a vivid environment to imitate the real, messy working process of ceramic artists, and even provides easy tools for adding textures after the virtual pottery is fired.

Price List (US \$)

- Maya: Starting at \$4,995
- 3dMAX: Starting at \$4,995
- AutoCAD: \$4,445
- SolidWorks: \$99.00
- Photoshop: \$149
- ACDSee: \$79.99
- Corel Paint Shop: \$59.99
- Let's create! Pottery: \$4.99

9. Lessons Learned

The following is a list of valuable lessons that we learned during our initial phases of data gathering and analysis:

- Artists like to talk more about their art and the inspiration behind it than the actual process of making it.
- It is not always the case that a computerized alternative for doing a job is always superior. For instance, the "cones" used to measure kiln temperature are more accurate than the computerized gauges.
- Although ceramic artists don't appear to have lots of technology in their studios, it does not mean they are not proficient at using computers.
- A key component in success of teamwork is early distribution of tasks and responsibilities within the team. This avoids last minute chaos and ensures quality output which we learned the hard way.
- Conducting interviews is a complex activity, as its success depends not only on choosing the right interviewees, but also asking them appropriate questions in order to effectively collect the data.
- Ceramic artists have their own culture, with a rich tradition, unique terminology and even geographic areas dedicated to ceramics.

10. Implications

The follow is a list of implications for implementing a new design for ceramic artists:

1. **User Adoption:** The adoption of a new design by ceramic artists can be influenced by the following factors-
 - a. Age: Age plays an important role in decisions related to technology adoption [7]. As most of our experts belong to the "Baby boomers" generation, they are more accustomed to seeking and applying traditional solutions to a job.
 - b. New technology: Ceramic artists are not heavy users of technology and adapting to a new technology might be more difficult for them.
2. **Environmental constraints:** Various activities in ceramic studios make the environment moist and potentially covered with clay, dust, slurry or clay shavings. Exposure to extreme temperatures is also a possibility. The design should be rugged enough to be used in such an environment.
3. **Tool complexity:** Ceramic artists are busy, and do not have the spare time to devote to learning and using a complicated system. The design should not be too complex for ceramic artists to use. It should be intuitive and should not require a lot of training prior to its usage.
4. **User Perspective:** Many artists see use of technology as a distraction or an encroachment that tries to systemize traditional skills and hinders creativity. The new design should unobtrusive, and never interrupt the creative process or infringe upon their creative domain. Ceramic artists are patient and can derive satisfaction from completing even very repetitive tasks; we must ensure that any automated system does not detract from artists' enjoyment of the process.
5. **Previous experiences with technology:** Although our experts are not computer experts, they are proficient at using a computer for everyday tasks such as email and

PowerPoint. Some ceramic artists have even more experience with complex software programs. Any technological system should take advantage of standard conventions our experts are likely to be familiar with.

6. **Lack of current electronic systems:** Ceramic artists tend to use more mechanical than electronic equipment. The current lack of a substantial electronic presence in their environment means that there is a lack of competing products for the majority of ceramic artists' tasks. This gives our design more flexibility, as our experts are not accustomed to specific electronic methods or program designs.
7. **Differing workflows:** Many parts of the artistic process differ between artists. To achieve the greatest impact, our system should likely focus on areas that are common between different artists, and not specific to one type of ceramic art, such as throwing pottery on the wheel.
8. **Tradition:** While technology has changed the process over time, ceramic artists have been working for literally thousands of years. Our system must be designed first and foremost with the knowledge that ceramic artists know what they are doing. We must show great respect for their long history of knowledge and not mess with systems that work.

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12. Glossary

Clay

Clay differs from the inelastic earths and fine sand because of its ability, when wet with the proper amount of water, to form a cohesive mass and to retain its shape when molded. This quality is known as clay's plasticity. When heated to high temperatures, clay also partially melts, resulting in the tight, hard rock-like substance known as ceramic material.

Cones

Full name is pyrometric cones. Pyrometric cones are used to measure the effect of the kiln's atmosphere on the glazes being fired. Cones are made up of refractories, such as silica, and melting agents; each type of cone is carefully formulated and manufactured for accuracy.

Extruder

Machine which forces plastic clay through a die to produce extruded clay shapes

Glaze

A ceramic substance, made from a combination of clay material and colorants (such as iron oxide and cobalt), suspended in water and intended to be applied by dipping, spraying or brushing on to a piece of pottery. The melting temperature of the material is usually several hundred degrees below the melting temperature of the clay body it is intended for use on. When fired, glazes become molten and form coherent silica structures, which result in a glass-like surface on the ceramic object that is fully vitreous, regardless of the state of the underlying claybody.

Kiln

A furnace or oven for burning, baking, or drying, esp. one for firing pottery

Potter's wheel

Potter's wheels (pottery wheels) have been used for thousands of years. Some have been powered by hand and others by foot, but all have had one thing in common: a heavy flywheel used to build up and store momentum and torque. One version, the kickwheel, is the most common form of human-powered wheel used by modern potters in the United States today.

Slab Roller

A slab roller is a mechanized but usually manually operated device for rolling out large uniform slabs of clay.

Slurry

Slurry is very, very closely related to slip. Both are liquefied clay, or suspensions of clay particles in water. Slurry tends to be thicker and is used to join pieces of leather-hard clay together.

Vitrification

Vitrification is process by which a ceramic body becomes fully solid and unable to be penetrated by water.

13. Appendix

Interview Questions

DEMOGRAPHICS

1. What is your age?
(18-25) (25-35) (35-45) (45-55) (55-65) (65+)
2. Gender?
3. How many years have you been working in your current field?
4. How did you come to work in ceramics?

TASKS

5. Please describe your typical workflow; that is, when beginning a project, what do you do first, then next, until your work is completed?
6. Are any parts of your work tedious, frustrating, or repetitive?
7. What is the most rewarding part of your work?
8. Is any part of your work significantly harder than the rest?

9. Have you ever used an automated tool to accomplish any of your tasks? If so, was it useful? Did you like it?
10. Who do you create ceramics for? Does a different audience change your workflow in any way?

ENVIRONMENT

11. Please describe your work environments. Where and when do you usually work?
12. What are your favorite and least favorite qualities of your working environment?
13. If you were given \$2000 to improve your working environment, what would you do with it?
14. If you were given \$20 to improve your working environment, what would you do with it?
15. What safety issues or risks are associated with your work ?

SOCIAL/TECHNOLOGICAL

16. How much of your time do you spend working with others? Who do you collaborate with?
17. What electronics do you use or own?
18. What do you use them to do?
19. Are there any unwritten rules of your work environment? Some examples: is it okay to bring others into the area? What noise level is appropriate? Is it okay to take a phone call in the middle of the room?
20. Is there anything else you would like to share?

Ceramic Artists



Ease tension by taking up a new hobby.
You might want to try throwing pottery.



UNC CHARLOTTE

Principles of Human Computer Interaction
Spring 2012

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14. Overview

Our goal is to support ceramic artists by facilitating the kiln loading process. The specific task we intend to support is finding an optimal, or close to optimal, arrangement of pieces to be placed in a kiln. To accomplish this task, our process must support both input (collecting dimension data for the pottery pieces) and output (displaying the kiln arrangement to users). Our intended users are all ceramic artists, although those who deal with the largest number of pieces, such as teachers, would benefit most. (For this reason most of our scenarios focus on instructors.) One of the reasons we chose this problem was that it effects all ceramic artists. Also, according to our expert evaluations, the kiln-loading process is both time-consuming (taking up to a full day) and dangerous, as pottery is most likely to break when moved. Further, this is one task more suited to algorithms than human brainpower, and using computers to solve this version of the knapsack problem would allow ceramic artists more time to spend on their artwork.

15. Requirements Summary

15.1. Functional Requirements

- **automatic dimension input**
The system should be able to determine the dimensions of a piece (or pieces) without the user needing to measure and then manually enter the dimensions.
- **manual dimension input**
The system should allow users to enter pottery dimensions manually, whether for the user's convenience or to correct an error.
- **photo input**
The system should take a photo of the piece as a means to identify it.
- **output display**
The system should display the kiln layout in a way that is easy to understand and is conducive to loading the kiln. For instance, for a kiln loaded from the bottom to the top, a side view might be inappropriate.
- **manual override**
The user should be able to manually override every automatic aspect of the system, including:
 - piece dimension measurements
 - kiln dimension measurements
 - location of specific pieces
 - location of kiln furniture

15.2. Non-Functional Requirements

- **ease of use**
The system should not require more than basic technological knowledge. It should be easy to learn and use; for instance, instructors should be able to expect students to use it without requiring individual instruction.
- **physical durability**
The system should be able to withstand the heat, moisture and mess of the ceramics environment.

15.3. Usability Requirements

- **learnability**
 - **predictability**: users must be able to understand what each system option will accomplish
 - **familiarity & generalizability**: the system should leverage users' existing knowledge to aid in ease of use
 - **explorability**: it should be impossible to accidentally cause irreversible changes, such as deleting a photo or a kiln arrangement
- **flexibility**
 - system pre-emptive
 - **task migratability**: the system should prompt the user when it encounters a task it is uncertain about; for instance, it might request the user verify that the highlighted objects on the screen are all in fact pottery pieces
 - **substitutivity**: the system should allow for easy conversion between units of measurement used
- **robustness**
 - **observability**: users should be able to understand at a glance what part of the system they are in (input or output), and the system information should be easily browsable

16. Design Space

The fact that technology is not already implemented in this environment is an indicator of the design requirements that are challenging, particularly the need for physical robustness. In our design space, we chose to focus on three dimensions: use of existing interfaces, mobility, and robustness.

Physical robustness, as mentioned previously, is important given the extreme conditions of the ceramics environment, and is one of the main reasons technology is not already used commonly in ceramics studios. Most electronics are not designed to be used by hands covered in slip or glaze. Therefore, improving robustness requires either creating devices that are hands-free and/or can withstand the mess, or moving part of the process out of the studio, which allows the use of existing electronics but is less convenient.

Mobility is another important factor, as mobile devices can be moved to the pottery rather than vice-versa. This is useful because pottery is heavy and prone to breaking when moved. A mobile device can also be used for all parts of the process, as it is easily moved from the studio (where dimensions are entered) to the kiln area (to view the kiln arrangement output). However, mobile devices also have small screens, making it difficult to view a large layout of information, especially when one's hands are full of breakable pottery. Stationary devices can make use of larger components, be they screens for displaying output or multiple cameras for capturing input.

Use of existing interfaces is a dimension that captures several factors, including cost and familiarity. A system that makes use of an existing interface is likely to be less expensive; for instance, it would be cheaper both to purchase and to develop an iPhone app, compared to a new handheld device. Existing interfaces also take advantage of users' familiarity with the system, and our users, while they do not use technology in the ceramics environment, have a basic understanding of familiar electronics such as computers or smart phones. However, existing interfaces are also less robust, as mentioned previously; it is a potentially very expensive mistake to use a smartphone in a ceramics studio. Further, using an existing interface requires users to own and/or be familiar with that specific interface. In the case of smartphones, for instance, the system would either have to be implemented on

multiple platforms or would alienate large segments of the population, not to mention those who do not own smart phones at all.

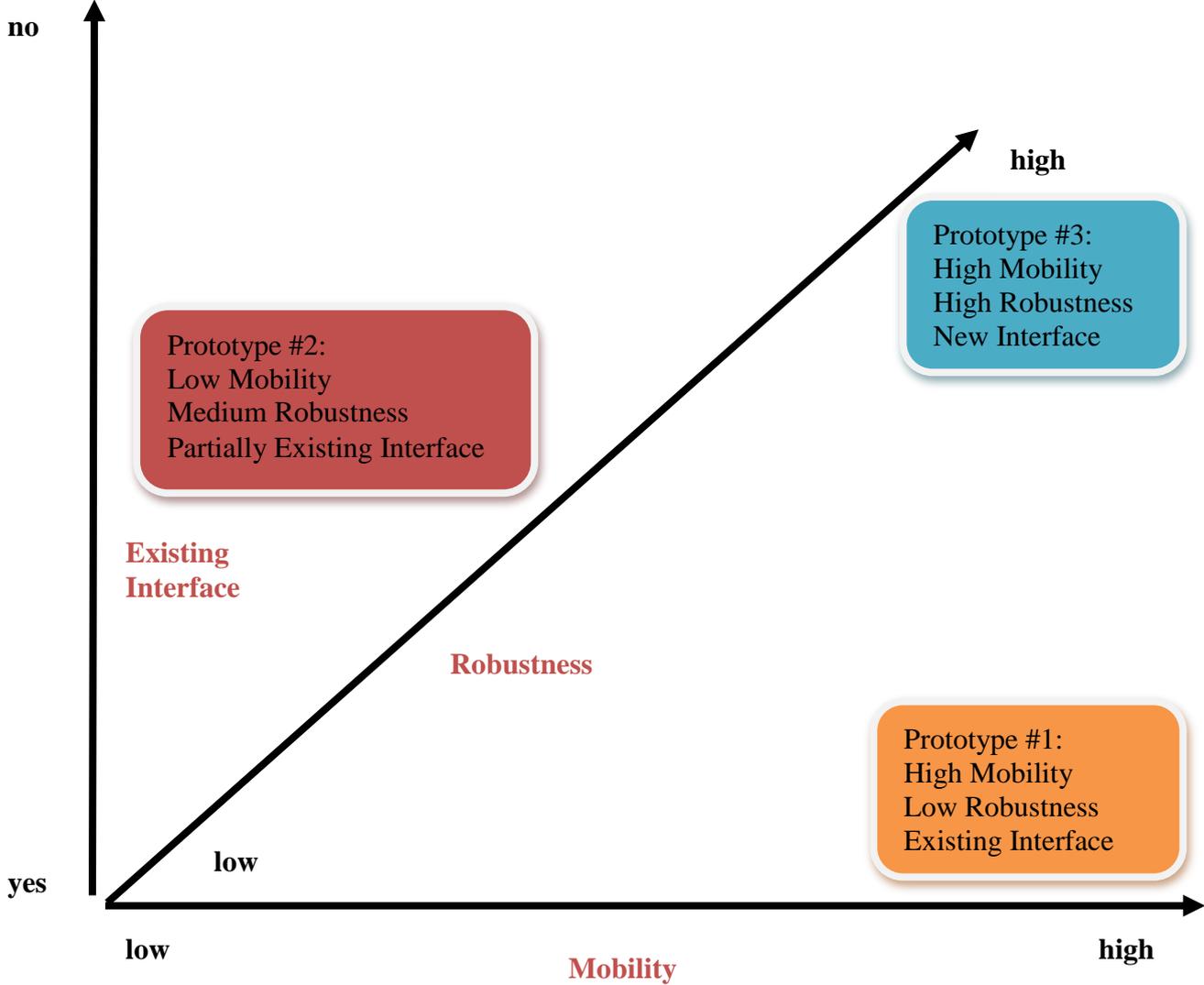
When considering design alternatives, we wanted to consider all parts of the spectrum. We originally favored both mobile devices and use of existing systems, but the advantages of stationary (non-mobile) devices were then discussed. We then realized we could invent an entirely new device to solve many of the problems we were experiencing with our designs for existing systems, although the use of a custom device had problems of its own. In the end, we did decide on three potential interfaces that represent well the different areas of our design space.

The first design is mobile and makes use of an existing smartphone interface. Therefore it is familiar, but has the low robustness which makes current electronics problematic; however it has the lowest cost, as it is built on existing hardware, and could be most easily implemented.

The second design is not mobile, but makes use of both existing hardware (the artist's computer and printer) and new hardware (camera setup implemented in the ceramics studio). This interface is much more robust than the first, but it accomplishes its robustness by removing much of the process of interacting with the electronic devices from the ceramics studio. This is both good (a printout of the kiln layout to be taped to the wall is much more in-line with the current culture and environmental constraints) and bad (it means lots of moving back and forth between office and studio when corrections need to be made). It is more expensive and costly to implement, as it requires installing cameras in the studio, but the input functionality is also much easier to use, and allows for the processing of multiple pieces at a time, making it ideal for a classroom environment.

The third design is a custom mobile device, designed to withstand the rigors of the ceramics environment. This design combines the mobile functionality of the first design with the robustness and superior measuring implementation of the second. However, as a custom device, it would be the most expensive to implement. It would also be unfamiliar to users, requiring extremely good design to ensure it is easy to use. If well-designed, it would allow novices (students) to use for dimension input, like the second device, requiring less work on the part of instructors.

Overall, these three designs all have strengths and weaknesses, and are balanced throughout the design space. A diagram of the design space and the positioning of our three prototypes is shown on the following page.



16.1. Alternative 1 - Smart Phones

This design alternative was selected considering the exponential increase in the usage of smart phones and enhanced features available in smart phones that help create user friendly application. Since most of our users own a smart phone that have inbuilt cameras, this alternative seems to be the most cost effective as well as the one that needs the least development time. Also, it provides a simple and familiar interface for the users.

The main idea is to develop a smart phone application that will allow efficient loading of the kilns. The main purpose of the application is to deduce the dimensions of an artifact based on its picture taken using an inbuilt camera and to calculate the most efficient way of loading the artifact into the selected kiln, so that the space inside the kiln is optimally utilized.

The design is created keeping in mind that the application would be used by a single person who is in charge of scheduling the kiln. Considering the technology proficiency of the users and the environment in which they would be using the application (which is usually messy and dirty), the user interface is designed in such a way that user is able to achieve the goal with least amount of typing and with quick, easy to navigate menus.

Various details like student names, their contact details and kiln types will be fed into the application during its initial setup. The application will provide various features to the users like deducing approximate dimensions of the piece with the help of an inbuilt camera. The user will take the picture of the piece and the application will estimate the length, width and height of the artifact. It will also provide a facility for the user to edit the dimensions. Once the dimensions have been noted, the user can decide the kiln in which the piece needs to be fired. Depending on the space left in the kiln, the application will calculate the best place where the piece can be positioned to maximize the space utility. A rough virtual kiln is then shown to the user who now knows where the artifact can be placed. The application also notifies if the kiln is more than 90% full. This information can help user schedule the firing of the kiln. Once the firing of the kiln is scheduled, an email notification is sent to all the students who have their pieces in that particular kiln. The application also gives an option for the user to check the previous history of kiln firing and manage the database for the kilns and students.

Pros:

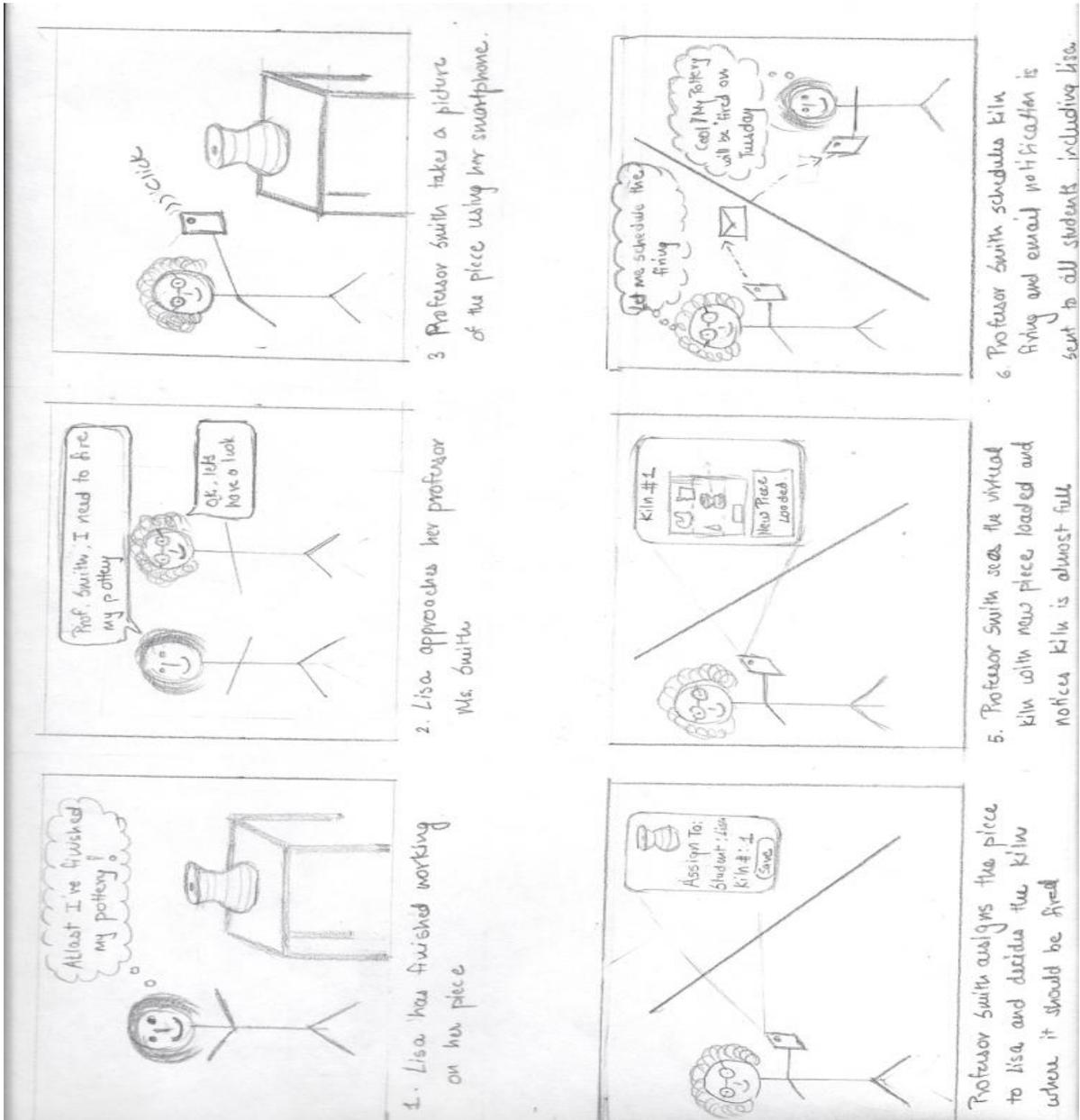
1. Highly mobile.
2. Easy to learn and use due to familiar interface.
3. No additional hardware is required except for the smart phone.

Cons:

1. Small screen makes it difficult to view the kiln layout.
2. The phone could be damaged in the messy ceramics environment.
3. Requires owning a smart phone with inbuilt camera.
4. Accuracy of calculating the dimensions will be comparatively less than other designs that use dedicated cameras to capture 3-D image of the artifact.

Scenario #1:

Lisa has just completed her vase on which she was working for over two weeks. Excited to fire it now, Lisa visits her Professor, Ms. Smith who is in charge of scheduling the kiln firing. Professor Smith takes a picture of the vase using the application, which calculates the approximate dimensions of the vase. Once Professor Smith confirms the dimensions, the application generates a unique number for the vase. Professor Smith then enters student name and the kiln number in which the vase should be fired. Once all the details are entered, the application displays a virtual kiln layout and the position where the vase should be fired. The application then alerts Professor Smith that the kiln is almost full and there is no more space for additional artifacts, so she schedules the firing of the kiln for Tuesday. An email notification is sent to all the students, including Lisa, who have their pieces in that kiln.

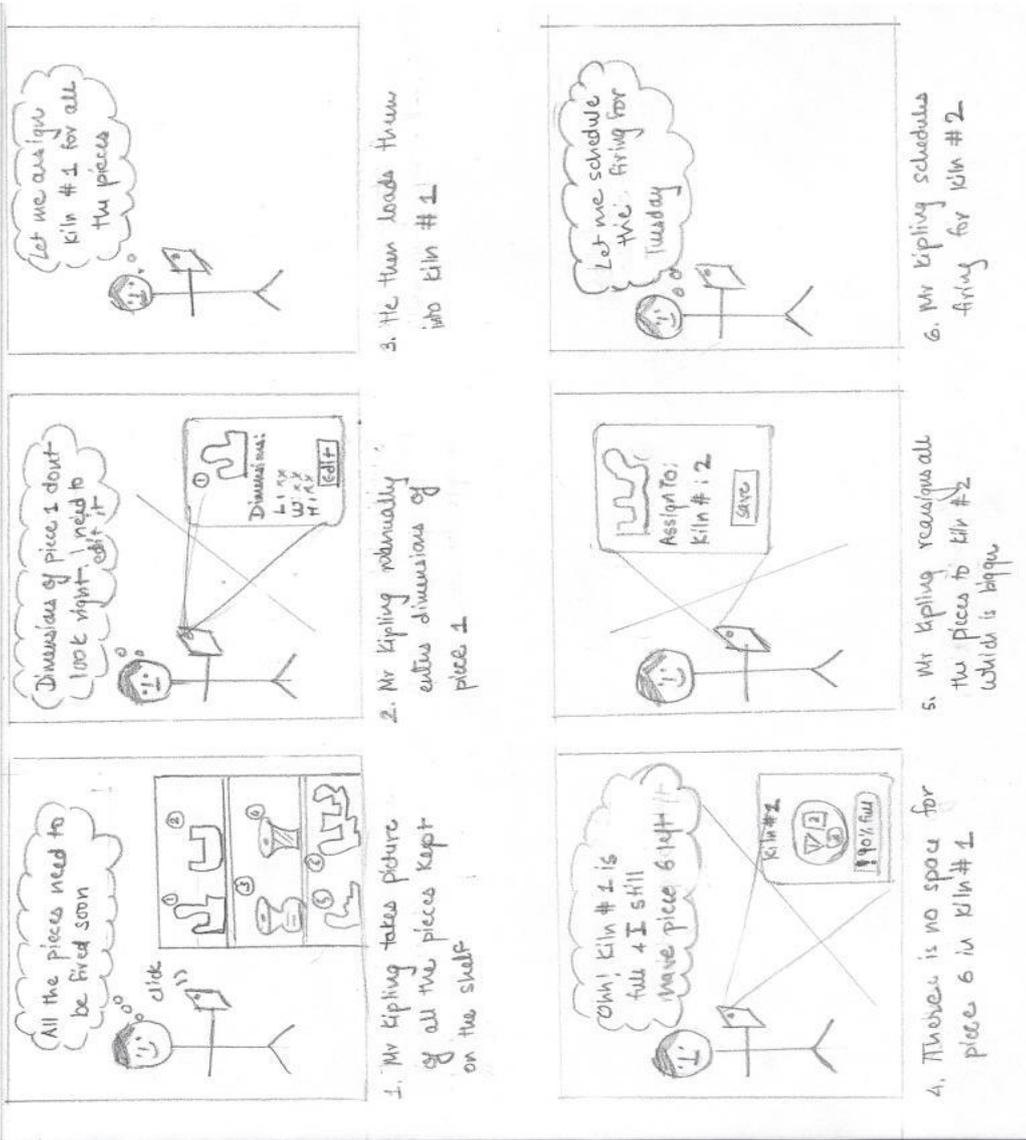


Scenario #2:

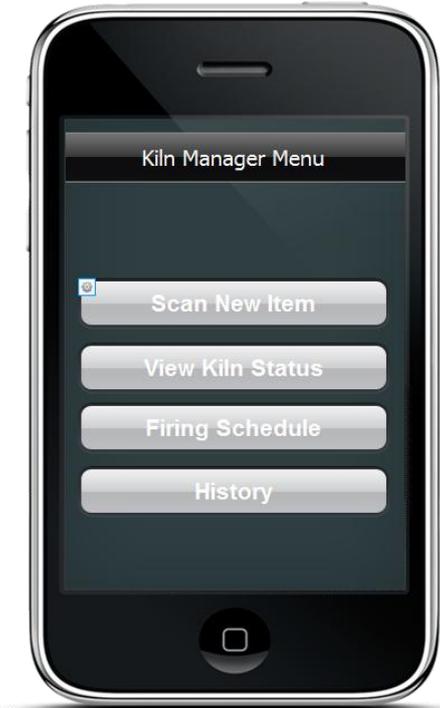
Mr. Kipling is looking forward to the new exhibition which is scheduled next month in which six of his students' ceramic artwork will be displayed. He is aware that most of the students have their artifacts ready to be fired and checks the shelf where students are supposed to place their artifacts. "Good! All 6 of them are ready", he exclaims and decides to schedule the firing of the kiln.

Mr. Kipling then uses his smart phone to take pictures of all the pieces and then starts to load them in kiln #1. He notices that the application could not estimate the dimensions of artifact 1 correctly due to its non-conventional shape and hence edits it by roughly measuring the artifact. By the time Mr. Kipling has finished adding five artifacts to Kiln #1, the application displays a warning 'The Kiln is 90% full'. When he tries to load Emma's piece (artifact #6), the application throws an error as there is insufficient space in Kiln #1.

Mr. Kipling then decides to go for kiln #2 as it is bigger in size than kiln #1. He then reassigns all the pieces to kiln #2 which is able to accommodate all six of them. Relieved, Mr. Kipling schedules the firing for coming Saturday.



Mock up screens:



1. User is presented with the main interface. User selects 'Scan New item'.



2. User scans the artifact using the camera and the application calculates the dimensions.



3. User assigns the artifact to the student and the kiln.



4. User views the virtual kiln to see where artifact is placed.

16.2. Alternative 2 – Computer Application

The original idea of this design comes from the Moodle Learning Environment which is widely used by a large number of students at many universities, including UNC Charlotte. The web-based Moodle system has many advantages: first, this system can be accessed by various devices, such as smartphones, PCs, and tablets. Second, since it is web based, students and advisors can login anywhere with internet access, whether at home or on campus. Third, students and advisors can have good communication through the system server. Based on these advantages, we integrated some of the components of Moodle into our ceramics system and designed a computer application.

The application would have two modules, one a web-based php program which provides access through web browsers, the other a shell, like SVN tortoise. Users can download the shell program to their own PCs from SourceForge and then do installation. When they launch the program, after login, they could access the database on the server.

Whether web browser module or shell module, they are both interfaces, and our users would run them as regular applications. Thus, both students and advisors can communicate with the information stored on the server. For students, they need to upload information regarding their pottery work, like dimensions, glaze information, and images. In our design, we have two kinds of uploading methods: manually and automatically. Manual upload requires students to measure the dimensions of their pottery, and then input the data through the program interface. The automatic method only requires students to put their works in the automatic measuring equipment. Then, the equipment cameras measure and upload the pottery data automatically. Instructors need to check the kiln arrangement result generated by the server according to the uploaded data. If he/she thinks the result needs some adjustment, he/she could adjust the arrangement manually through the interface. If the advisor judges a arrangement result is satisfactory, he/she could print it out and load the heavy pottery into the kiln based on it, rather than rearranging the pottery in real time. In addition, before the students' uploading, the advisor should set parameters of the kiln for the arrangement algorithm.

Pros:

1. Allows uploading multiple pieces at once
2. Two uploading methods.
3. Web based database system is accessible from any device
4. A printed kiln layout can be pinned to the wall, and if it is destroyed by the messy environment another can be printed

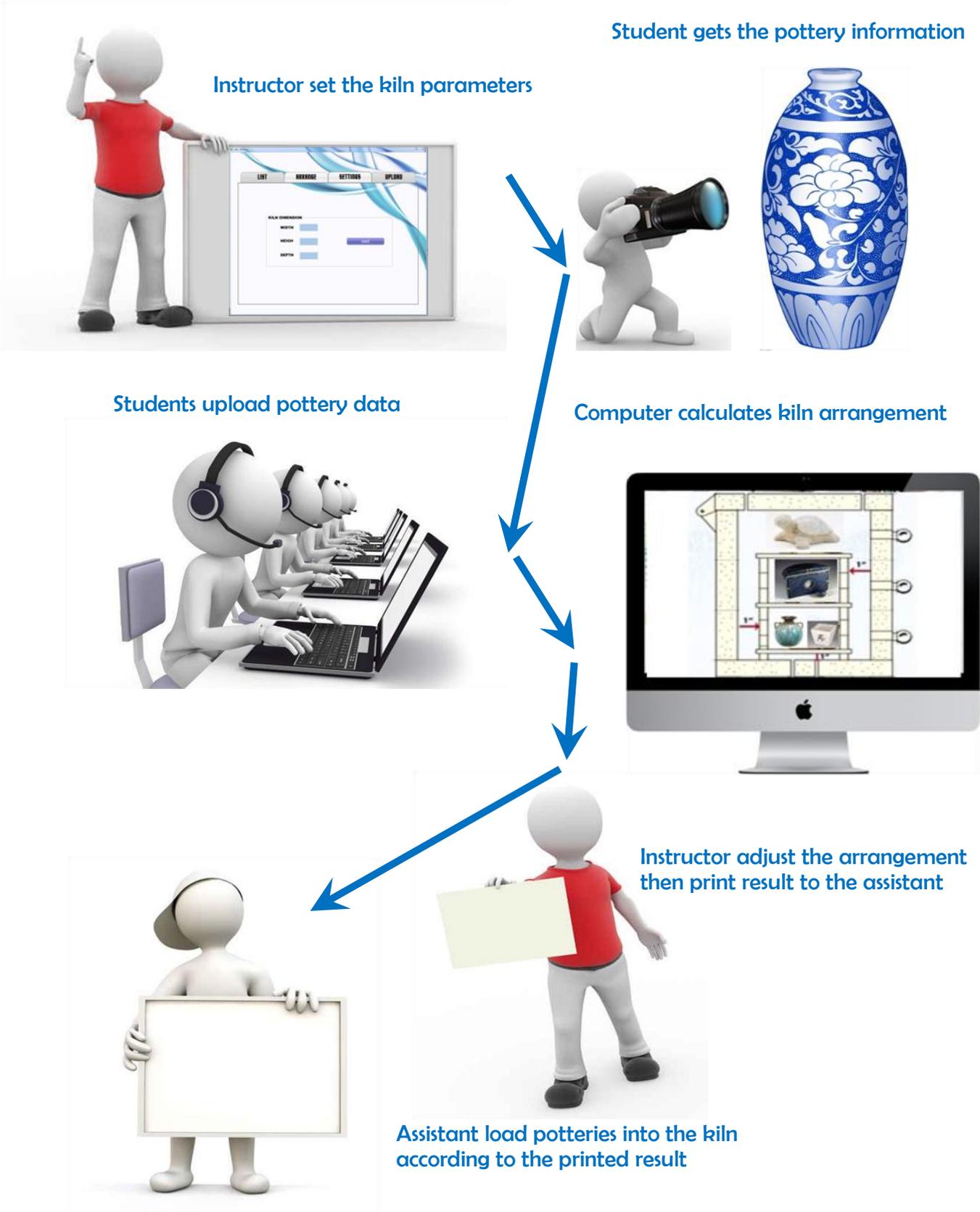
Cons:

1. Requires installing a camera system in the studios; expensive
2. No automatic feedback as to whether the calculation was successful
3. Requires additional movement of heavy and fragile pottery
4. Requires having a computer nearby to finalize the kiln layout

Scenario #1:

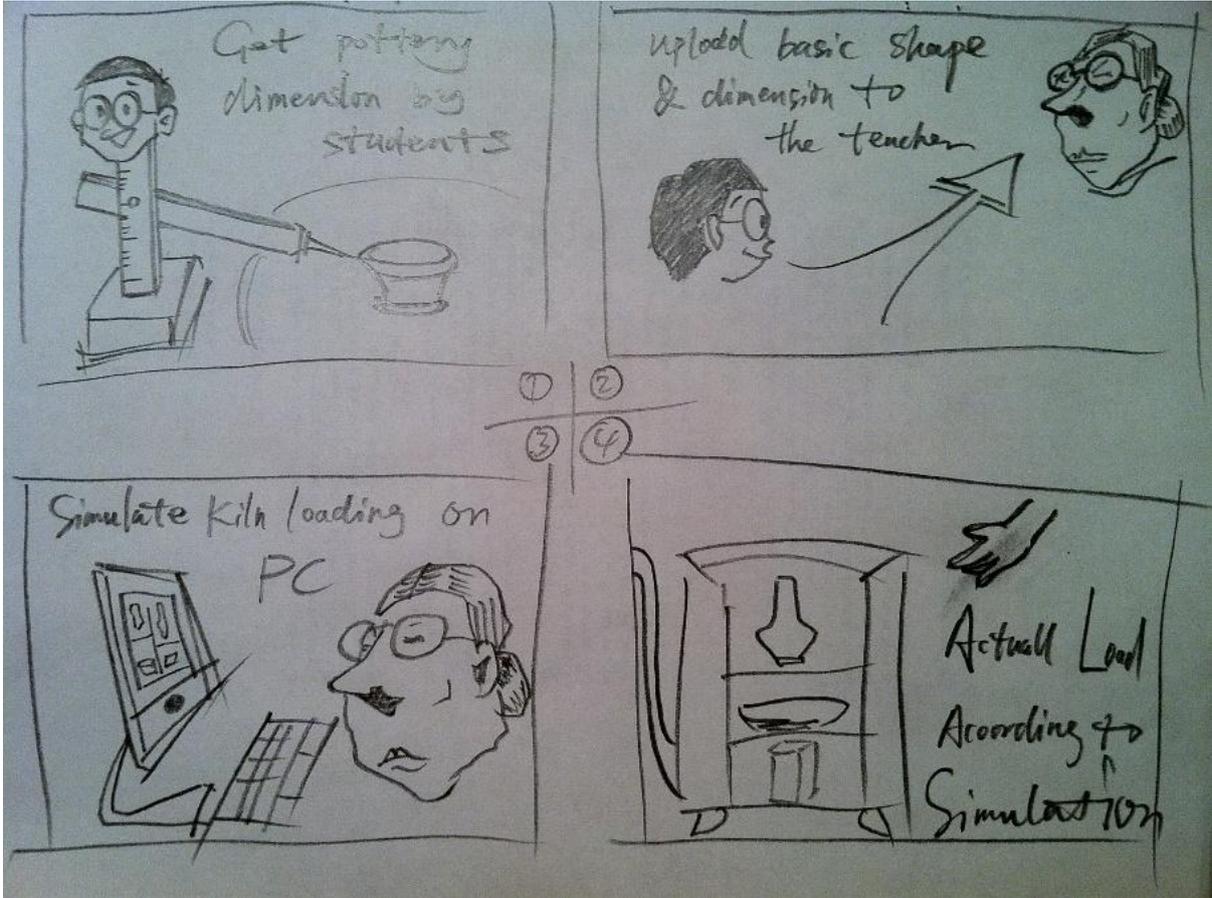
The deadline for submitting pottery projects is approaching, and many students are working in the studio. The course instructor, Mr. White, has set the parameters for the web-based kiln loading software (KIS) for the various kilns available to the students. Clark has just finished his work. He moves his pottery to the unused dust collecting machine in the corner and presses a button on the wall. The cameras mounted on the ceiling and wall photograph all of the pieces and calculate their dimensions and upload the data to the website. Lex has just finished as well, but his piece is large and heavy. Rather than move it to the dust collecting machine, he measures his work manually using a ruler, takes a photo with his cell phone and uploads his data using the Internet. When the software determines that the kiln cannot take any additional pieces, it sends an alert to Mr. White, who reviews the automatically generated layout and revises some of the locations manually. He prints the kiln diagram and gives it to his assistant Jimmy to load the kiln.

Kiln Loader for Ceramic Artists

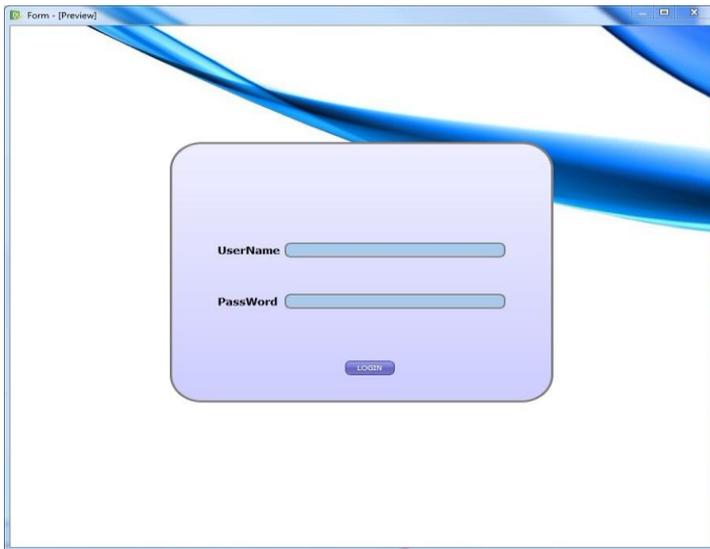


Scenario #2:

Student Lois got sick and cannot be on campus for at least one month, however, she is still working at home. She just finished one of her pieces and plans to submit her pottery data. Of course she has no automatic measuring equipment. Thus, she measures by hand using a ruler. She measures three parameters of her pottery: width 12", height 20", and depth 10". She takes a photo of her work and uploads it with the three parameters to the ceramic system through the internet. Instructor Perry checks the system, ensuring each student has uploaded his/her data, then, he adjusts the automatic pottery arrangement, then prints it out for real kiln loading.

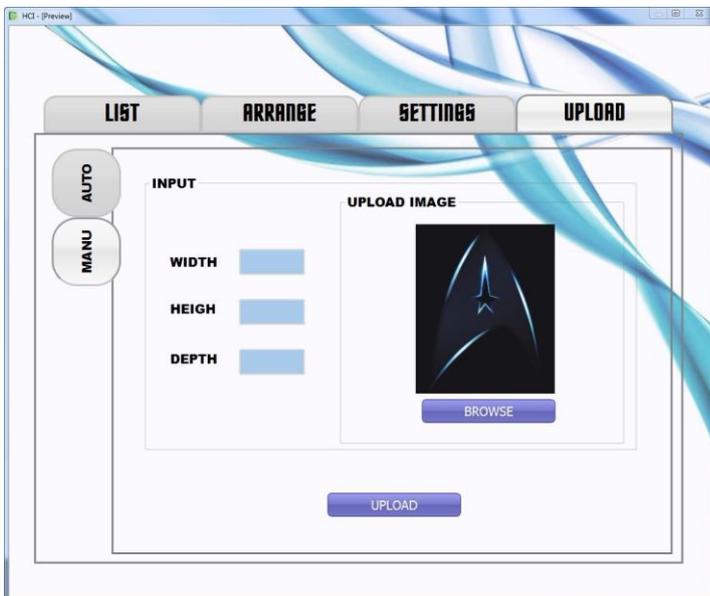


Mock up screens:



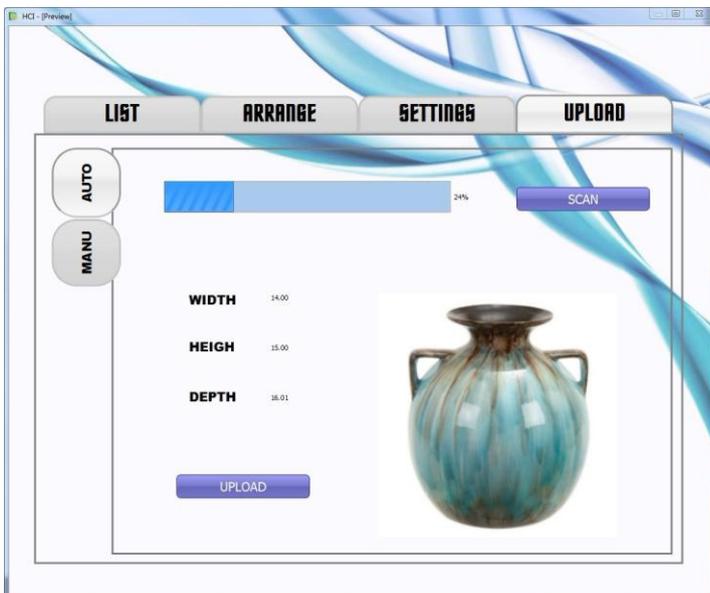
This is the login page.

After login, the student and instructor should see different contents based on their different authorizations.



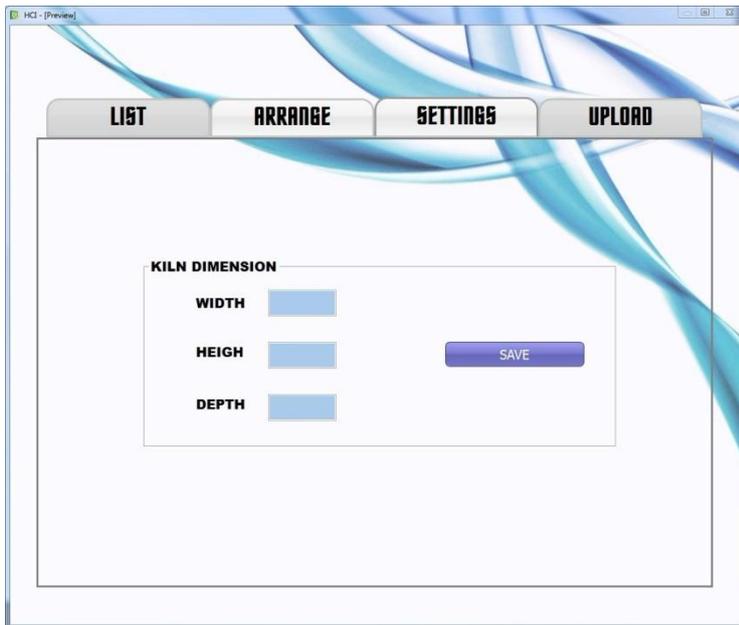
The upload tab contains two kinds of upload methods: automatic and manual.

In the sub-menu tab, students should upload the information of their works manually.



In the sub-auto tab, students could upload the pottery information automatically. In this method, maybe the students just put their pottery in a space surrounded by cameras and then push the SCAN button, the system will scan the pottery and get the dimension and picture of the pottery automatically.

Kiln Loader for Ceramic Artists

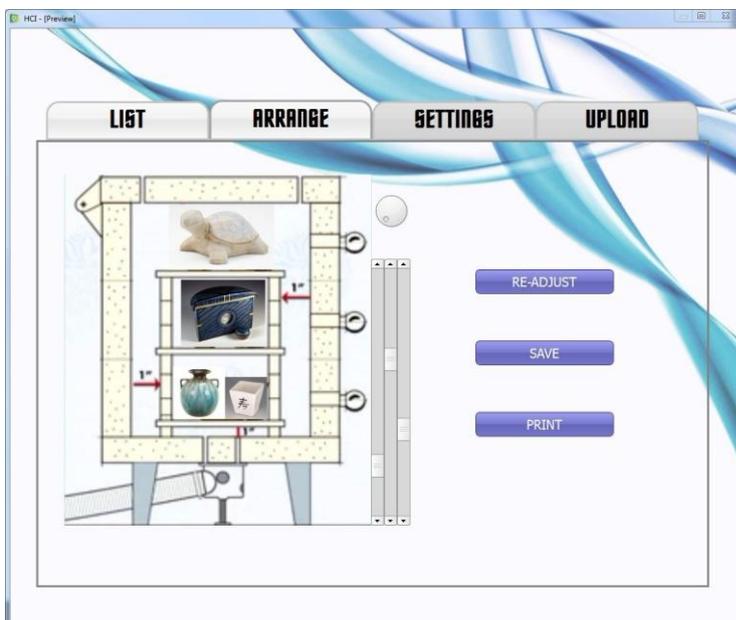


In the setting tab, the teacher or organizer has the authority to set the dimension of the kiln. (This software should be used according to different sizes of the kilns)

The screenshot shows the 'LIST' tab of the Kiln Loader software. It displays a table with the following data:

| | NAME | POTTERY | DIMENSION | GLAZED | THUMBNAIL |
|----|----------|---------|-----------|--------|-----------|
| 1 | | | | | |
| 2 | Amy | turtle | 13×13×13 | No | |
| 3 | Curtis | camera | 14×14×14 | Yes | |
| 4 | Priyanka | vase | 15×15×15 | Yes | |
| 5 | Jinbo | cup | 16×16×16 | No | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |

The pottery database updates their data automatically after the uploading of the students.



In the ARRANGE tab, actually, there is a 3D model which automatically show the optimized arrangement result generated by the computer.

Teacher or student could use the slider bars to rotate the 3D model to see the arrangement from different angles.

16.3. Alternative 3 – Custom Device

The third design is a custom hand-held device designed to provide maximum accuracy and flexibility in allowing our experts to input the spatial data of their work. The device is designed similar to a personal digital assistant (PDA) device in its form factor, and in the types of controls it employs. The device functions utilizing multiple laser measuring sensors and a low-quality digital camera to acquire the required data for the task.

The device is designed to be kept in a charging cradle mounted on the wall of a ceramics studio, or in a kiln room. When the device is first removed from its cradle it will greet the user with a menu requesting that they select an option. The primary options are: Add Piece to Queue and Load a Kiln. The simple menu design is to maximize efficient use of the device and minimize confusion over the operation of the device.

If the user selects “Add a Piece” the device will activate the camera and provide an overlay animated graphic to direct the user in how to get the best possible reading of their piece. Once the user frames their piece in on-screen grid, they are directed to press the data acquisition button on the device. Once the acquisition button is pressed, the device takes readings of its distance from the face of the piece. This information is combined with the photo to estimate the dimensions of the piece. At this point the user is asked to confirm that the dimensions are reasonable for the piece being scanned. The problem most likely to occur in the process is the wrong object is measured; this step helps the device correct that error. Once the dimensions are confirmed the user is asked if they would like to enter another piece, or take additional measures for the current piece. If they continue to another piece, the process repeats. If the user decides to enter more information, then on-screen instructions guide the user through how to rotate their piece for optimal additional readings. The device will attempt to match the faces of the object to generate a virtual representation of the piece. At the conclusion of piece entry the user will be asked to input their ID and to select whether the piece is to fire as glaze or bisque. In mixed-ware environments, the user may also be asked to select a firing range (high-fire, low-fire).

If the user selects “Load a Kiln” they will be prompted to decide if they will select which kiln to use, or if the device should select a pre-configured kiln based on the size of the load waiting. Once the kiln is established, the device will calculate how to load the kiln to fit the most pieces in for a single firing. If more ware exists than will fit into a single kiln, the pieces will be sorted based on a set of factors (such as time the piece has been waiting, absolute most optimized kiln load, or local factors such as deadlines) determined by the kiln administrator. The device software will output a chart showing the steps for loading the kiln, including insertion of kiln furniture and the actual pieces. The user will be able to move pieces using the on-screen display if they desire to make manual changes to the calculated load design. When the user is satisfied with the diagram they will select “Begin Interactive Load” and the device will guide the user through loading each piece, including identifying the basic shape of the piece. The user will be reminded of common mistakes while they are loading (such as allowing glaze ware to touch, or forgetting to put a cone in a sitter kiln).

If the user would like to load a kiln, but not be bound to the small device screen while loading, the user may download the data from the device to its companion desktop software for printing a loading diagram, or making changes to the diagram using a standard mouse.

The device utilizes several safety factors for its own survival in the environment. The exterior of the device is covered in a rubber material that is designed to absorb impacts from drops and also protect the device from moisture, including full submersion. The device design also includes a thermal sensor that will trigger an audible alarm if the device reaches

170° F, this is to protect the device from accidentally being left in the kiln as it begins to ramp¹ toward a high temperature.

Scenario 1:

It is a Thursday afternoon and Ms. Rogers, a ceramic artist and art instructor, is checking on her beginning wheel ceramics students and realizes that many of them have ware ready to fire. Ms. Rogers announces to the class that she will load the kiln to fire over the weekend. As each student completes their present task, they retrieve the ceramic scanner from its charging base on the wall of the studio. Each student places their work on the work tables, then holds up the device a few inches from their work, pressing the button to scan their work. Once they have a green light, then return the device to the base and move their work to the kiln loading area.

Once every student has scanned their work, Ms. Rogers takes the device to her office computer and plugs it in to retrieve the data and print a loading schematic. Ms. Rogers could obtain the diagram directly from the device, but prefers using a hard copy from the desktop-software counterpart. On this particular day Ms. Rogers is advised by the software to use electric kiln #3. She retrieves the kiln furniture that is suggested by the application, and begins loading the kiln one layer at a time. Once loading is complete she places her desired protection cone in the sitter and sets the computer control for a slow firing to cone 06. Ms. Rogers enters this data into the device, it returns an estimated firing time. Ms. Rogers goes home much more relaxed than in the days of trial-and-error kiln loading.

Pros:

1. flexible, can be plugged into a traditional desktop or as a mobile application
2. Not as time consuming for instructors, as students can scan their own work
3. Device is resistant to messy ceramics environment

Cons:

1. Expensive
2. potentially difficult to learn to use, as it is not a familiar device

¹ Ramping is the process of heat-work used in kiln programs, whether computerized or manual, to reach the desired temperature. These are usually carried out in stages, such as room temperature to 200° F, then 200 to 1000° F, and finally 1000° F to the final temperature.

17. Poster Session Feedback

Many viewers had very positive comments on our poster. Several people were concerned about the fact that a smart phone would be used in an environment which is messy and filled with clay and there are high chances of the phone getting damaged, which further reinforces our belief in physical robustness as a key component of a successful design.

Many people agreed that web based system makes students and instructors communication much more convenient. One viewer had a significant point: “You should also allow users to change the location of the generated layout.” This is important, and we also have added this function into the system. Some viewers inquired about the automatic measuring equipment. They noted that a shortcoming of this kind of measuring equipment is that it would be expensive.

Also, there were concerns regarding the accuracy of the dimensions of the artifact to be captured. As the calculation would be done based on the picture of the artifact, there were questions on how the width of the artifact will be capture using a 2D image. We will need to emphasize the need for users to check the dimensions calculated by the system, particularly when pieces are not symmetrical.

There was also a suggestion of providing a sync feature with a PC, so that users would be able to see the virtual kiln on a bigger screen which people felt would be more helpful than trying to figure out where the artifacts are placed on the small smart phone screen.

18. Summary

After receiving feedback on the poster session and exploring more in-depth scenarios with our designs we discovered that overall our designs are likely to meet the needs of our clients. During the poster session we learned that most people reacted negatively to the idea of using their personal cell phones in a ceramic studio for taking the measurements required to solve the kiln-loading problem. There was considerable positive feedback for design #2, the computer application and measuring equipment installed in the studio. There were no major changes to the requirements for our designs from this first part of the project. Some minor changes include a clearer understanding of the type of measurements that will be required of the system and a formal statement of our intention to allow whatever software is integrated into the system to change between units easily so that the measurements can be validated easily by any user, regardless of the system of measure they are most comfortable with. During the poster session the difference between a top-load diagram and front-load diagram were noted as potential problems. We have now formalized the intention to present views of the kiln that are consistent with the way in which the kiln is to be loaded. While this issue may have been confusing for the lay during the session, it is something that is apparent to experts in ceramics or to anyone who is interacting with the kiln. One of the most important things learned during this component of the project was that there are many ways to implement our solution, but only a few basic form facts in which we can reasonably execute the solution. All solutions thus far require software that is designed in a similar way, whether running on a desktop PC or on a custom hand-held device, the basic layout and operation of the software is similar. Our designs met with overall positive reactions and we are ready to move forward with refining these designs and selecting a final design that we will present to our experts for evaluation.

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20. Glossary

Clay

Clay differs from the inelastic earths and fine sand because of its ability, when wet with the proper amount of water, to form a cohesive mass and to retain its shape when molded. This quality is known as clay's plasticity. When heated to high temperatures, clay also partially melts, resulting in the tight, hard rock-like substance known as ceramic material.

Cones

Full name is pyrometric cones. Pyrometric cones are used to measure the effect of the kiln's atmosphere on the glazes being fired. Cones are made up of refractories, such as silica, and melting agents; each type of cone is carefully formulated and manufactured for accuracy.

Extruder

Machine which forces plastic clay through a die to produce extruded clay shapes

Glaze

A ceramic substance, made from a combination of clay material and colorants (such as iron oxide and cobalt), suspended in water and intended to be applied by dipping, spraying or brushing on to a piece of pottery. The melting temperature of the material is usually several hundred degrees below the melting temperature of the clay body it is intended for use on. When fired, glazes become molten and form coherent silica structures, which result in a glass-like surface on the ceramic object that is fully vitreous, regardless of the state of the underlying claybody.

Kiln

A furnace or oven for burning, baking, or drying, esp. one for firing pottery

Potter's wheel

Potter's wheels (pottery wheels) have been used for thousands of years. Some have been powered by hand and others by foot, but all have had one thing in common: a heavy flywheel used to build up and store momentum and torque. One version, the kickwheel, is the most common form of human-powered wheel used by modern potters in the United States today.

Slab Roller

A slab roller is a mechanized but usually manually operated device for rolling out large uniform slabs of clay.

Slurry

Slurry is very, very closely related to slip. Both are liquefied clay, or suspensions of clay particles in water. Slurry tends to be thicker and is used to join pieces of leather-hard clay together.

Vitrification

Vitrification is process by which a ceramic body becomes fully solid and unable to be penetrated by water.

Kiln Loader for Ceramic Artists



Ease tension by taking up a new hobby.
You might want to try throwing pottery.



UNC CHARLOTTE

Principles of Human Computer Interaction

Spring 2012

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21. Project Description

Our goal is to support ceramic artists by facilitating the kiln loading process. The specific task we intend to support is finding an optimal, or close to optimal, arrangement of pieces to be placed in a kiln. To accomplish this task, our process must support both input (collecting dimension data for the pottery pieces) and output (displaying the kiln arrangement to users). Our intended users are all ceramic artists, although those who deal with the largest number of pieces, such as teachers, would benefit most. (For this reason most of our scenarios focus on instructors.) One of the reasons we chose this problem was that it affects all ceramic artists. Also, according to our expert evaluations, the kiln-loading process is both time-consuming (taking up to a full day) and dangerous, as pottery is most likely to break when moved. Further, this is one task more suited to algorithms than human brainpower, and using computers to solve this version of the knapsack problem would allow ceramic artists more time to spend on their artwork.

The design that we have selected is a web-based application which can either be accessed from a computer or from a smart phone. As mentioned earlier, the design is logically divided into two major functionalities – Collecting dimensions data for the pottery and displaying the kiln arrangement. We believe that collecting dimensions can be more effective with a mobile device as the users will be on a move and a smart phone would prove to be handy, whereas kiln arrangement can be best visualized on a computer. Hence we have given flexibility for the user to either use it on a smart phone or on a computer.

22. Requirements Summary

The system should be able to provide an efficient way for getting the dimensions of the artifact and displaying the kiln arrangement. The process of getting the dimensions should be quick and easy to learn as people might use it while on the move and would want to get things done quickly with minimum number of steps. The system should also be flexible enough to be used both on a computer and/or on a smart phone.

22.1. Functional Requirements

- **Automatic dimension input**
The system should be able to determine the dimensions of a piece (or pieces) without the user needing to measure and then manually enter the dimensions.
- **Manual dimension input**
The system should allow users to enter pottery dimensions manually, whether for the user's convenience or to correct an error.
- **Photo input**
The system should take a photo of the piece as a means to identify it.
- **Output display**
The system should display the kiln layout in a way that is easy to understand and is conducive to loading the kiln. For instance, for a kiln loaded from the bottom to the top, a side view might be inappropriate.
- **Administrative privileges**
 - The system should have special administrator accounts that will allow users to:
 - Manage users of the system
 - Manage user's privileges

- Manager kilns

22.2. Non-Functional Requirements

- **Ease of use**
The system should not require more than basic technological knowledge. It should be easy to learn and use; for instance, instructors should be able to expect students to use it without requiring individual instruction.
- **Physical durability**
The system should be able to withstand the heat, moisture and mess of the ceramics environment.

22.3. Usability Requirements

- **Learnability**
 - **Predictability**: users must be able to understand what each system option will accomplish
 - **Familiarity & Generalizability**: the system should leverage users' existing knowledge to aid in ease of use
 - **Explorability**: it should be impossible to accidentally cause irreversible changes, such as deleting a photo or a kiln arrangement
- **Flexibility**
 - system pre-emptive
 - **Task Migratability**: the system should prompt the user when it encounters a task it is uncertain about; for instance, it might request the user verify that the highlighted objects on the screen are all in fact pottery pieces
 - **Substitutivity**: the system should allow for easy conversion between units of measurement used
 - System should be able to run on any operating system and browser.
- **Robustness**
 - **Observability**: users should be able to understand at a glance what part of the system they are in (input or output), and the system information should be easily browsable
- **Memorability**
 - The system should be easy to learn and remember and should put less cognitive load on the users.

23. Envisioning Cards Values Discussion

23.1. Card 1: Work of the Future

The work of the future could be different from our current work module. A prominent feature will be that more of the human work load, either mental or manual, will be greatly facilitated by intelligent machines. According to the current technical trend, the future work will be much more efficient. For instance, a motor factory almost only needs one technical worker with remote control to handle various tasks like painting, assembling and forging done by smart machines.

However, as we speak now, the Artificial Intelligence does not seem to be so advanced as we had expected it to be about 25 years ago. Thus, Intelligence Amplification (IA) is more widely accepted right now. Since computers have already played a role as human intelligence amplifier, we expect they will do more feasible work in the future. For one

thing, computers play a major part as taking most of workloads from human; for another thing, although it is hard for computers to evolve themselves and replace some high intelligent or creative work of human, they could still help our intelligent and creative thinking.

For a specified area like ceramic art, computer aided work flow will help a lot. Actually, currently, most of the ceramic manufactures are being done by intelligent machines, obviously, in the future, more intelligent ceramic machines and specified computers will play more important role. However, the ceramic design will still strongly rely on human creativity. Moreover, different from mass industrial production, ceramic artists should be supported by computer techniques in different forms.

What we need to do is to use the computer as a great intelligent amplifier of the artists. As stated before, computers should take as much repetitive works as possible and leave the creative part for the artists and help them realize their creative ideas. Absolutely, our ceramic design is not perfect. According to the trend of future work, we should apply more advanced HCI technologies to release more unnecessary work from artists and help them to test, manufacture and revise their work in a short time. Most of the repetitive work would be finished by machines. The value of human work will be more creations than production.

23.2. Card 2: Non-targeted Use

Here are three examples of non-intended use for our system, in order of how “nefarious” the purpose is. First, someone might use the system simply to keep a record of their pottery—what they produced when, and what it looked like at each stage of firing. This is not misuse at all if an individual is using the system, and could possibly be helpful, though our system is not designed to support such usage. (It should have a place for notes and a more time based feature, and an ability to display multiple images of the same piece.) However, such usage could possibly hog system resources unfairly if the system is implemented at a school or group studio.

Second, it is possible that someone could use the system to deny others access to resources (the kilns). They could start firing a kiln when they see that another group has almost enough pieces to fire, or a student who sees that the kiln is almost full might hurry to submit their piece before their classmates do (perhaps not letting go of the classroom scanning device?) to ensure their piece enters the system first and is accepted into the kiln load. I’m not sure this would be a problem in actuality, however, because the system shouldn’t take this information into account when creating the kilns—but if the perception is there, the same problem would occur.

Finally, someone with full administrative access who was drunk or horribly angry at ceramic artists could do irreparable damage to the system, deleting everything and removing everyone’s access privileges. It would probably be a good idea to not allow admins to remove other admin’s access, and perhaps allow admins control only to delete pottery pieces/kiln layouts based on collections they have rights to. One positive is that no administrator has access to anyone else’s passwords, so a vandal couldn’t pass it off as someone else’s work.

23.3. Card 3: Envisioning

Variation in human ability is a factor that impacts the use of a system. People experience different levels of ability in sight, hearing, touch, speech and motor control. Abilities can also be impacted by the context in which a system is being used.

Our system can be impacted by visual impairments and motor control difficulties. To accurately enter measurement information for each piece into the system, the end-user must be able to read the text on the screen, or use a screen reader. The photographic component of the prototype presents additional difficulty for the visually impaired person, as vision is required to compose the image to be captured. Additionally, physical motor control is required to stabilize the device to capture the image, and the end-user must have the ability to enter data using a keyboard, mouse or other data entry device.

It is anticipated due to the visual and physical nature of ceramics that all end users will have the capability of at least limited sight, and significant motor control. In a classroom studio situation, assistance is likely to be available for any user who does not have the ability to enter their data.

The kiln loading portion of the application utilizes only a visual representation of the output, and therefore is not adaptive to users who do not have the ability to see. This is not anticipated to be an issue because of the physical and visual interaction that must be performed in the physical world to load a kiln.

There are no hearing considerations for this project as we do not utilize audio feedback.

23.4. Card 4: Choosing not to use

If any of the stakeholders of our system decide not to use the system, it can impact them personally as well as have an adverse impact on the entire system. Considering the educational environment, following are the three examples illustrating what can happen if the users after using the system many years from now deliberately choose to not use it -

Firstly, if the ceramic expert who is in charge of loading and firing the kiln, chooses not to use the system, then it will personally affect his/her performance as he/she will have to spend additional time using trial-and-error technique to see what goes where in the kiln which can hamper the overall schedule of the kiln firing and can also increase the cognitive load on the user.

Secondly, if the administrator decides not to use the system or the professor who also has administrative privileges decides not to exercise the administrative option, then it can make the system inefficient and even partially dysfunctional. Imagine an instance where one of the kilns has stopped working. If the status of the kiln is not updated as 'Out of Order', then others might end up loading their pieces into the kiln only to later realize that it is not working and to redo the entire task of loading the kiln. Also, if a new student has not been added into the system, he/she won't be able to load any pottery using the system.

Thirdly, if the student decides not to use the system, then it will affect his/her efficiency as he/she will have to either approach the professor in charge of the kiln to load the pottery and if all the students start doing that, then the professor will have an overhead of getting and managing each piece's information. Also, if the student decides to completely bypass the whole process and just go ahead and put the piece in the kiln, then it can fail the entire purpose of automating the kiln rearrangement task.

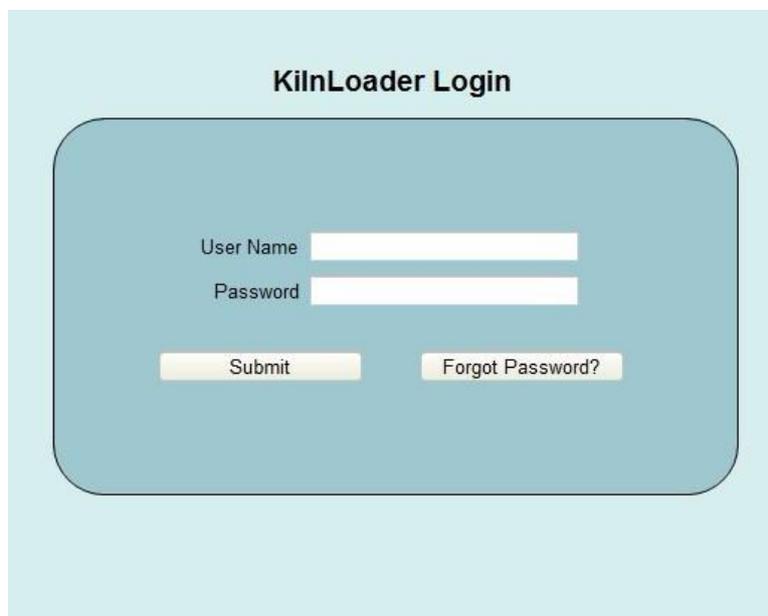
24. Design Summary

The interface design that we have finalized will be a web-based solution that can be accessed from either a mobile device or from a desktop computer. The interface is unified to include both end-user and administrative functions on the same system, varying the visible options based on the authorization level of the user logging in. The administrative users can login to manage available kilns, configure end-users and set overall permissions and parameters for use of the system. The end-users may log in from their smart phone or a desktop computer to enter details of their ceramic work, to place them in the queue for firing. The application streamlines the overall firing process, keeping the end-user more informed about the status of their work and helping studio staff or instructors keep track of the amount of work that needs to be fired, which ultimately will speed up the ceramic process and decrease the turn-around time from piece completion to firing completion. On the side of studio staff, the software will assist in selecting the appropriate kiln(s) for firing the amount of ware that has accumulated since the last firing and will display a diagram for the most efficient way to load each kiln. Ceramic artists are hands-on people and there is no way for the software to know all of the special cases that may arise in a studio situation, and as such, the person loading the kiln can manually move pieces around in the virtual kiln and the software will recalculate the position of the other pieces to be optimized while still allowing the preferential placement of special-case pieces.

25. Prototype Description

Following screenshots demonstrate various functionalities of the Kiln Loader application:

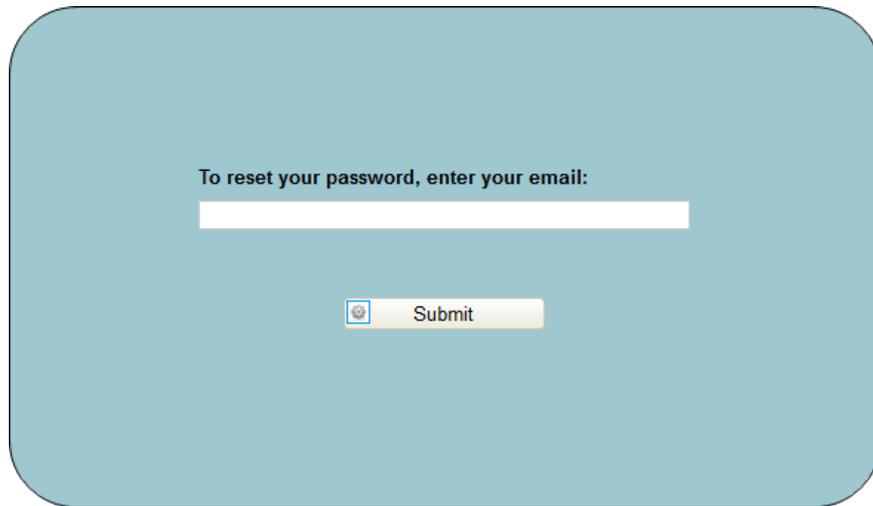
Login:



The screenshot shows a login interface for 'KilnLoader'. It features a light blue background with a central rounded rectangle containing a darker blue background. The title 'KilnLoader Login' is centered at the top. Below the title, there are two input fields: 'User Name' and 'Password'. At the bottom of the form, there are two buttons: 'Submit' and 'Forgot Password?'.

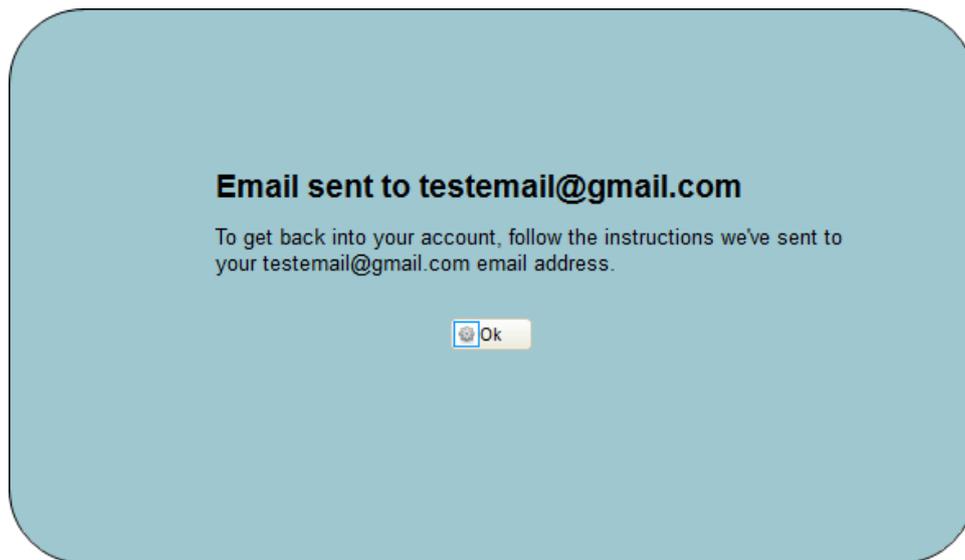
The login page is the gate of the software. The screen will be common to the security expert or course advisor, administrator and students. Depending on the user who has logged in, the system will automatically show/hide various menu options based on user's privileges. An administrator account will have access to all the features and menu options of the system. Once the user logs in, **Main Screen** (discussed below) will be displayed to the user.

If the user forgets his/her password, on clicking the '**Forgot Password?**' button, the system will display the following screens to the user:



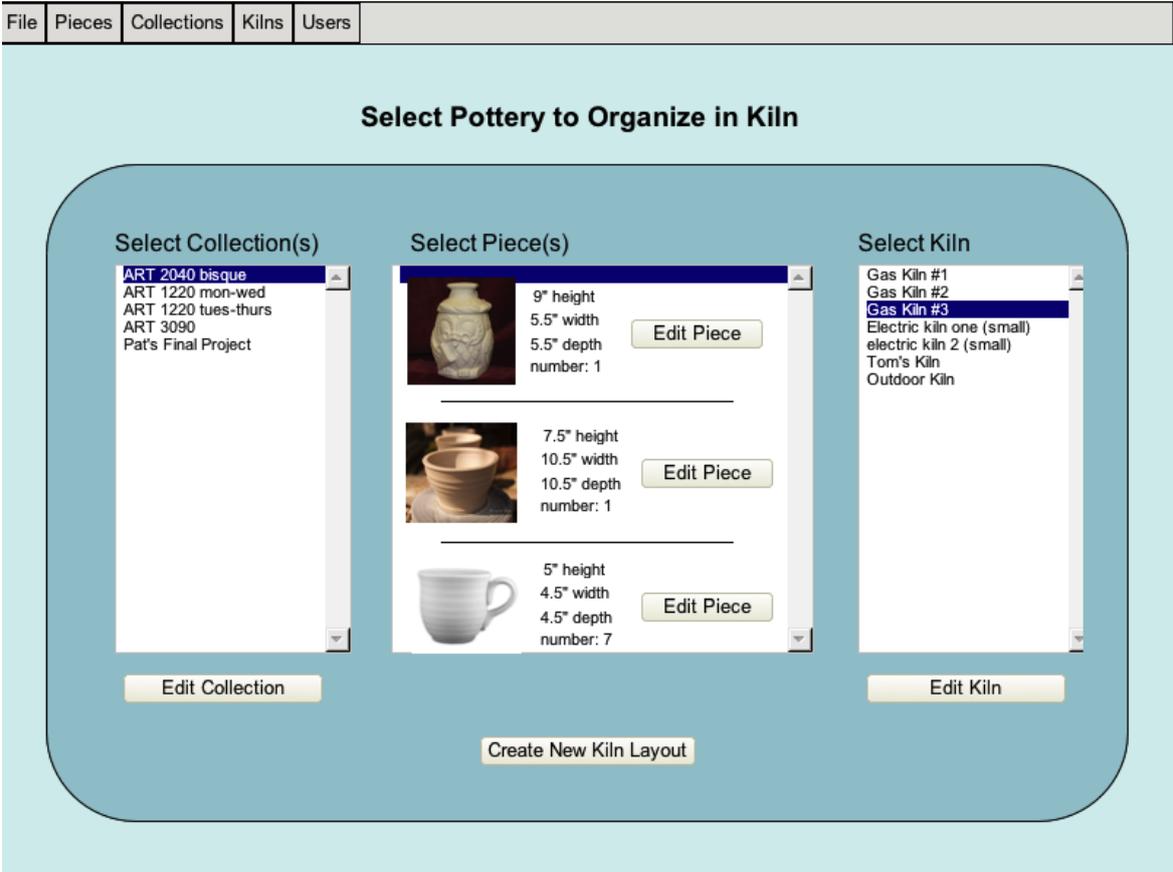
The screenshot shows a light blue rounded rectangular dialog box. At the top, it says "To reset your password, enter your email:". Below this is a white text input field. At the bottom center, there is a button with a gear icon and the text "Submit".

Once the user enters the email ID, the system will send an email to the user and a confirmation of it will be displayed to the user as follows:



The screenshot shows a light blue rounded rectangular dialog box. At the top, it says "Email sent to testemail@gmail.com". Below this, it says "To get back into your account, follow the instructions we've sent to your testemail@gmail.com email address." At the bottom center, there is a button with a gear icon and the text "Ok".

Main Screen:



This is the main page of the application, from which the vast majority of the functionality can be reached, and from which pieces are selected to be placed into kilns and layouts produced. The **Select Collection(s)** option on the left allows the user to select a collection; the pieces in the selected collection will then appear in the middle window. A collection can be edited by selecting it, then pressing the **Edit Collection** button underneath the collection list.

The **Select Piece(s)** section allows a user to perform multiple tasks. A user can view the pieces in a collection, editing pieces with the “**Edit Piece**” buttons as needed. Further, if a user wishes to create a kiln layout using only some of the pieces in a collection (or collections), they can highlight the desired pieces and the system will only consider these.

The **Select Kiln** section allows the user to select the kiln in which they would like to fire the selected pieces. A kiln can be edited by selecting it and then pressing the **Edit Kiln** button. When a collection(s) (or specific pieces) and a kiln have been selected, the **Create New Kiln Layout** button can then be pressed to access the Kiln Layout View screens.

Menu Options:



The menu at the top of the screen is consistent for the majority of the program; therefore we describe its functionality in this section. (Note that several of these items are not yet

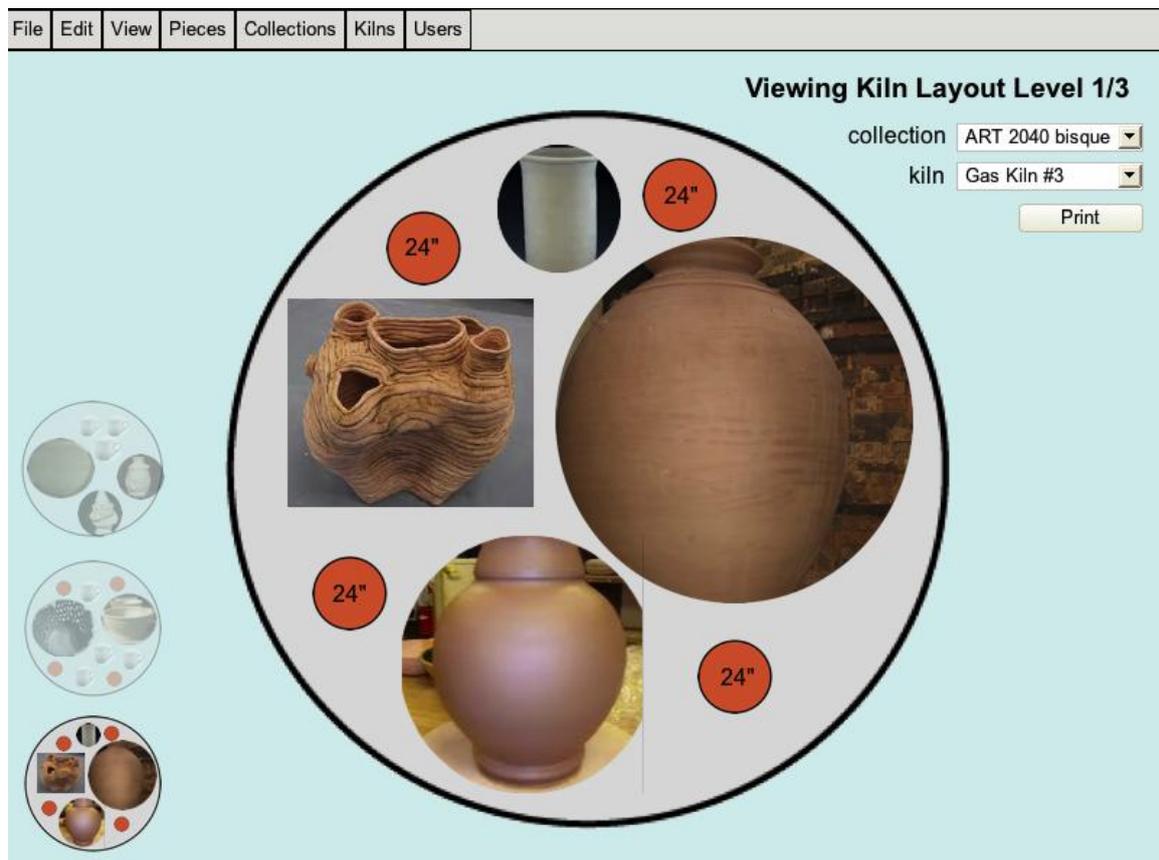
implemented.) Under File, the user has the option to create a “new” kiln, layout, piece or other object, depending on the current screen. The user is also given the option to Exit **KilnLoader**.

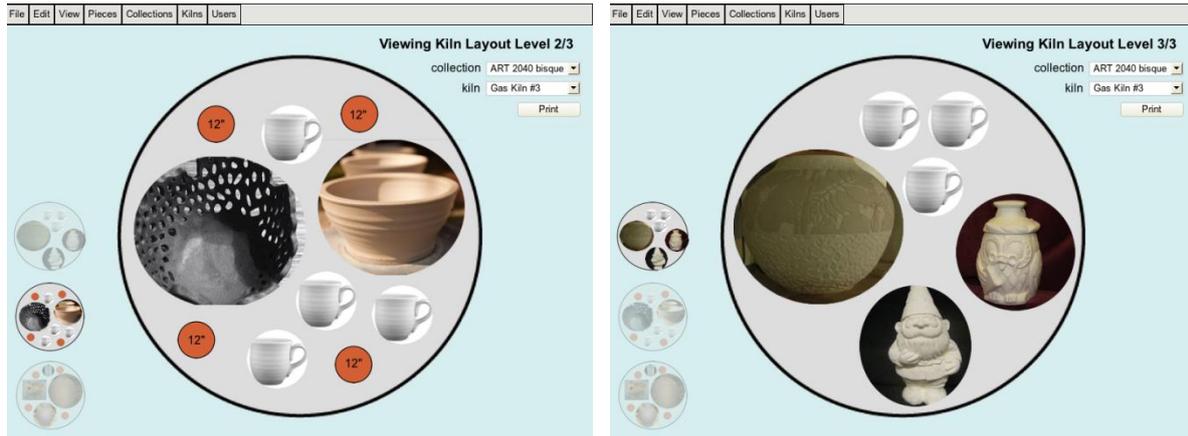
The Pieces option has two options: **New Piece**, which takes the user to the New Piece screen where they can input data for a new piece of pottery, and **Edit Piece**, which allows the user to view existing pieces and choose one to edit. The Collections option is similar; **New Collection** allows the user to create a new collection, specifying its name, and Edit Collection allows the user to choose a collection to edit or delete.

The Kilns option is similar to the Pieces menu option. (This functionality is not given to all users, depending on their permissions levels.) New Kiln allows a user to input kiln information; Edit Kiln Parameters allows a user to choose a kiln to edit or delete, and **Edit Kiln Furniture Parameters** allows the user to edit the availability and type of kiln furniture the system can use.

Finally, the Users menu option (again, not available to all users depending on permissions levels) allows the user to perform administrative tasks regarding managing others’ use of the software. **Add User** directs the user to the New User page; **Manage User Permissions** to the page that allows administrators to decide the permissions of each user individually, and **Manage Default Permissions** directs to the page that sets the default permissions for new users.

Kiln Layout View(s)





The kiln layout view shows the final layout of pottery pieces in the kiln as automatically generated by the program. The current layer of the kiln being viewed is represented by the large shape in the center of the screen. All the kiln layers are visible, from topmost to bottommost, on the left side of the screen; the non-current layers are grayed out, and can be accessed by clicking them. The current kiln layer is also indicated by the title in the upper right corner of the screen.

The pottery pieces are shown as photos cropped to the size of the pottery piece's 'footprint' in the kiln; for instance, a long, narrow piece would have a long, narrow photograph to visually indicate how the piece is to be placed in the kiln. The **orange** circles indicate the location of kiln furniture, that is, the blocks that support the kiln shelf above this one. (Note the topmost shelf does not have furniture.) The size of the furniture (height in inches, although all measurements can be toggled to centimeters) is written on the orange circles. The photographs can be clicked to access the Edit Piece page for each piece of pottery.

The current pottery collection and kiln are shown in the upper right corner of the screen, and can be changed using the drop-down menus. This will cause the program to recalculate the arrangement using the new space and/or pieces. Further, the final layout can be printed using the Print button also available in the upper right hand corner.

Besides the regular menu options, the kiln layout screen has several unique options. Under File are **New Kiln Layout** (which returns the user to the Select Pottery to Organize in Kiln screen), **Save Kiln Layout** (which saves the layout to be accessed later), **Print Kiln Layout** (another method for printing) and **Delete Kiln Layout** (which deletes a saved layout). Under Edit, there are options to change collection and change kiln (providing the same functionality as the collection and kiln buttons in the upper right hand corner). Also under Edit are **Edit Kiln Parameters** (to edit the kiln currently in use) and **Edit Kiln Furniture Parameters** (to edit the number and types of kiln furniture available – this is a “set up” feature that should rarely need to be used). The last option under Edit is **Manual Arrangement**, which is currently set to off. When on, this option allows the user to manually arrange pieces within and between the kiln layers and then print the resulting layout. This functionality is provided for instances when advanced factor such as glaze type need to be considered. The final additional menu option is View, under which are two view options which can be toggled: **View Furniture** and **View Photographs**. The former allows the user to remove the kiln furniture if desired. The

latter removes the photographs, replacing them with outlines; this may be more practical for viewing and/or printing depending on the layout and pieces in question.

New Kiln:

The screenshot shows a web application interface with a navigation bar at the top containing tabs for 'File', 'Pieces', 'Collections', 'Kilns', and 'Users'. The main content area is light blue and features a rounded rectangular form titled 'New Kiln'. Inside this form, there are five input fields: 'Name' (a text box), 'Type' (a dropdown menu with 'gas (square)' selected), 'Height' (a text box), 'Width' (a text box), and 'Depth' (a text box). At the bottom of the form are two buttons: 'Save & Return' and 'Cancel'.

When the administrative users become aware of a new kiln in their studio, they will visit this screen to specify all of the dimensions for the kiln, as well as select its type. After completing this screen, the kiln will be available in the system for use.

Edit Kiln:

The screenshot shows a web application interface for editing kiln information. At the top, there is a navigation bar with tabs for 'File', 'Pieces', 'Collections', 'Kilns', and 'Users'. The main content area is titled 'Edit Kiln' and contains a form with the following fields: 'Name' (text input containing 'Gas Kiln #3'), 'Type' (dropdown menu showing 'gas (round)'), 'Height' (text input containing '4' 2\"), 'Width' (text input containing '3' 5\"), and 'Depth' (text input containing '3' 5\"). Below the form fields are three buttons: 'Delete', 'Save & Return', and 'Cancel'.

This screen provides the user the opportunity to update the information for a kiln. Previous information is retrieved from the system, and the user is able to modify the values to reflect accurate information about the kiln.

Add/Edit Pottery Piece:

| | | | | |
|------|--------|-------------|-------|-------|
| File | Pieces | Collections | Kilns | Users |
|------|--------|-------------|-------|-------|

Add/Edit Pottery Piece



Height

Width

Depth

Collection

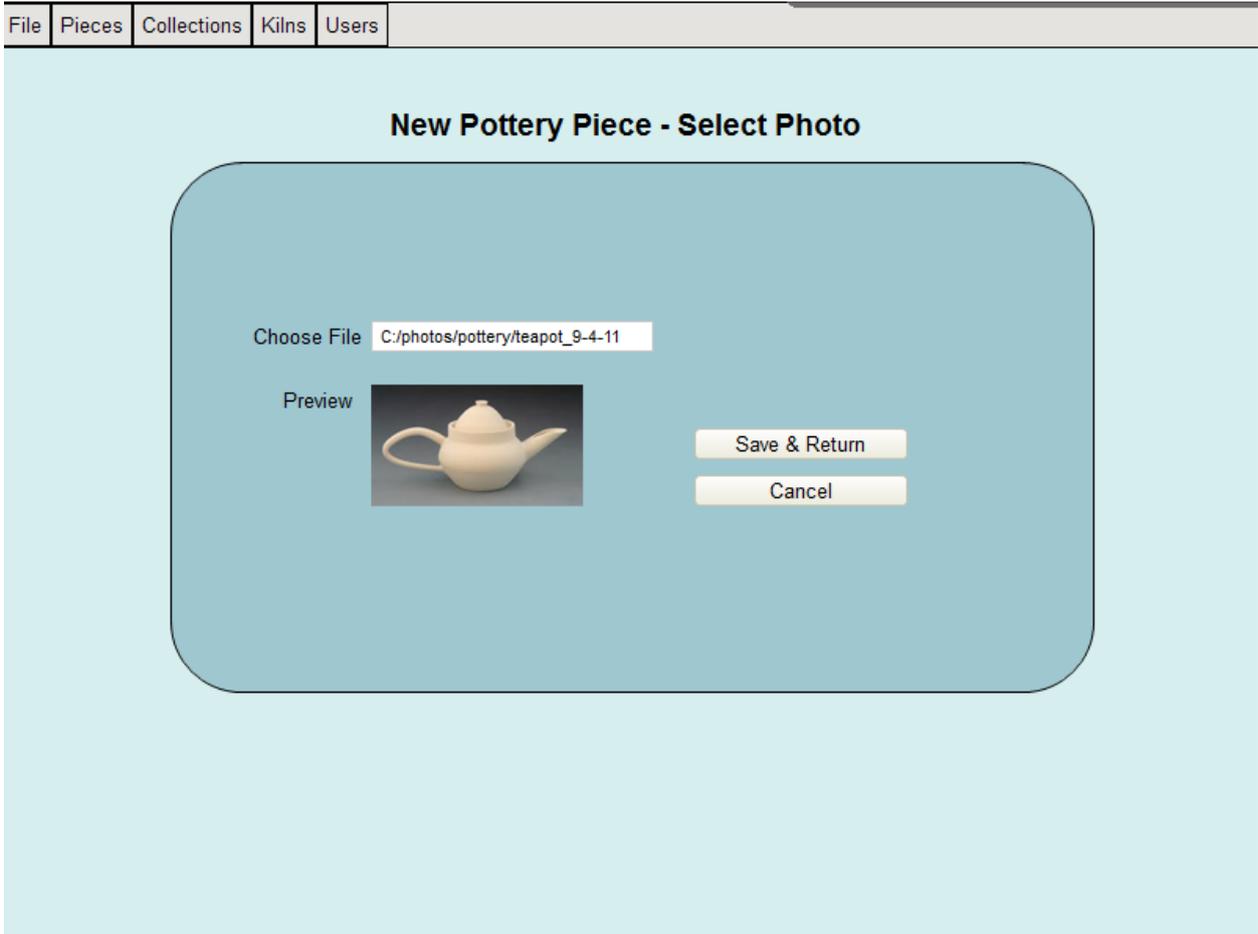
How many

If a piece has not yet been fired the user may visit this screen to update the dimensions, perhaps to account for shrinkage in the medium, or to change the number of pieces that are in a set of similarly shaped pieces to be fired. This screen can also be used to move a piece to another collection, or to delete the piece completely.

New Pottery Piece:

The screenshot shows a web application interface for adding a new pottery piece. The top navigation bar includes 'File', 'Pieces', 'Collections', 'Kilns', and 'Users'. The main content area is titled 'New Pottery Piece' and features a light blue background. On the left, there is a square placeholder with a diagonal 'X' and a 'Choose Photo' button below it. To the right, there are three input fields for 'Height', 'Width', and 'Depth'. Below these fields is a 'Convert to centimeters' button. Further down, there are two dropdown menus: 'Collection' (currently set to 'ART 2040 bisque') and 'How many' (currently set to '1'). At the bottom of the form, there are two buttons: 'Save & Return' and 'Cancel'.

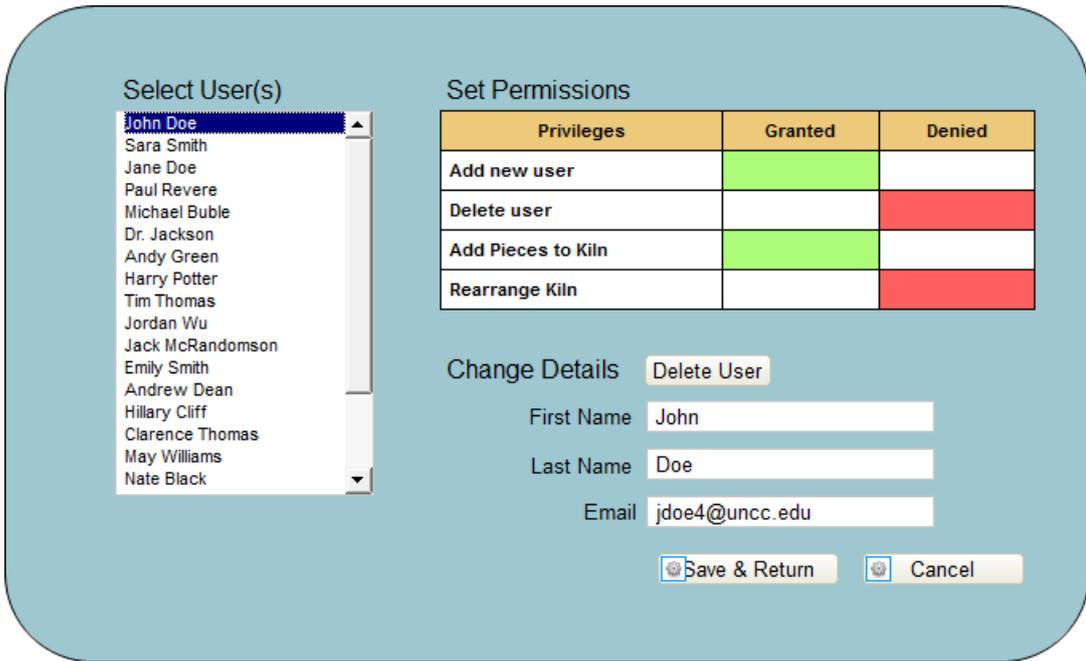
Upon selecting the option to add a new pottery piece to the collection, they are presented with a screen that asks for the input of a photo and manual dimension entry. At this stage the user will select which collection to add the piece to, as well as how many there are. This screen will accept units in either inches or centimeters. Upon completing this screen, the user can select “Save & Return” to go back to the piece overview.



From the add piece page, the user will select an image of their piece for the purposes of identification and for estimating the size of the piece.

User Administration Screens:

1. Set user permissions



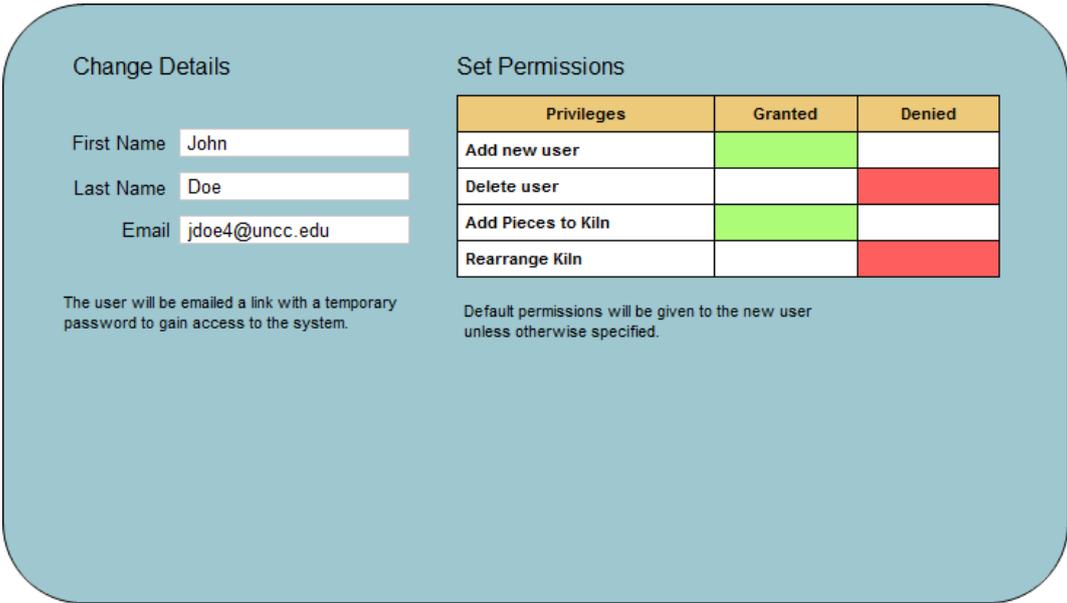
This page allows an administrator to view and edit permissions and details for each of the user. The current users of the system are displayed in a list present on the left panel. Clicking on a user displays his/her permissions of the right panel that can be viewed or edited. **Delete User** button allows the administrator to delete the selected user.

2. Edit default permissions:



Whenever a new user is created into the system, default permissions are given to the users. These default permissions are shown in the above screen. The **Edit Default Permissions** screen will allow the administrator to edit the default privileges to be given to the new user.

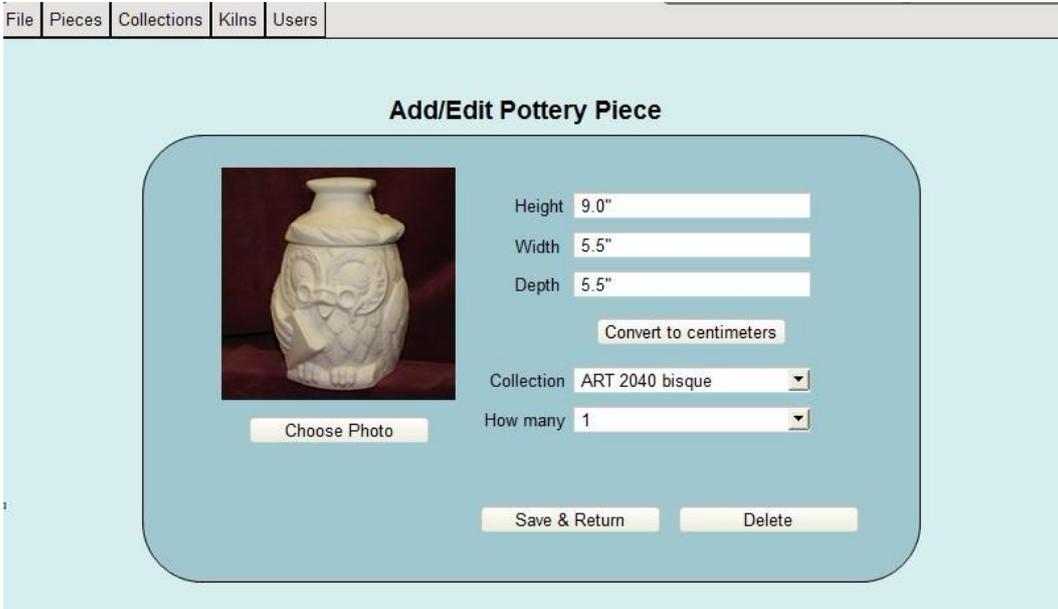
3. Add New User



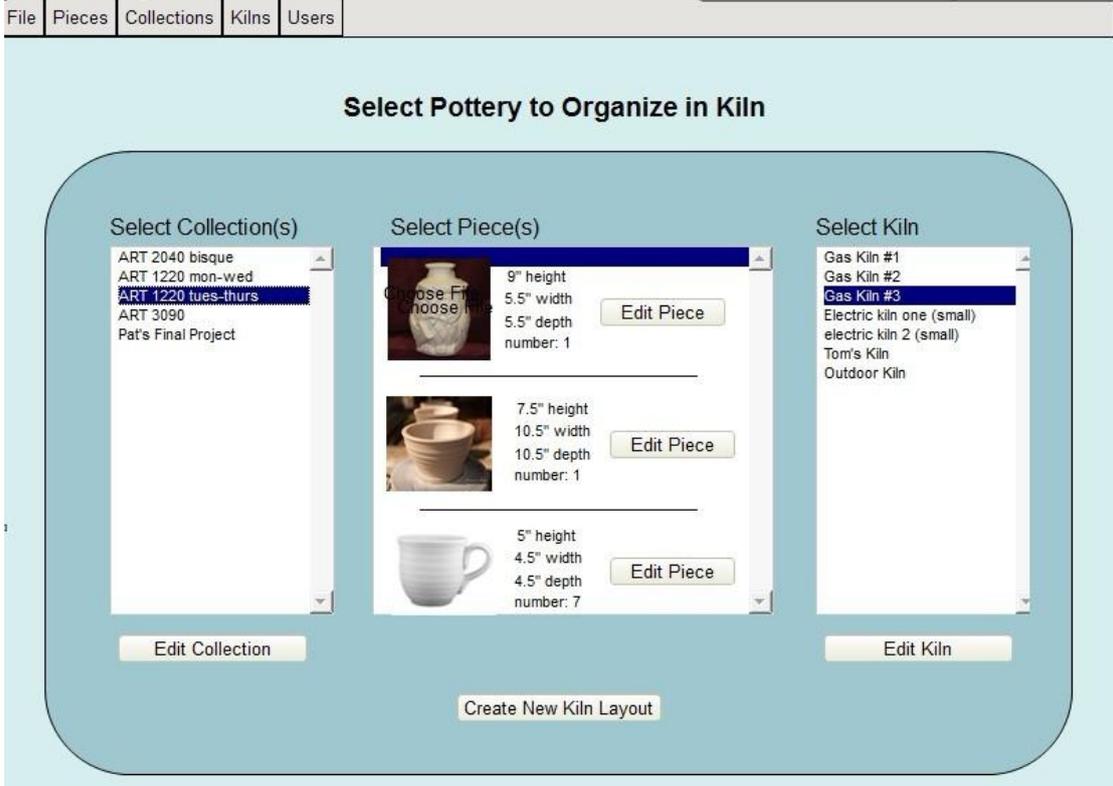
This screen allows the administrator to add a new user to the system. Administrator can set the basic information for the new user and a link to access the system with a temporary password will be emailed to the new user.

End-user Scenario:

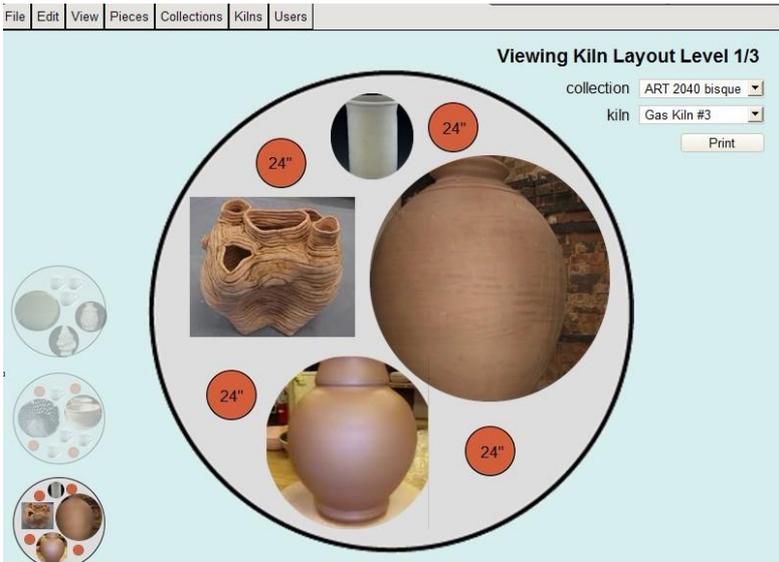
Student Ruth has just finished working on her owl shaped vase and decides to submit it for firing. She logs on to the web application using her credentials and selects the **Add/Edit Pottery Piece** option to add her vase. Since she had already taken the dimensions of the piece, she prefers to use the application in manual mode. She enters the following details: width 5.5”, height 9”, depth 5.5” and quantity 1 and submits it to her instructor Ms. Rogers.



When Ms. Rogers logs onto the system, she sees that Ruth has submitted her vase which is not loaded into any of the kilns. Ms. Rogers selects it from the ‘Select Piece(s)’ section and select gas kiln #3:



Once she selects Create New Kiln Layout, the software displays her arrangement of the pieces one layer at a time:



She saves the arrangement and realizes that it is almost full and there is no place for anymore pieces. She then prints the kiln diagram and gives it to her assistant Jimmy who will load the pieces into the kiln. Ms. Rogers feels much more relaxed than in the days of trial-and-error kiln loading.

26. Evaluation Plan

The evaluations will be conducted on our functional prototype in order to predict the usability of the product by evaluating the potential for errors and difficulties faced by the users prior to the product release. The target group will include around 5-6 expert ceramic artists and the advanced ceramic art students.

The goal of the evaluation is to understand whether:

1. Participants are able to complete the given tasks within specific time limits.
2. Participants are able to find relevant information for the tasks with the given information.
3. Participants are able to complete the tasks without getting frustrated or confused.

The evaluation will be initiated with a brief introduction to the system wherein all the participants will be given a power point presentation on how the application works and what are the main features of the application. The presentation will be sufficient for the users to get familiar with the system, but at the same time it will be ensured that the users are not given information of how to carry on the tasks that will be given to them for evaluation purposes.

Post presentation session, each of the users will be handed over a list of tasks that they need to carry out on the application. Since the system can be used both on a computer and a handheld device, the participants will be divided into two user groups and a between-group study will be carried out where each group will be either be given a mobile device or a desktop to work on.

Following sequence of tasks will be given to the user:

1. Use the manual option to enter the dimensions of the pottery and load it into Kiln#1.
2. Use the auto option to take the dimension of the pottery and load it into Kiln#1.
3. Manually override the arrangements of Kiln #1 to move Vase #2 to the bottom shelf.
4. Use history feature to find out when Kiln#2 was last fired.
5. Login as an administrator (username and password will be provided) and complete the following tasks:
 - a. Add a new user (Details of the user will be provided)
 - b. Delete an existing user (Details of the user will be provided)
 - c. Change Kiln dimensions (Kiln number will be provided)

User observation technique will be used in order to observe the users while they carry out the tasks. Notes will be taken to find out the number of steps taken by the user to carry out each of the task, problems faced by the participant, various user errors, inability to complete any of the tasks and any indication of joy or frustration. Participants will be requested to think-aloud in order to understand their mental model of the task and their approach to carry it out.

After all the tasks are complete, a post evaluation questionnaire will be given to the participants to share their opinions on the product's usability and their overall experience of the product. Following questions will be included in the questionnaire:

1. On a scale of 1 to 5(1- very easy; 5- very difficult), how easy was the interface to use?
2. On a scale of 1 to 5(1- very easy; 5- very difficult), how easy was it to manually enter the pottery dimensions?
3. On a scale of 1 to 5(1- very easy; 5- very difficult), how easy was it to use the auto option to capture the pottery dimensions?
4. On a scale of 1 to 5(1- very easy; 5- very difficult), how easy was it to view the kiln arrangement?
5. What did you like the most about the system?
6. What did you not like about the system?
7. What additional features would you like to see in the system?
8. Did any of the tasks frustrate you or took you an unnecessary amount of time?
9. On a scale of 1 to 5(1- Awesome; 5- Terrible), how would you rate your overall experience with the system?
10. On a scale of 1 to 5(1-Ofcourse! 5- No ways!), will you be willing to train other users on the system?
11. On a scale of 1 to 5(1-Ofcourse! 5- No ways!), will you be willing to use the system in the future?

27. Final Summary

During this part of the project, we were able to narrow down on a single prototype and refine it to accommodate various functionalities. We took the best from two of our initial prototypes- mobile based application and a desktop application and merged them into a single web-based application that would facilitate both the options. We realized that both the options are important for the usability point of view and hence combination of the two prototypes will help make the application more flexible and enhance user experience.

Most of the usability requirements have remained unchanged except for the robustness part. Earlier we were focusing more on the robustness, but when we revisited our usability requirements, we realized that using the existing interfaces and making the system mobile would be more useful and cost effective than making the application robust. Also, it would increase the availability of the system as most of the users own smart phones. The robustness of the application will now depend on the robustness of the smart phone and the desktop.

We used JustinMind prototyper to design the high-fidelity prototype. We first brainstormed on how our final prototype should look and what features should it have. Once the design was finalized, we split up the major logical sections of the design and each one of us created a prototype using the software and ensured that GUI features discussed during the meetings were incorporated.

One of the challenges that we faced during the design was how to display the three dimensional kiln in two dimensions without affecting the user experience. Earlier we had two options of either displaying a 3-dimensional kiln or a 2-dimensional kiln, but each of them had some disadvantages. A 3-D kiln would have been difficult to see on a mobile device whereas a 2-D kiln would not have been able to correctly depict the position of the pieces in the kiln. This was resolved in this design by displaying the top view of one layer

of the kiln at a time, giving flexibility to the user to select the layer he wants to see. So, this was the design change that we made in this prototype.

The functionality of manually overriding the kiln arrangement suggested in the requirement phase and earlier prototypes was not implemented in the final system, as we realized that letting the user manually override the complete kiln arrangement would defeat the whole purpose of automating it and at the same time might lead to various user errors like incorrect positioning of the piece in the kiln, overloading the kiln beyond its capacity etc.

By incorporating the above mentioned changes in the high-fidelity prototype, we believe that our system will effectively meet the user's needs and will be easy to use and learn.

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29. Glossary

Clay

Clay differs from the inelastic earths and fine sand because of its ability, when wet with the proper amount of water, to form a cohesive mass and to retain its shape when molded. This quality is known as clay's plasticity. When heated to high temperatures, clay also partially melts, resulting in the tight, hard rock-like substance known as ceramic material.

Cones

Full name is pyrometric cones. Pyrometric cones are used to measure the effect of the kiln's atmosphere on the glazes being fired. Cones are made up of refractory, such as silica, and melting agents; each type of cone is carefully formulated and manufactured for accuracy.

Extruder

Machine which forces plastic clay through a die to produce extruded clay shapes

Glaze

A ceramic substance, made from a combination of clay material and colorants (such as iron oxide and cobalt), suspended in water and intended to be applied by dipping, spraying or brushing on to a piece of pottery. The melting temperature of the material is usually several hundred degrees below the melting temperature of the clay body it is intended for use on. When fired, glazes become molten and form coherent silica structures, which result in a glass-like surface on the ceramic object that is fully vitreous, regardless of the state of the underlying claybody.

Kiln

A furnace or oven for burning, baking, or drying, esp. one for firing pottery

Potter's wheel

Potter's wheels (pottery wheels) have been used for thousands of years. Some have been powered by hand and others by foot, but all have had one thing in common: a heavy flywheel used to build up and store momentum and torque. One version, the kickwheel, is the most common form of human-powered wheel used by modern potters in the United States today.

Slab Roller

A slab roller is a mechanized but usually manually operated device for rolling out large uniform slabs of clay.

Slurry

Slurry is very, very closely related to slip. Both are liquefied clay, or suspensions of clay particles in water. Slurry tends to be thicker and is used to join pieces of leather-hard clay together.

Vitrification

Vitrification is process by which a ceramic body becomes fully solid and unable to be penetrated by water.

Kiln Loader for Ceramic Artists



Ease tension by taking up a new hobby.
You might want to try throwing pottery.



UNC CHARLOTTE

Principles of Human Computer Interaction

Spring 2012

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30. Problem Area

The selected problem space is that of the loading of a high-temperature (up to 2500° F) ceramic kiln. Loading a ceramic kiln is a difficult and time-consuming process that in most instances is not completed to the highest level of efficiency. Traditionally the ceramic artist must either sketch a diagram to determine how to arrange the kiln, or attempt to load the kiln by trial and error. Both of these methods have been relied upon for centuries. These methods can be precise when applied correctly, but they represent a large amount of time that is consumed by the artist that could otherwise be spent in pursuit of artistic goals.

While the traditional methods of kiln arrangement can be used effectively, even given infinite time, artists may become frustrated with the process of loading the kiln and ultimately run the kiln in a less than optimum configuration. An inefficient kiln load costs more than time. If the amount of ware loaded in a kiln is not the largest amount of ware that can be possibly loaded, then additional loads will be necessary that may have been trimmed from the firing schedule.

Another concern with an inefficient kiln load is uneven firing and slow firing. The ceramic process is based on heat-work. Electric elements or gas burners will fire on a set interval to slowly increase the temperature of the kiln. Vitrifying ware (in bisque) or rendering glazed molten (glaze/final firing) requires that the kiln not only reach the required temperature, but hold that temperature for a specific set of time. This level of heat work is measured in a system of cones². Oxygen gas is not a good form of matter to hold heat at the temperatures required for these firings and as such the kiln structure, kiln furniture and ware itself are responsible for holding heat. An inefficient load will have holes, which will encourage uneven firing as well as a waste of energy as the heat dissipates in the gaps.

The problem space is to combat the waste of time and waste of energy which occurs through inefficient kiln organization by solving the problem programmatically.

31. Proposed Design Solution

The proposed solution is a web-based application which will allow ceramic artists to electronically inventory their work and utilize the inventory to create a diagram for loading their kilns in the most efficient way possible. The application is designed to be used from a desktop PC, a kiosk-style interface, a smart phone or any other type of personal device with web-browsing capabilities. The application allows for the input of the dimensions of ware and a photograph to identify the ware. Each piece does not have to be input individually. If the artist works in sets or creates similarly sized pieces, then the artist can enter dimensions in an object template and then specify the number of that type of object that will be in each firing. Once ware is entered it is classified into sets or collections that can be manipulated to be assigned to a kiln and ultimately appear on a

² Cone refers to a pyrometric cone, a pyramid shaped measuring device that is composed of ceramic elements that are designed to warp at a specific level of heat-work (Cone 04 = ramp to 1940° F at 170° F/hour). In electric kilns small cones are typically used to automatically shut down a kiln. In gas kilns, large cones are used to monitor the level of heat work performed in the kiln.

kiln firing diagram. The solution allows the user, or the users' administrator to enter information about the kilns that are available as well as the kiln furniture that is available for use in each kiln. This allows the solution to be customized to each studio or classroom in which it is used. Once a kiln layout is designed, it is not static. The kiln layout can be customized by the artist to take into account variables that cannot be anticipated by the software, such as glazes that do not perform well together or other special circumstances. One potential use case that can never be programmatically anticipated is the arrangement of a salt or sodium bicarbonate kiln that is designed to favor a particular piece or set of pieces to receive a certain level of vapor coverage. The distribution of vapor varies with each kiln as well as with the artist's technique for introducing the sodium solution. Allowing the user to customize the load still takes advantage of the optimized loading technique, while still being flexible to the user's needs. Once the kiln diagram is finalized it may be viewed layer-by-layer or displayed in a printer-friendly way.

32. Evaluation Techniques

To evaluate the design of our proposed solution we decided to take our solution to the very users for whom it was intended, ceramic experts. We utilized the ceramic faculty (Ms. Janet Williams and Mr. Keith Bryant) as well as students in advanced ceramics courses such as Ceramic Projects and Ceramic Materials to evaluate the prototype. These experts were selected because we feel that they best represent the target audience of our solution, as they interact with kilns on a daily basis and work in a ceramic studio where there are limited resources that must be shared by the faculty, advanced students as well as beginning students. The studio uses all major types of kilns (electric, gas, raku and vapor) and has an assortment of ware, from functional work to large sculpture.

We selected to evaluate our system by introducing the users to the system without instruction after being given a brief description of the purpose of the software. Our evaluation plan included a set of tasks that each user was to perform after orienting themselves in the system and a form for a formal reporting of their results. Our instruction instrument (Appendix A) was written to guide our experts through tasks that will be commonly performed by a user, such as adding users to the system, adding pieces to a collection and creating a kiln layout. Our survey instrument (Appendix B) is designed with several Likert items and several free response questions. These questions are designed to assess the ease of use of the application, the ability of a user to accomplish the needed tasks as well as general opinion of the features.

The time during which we were invited to have our experts evaluate our solution was during a class meeting in which the advanced students and both faculty members would be gathered. After meeting with our experts for a few minutes it became clear that our evaluation plan would ultimately not result in the most valuable data, as unlike many participants our experts wanted to "think aloud" and freely explore the system, discussing their findings as they proceeded. As a result the evaluation plan was amended on site. The evaluation plan that was put into place involved allowing the users to freely explore the software, with prompting if requested, ask questions and provide verbal feedback on their impressions of the software. The users were observed by at least two members of our team at all times. Users were encouraged to continue to think aloud as they explored the software and attempted to accomplish tasks in the software. Verbal comments were written as the users expressed them, and clarification was requested where necessary.

Before we took our design to our experts, a discount evaluation and a cognitive walkthrough were performed in the classroom. The discount evaluation allowed experts to evaluate the prototype by judging its compliance with the heuristics list provided by us (Appendix C). The cognitive walkthrough used an instruction instrument (Appendix D) similar to that which was included in the expert evaluation plan. Two groups of peers were asked to perform tasks in the software and report their findings.

33. Design Rationale

Our evaluation plan was centered on collecting valuable data that would allow us to know our users' impressions of our system. Our goal was to keep the user at the center of our design process. The initial formal evaluation plan was structured in such a way to allow the user to perform tasks in the interface with the limited set of tasks that can be accomplished in the prototype at this stage of development. The instructions instrument was constructed to allow the user to interact with all aspects of the interface in a pre-defined way. The instructions instrument did not instruct the user in how to perform the tasks, only to perform them. This method was selected as a way to determine if the prototype is learnable. A survey instrument was constructed to collect quantifiable data about the responses of our subjects. The intention for this data was to construct a numerical understanding of how well our users felt that the prototype could meet their needs and appeal to them if it were to be implemented. The open-ended questions in our survey instrument were implemented to gather qualitative data that could be directly applied, such as suggestions for features or specific changes that the users would like to see in our design.

Due to our user-centered plan for evaluation we switched to the alternate evaluation plan because it put our users more at ease and was a closer fit to the type of environment our users are accustomed to working in. The introduction of the prototype to the room without close control over the interaction between users or between the users and the system was a closer to representation to how the participants would have reacted to the new system being installed to their environment. The ceramic environment is very social and cooperative, especially in a classroom studio setting. Through observing the users' reactions to the system without a firm structure we could collect data on their real reactions more than would have been possible with the pre-arranged tasks. Ultimately this evaluation process was a better fit than the initial plan because of the receptiveness of the participants, which is something that could not be anticipated in advance.

34. Study Results

Final Expert Evaluation:

The results of our evaluation were encouraging, as all potential users found the concept intriguing and/or potentially useful. We were happily surprised by their profoundly positive reaction to incorporating technology into their workflow, considering their current limited use of electronics. We also received a positive reaction to the problem we chose to address, with all participants interested (and one extremely enthusiastic) about a better solution to the kiln loading problem. When conducting our think-alouds, we received ample feedback on many topics, which we have categorized into the following main areas:

- Clarification of labels
- Unclear tasks
- Improved visualization of kiln layout
- More options for organizing pieces
- More options for a more realistic kiln layout
- Possible other features

The first topic that was widely addressed was the need to clarify labels and generally better organize the menu system so that navigation and other interactions were clearer. For instance, all of our participants asked us how to go “back” from the kiln display page to the main page. One of our experts requested better labeling for the layers of the kiln display, as was also suggested during our in-class review. Another label noted to need clarification was the “how many” field, which as-is requires explanation. Another participant asked for clarification regarding whether they needed to manually input the “inches” mark after entering a length, indicating that what needs to be put in the text box needs clarified. Further, several participants stated that they would like to view more information regarding the kilns from the home screen (mostly size data). The kiln “edit” button was also noted as needing changed; as one participant pointed out, kilns don’t need editing, they are always the same size. Finally, our participants, while understanding the collection concept for categorizing pieces after it was explained, did not find it immediately intuitive. When prompted for alternative names, one suggested either “group” or “load”.

The next topic we received feedback on was unclear tasks. This is closely related to the previous section, as unclear labels led to unclear task progressions. Specifically, participants were unclear how to add a new piece to the system, and how to select collections. Further, the layout on the main page needs clarification to indicate that the pieces in the middle are part of the collection selected.

We also received lots of feedback on improving the virtual kiln layout to better match how real kilns are laid out. This area was particularly important, as we need our kiln layout to match the way ceramic artists work. One major point discussed was the need for a distinction between bisque and glaze firing, as in glaze firing pieces cannot touch, while in bisque firings pieces can touch and even be stacked within each other. One participant stated that they would like to choose the type of firing earlier in the process, rather than as an option once pieces have already been selected. Other practical considerations include the need to load the kiln with the larger pieces on top, the proper positioning of kiln furniture (in a square, with furniture in the same spot on each level), and the use of props and kiln shelves as well. One participant requested an additional front view for side-loading kilns, to match what is actually seen by the artist. Overall, the kiln model top-down layout was well accepted, but is abstract enough to cause confusion; making the kiln appearance less abstract may resolve this.

The fourth area in which we received feedback was the need for more options to support effective kiln loading. Examples include: support for more kiln shapes (hexagonal, oval, rectangle), selection option for shelf thickness, support for half shelves (more common than whole shelves), and spacing options to allow for wadding, stilts and cones. Two participants suggested a “pick and choose” option for kiln furniture, with the obvious options provided with the system and the ability to add custom furniture pieces. One participant noted that some ceramic artists leave kiln shelves in position permanently (such as functional artists, who make many similar pieces), and suggested we support this feature.

Finally, we also received suggestions on possible other features which may or may not be useful to include in the program, most of which involved keeping a record of what was fired and when (“kiln logs”). One participant suggested keeping a log of kiln hour usage for maintenance purposes, so one would know when to replace or maintain parts. Another suggested keeping track of the cost per firing, stating while it is a non-issue at UNCC, it may be useful for independent artists.

Overall, we were pleased with the feedback we received, which seemed to indicate that both the overall concept and the basic kiln layout were endorsed by our experts, while they offered numerous suggestions for refining the program into a more understandable, more realistic, and more visual interface.

Discount evaluations:

In class, we conducted both a heuristics evaluation and a cognitive walkthrough of our prototype, using our fellow HCI students as experts for discount evaluations. The heuristic evaluation consisted of twenty six questions spread across six categories:

- Visibility of system status
- Match between system and the real world
- User control and freedom
- Consistency and standards
- Recognition rather than recall
- Aesthetic and minimalist design

The possible responses given were yes, no, and N/A (not applicable); a space for comments was also provided for each question. Comments were sparse, suggesting that the evaluation itself was too lengthy, and/or did not request feedback in ways which encouraged evaluators to expand upon the topic at hand. Several questions were marked two or three (out of three) times as “not applicable,” suggesting that these should be either reworded more clearly or removed to shorten the evaluation. Examples include: “If users can go back to a previous menu, can they change their earlier menu choice?” and “Are all icons in a set visually and conceptually distinct?” Several questions regarding icons were marked NA, suggesting that “icons” is not an appropriate word given the prototype layout.

Half of the questions (13) were rated “yes” by all three participants, indicating positive or acceptable features of the prototype. These questions were spread throughout all six categories. Some examples include:

- Is there a consistent design scheme across the system?
- Do menu choices fit logically into categories that have readily understood meanings?
- Can users easily reverse their actions?
- Are field labels brief, familiar, and descriptive?

Three questions received two “no” responses, suggesting that these features require further work. Those questions were:

- Is there some form of system feedback for every user action?
- Are menu choices ordered in the most logical way?
- Do data entry screens and dialog boxes indicate when fields are optional?

The first two questions also garnered the most response, with participants indicating that the system did not provide feedback for every action (“not fully functioning system”, “not across all functions”) and that the menu system requires adjustment (“sometimes hard to match button to desired actions”). Overall, the heuristic analysis revealed that while the majority of the system is functioning, there are trouble spots in regards to feedback, menus and labeling, and our evaluation methodology itself.

We also conducted a cognitive walkthrough, in which a group of participants performed tasks with the system and noted their results. Our participants found logging into the system easy. Creating a new kiln layout caused difficulty due to “[confusion] about other kiln options” and a lack of noticeable feedback when navigating the kiln layout. Uploading a new pottery piece and entering data was mostly intuitive, except for a flaw in the prototype requiring information to be entered in a particular order. Creating an updated kiln layout presented feedback difficulty again, as it “wasn’t evident where to create a new kiln layout”. Finally, our participants had no difficulties in relocating the piece in the updated layout and exiting the system. Overall, confusion due to labeling and confusing menu and button options appears to be the main difficulty disclosed by the cognitive walkthrough, as well as a need for greater feedback when navigating between kiln layers.

35. Analysis of the Results

Our primary purpose of the evaluation is focused on the qualitative part. For one thing, obviously, our idea will significantly reduce the kiln loading time, thus, not that necessary to get quantitative value thus as time consuming. For another thing, because our system is relatively complicated to implement most of the functions, thus, it is not feasible to test the ceramic firing result based on current kiln loading system.

The first question we considered was whether the usage our system is intuitive for our participants and whether they could use it smoothly. According to our user study, some parts of our system were not easy to understand and hard for the users to figure out how to use. For instance, some of them feel confused about the relationship between the menu and various pages. Also, we they feel hard to jump to the intended page they wanted to look into during the using process.

Another issue that we considered was the way that feedback, whether visual or audible, impacted the way a user navigated through the prototype. Although we were able to construct a functional prototype, we were not able to develop some of the more complicated features such as kiln arrangement changes after new pieces added in and the temperature distribution indicated/ displayed by rainbow color map in the virtual kiln space.

Another issue that we considered was the kiln arrangement window. They really like the arrangement of ceramic pieces in different layers. However due to the time limitation, although we implemented the navigation between different layers, we haven’t enabled the flexible locating of the ceramic pieces. If we had more time, we would have undertaken a more detailed study of graphical representation to implement such critic functionalities.

36. Implications

We felt the feedback we received from users during testing was more positive than we thought. Our observations of the users combined with the questions they asked lead us to several areas of the prototype which we could improve to increase its functionality. Below is a list of recommended changes that we compiled from the users feedback of possible changes and improvements to functionality.

Recommended Changes -

1. Add a back button to go back to previous worked page.
2. Rework menu structure.
3. Better labels for layering system.
4. Add selection option for shelf thickness.
5. More kiln shapes – hexagonal, oval, rectangle.
6. Support half shelves (more common than whole shelves)
7. Enable tracking of cost per firing?
8. Add log to record kiln hour usage (for maintenance)

37. Evaluation Plan Critique

The first evaluation that we carried out was in-class cognitive walk through of the prototype wherein users were assigned a fixed set of tasks that they had to carry out. This evaluation gave us good feedback on how to improve the interface. Many tasks that we thought were easy, e.g., to check whether a piece is loaded into the kiln or to see the kiln layout, were apparently not so intuitive to the users as they found some issues with the navigation and were not able interpret some aspects of the kiln layout. These inputs helped us improvise on our prototype.

The second evaluation carried out was the in-class heuristic evaluation. The feedback received from this evaluation technique was more positive than the one we received from the cognitive walk through, but we realized that it did not really provide any constructive feedback in terms of improving the prototype functionality. Since there were no tasks that the users had to carry out, the users were confused on how the prototype worked or what steps needed to be carried out to accomplish a task. Also, we realized that since not many users are aware of the terminologies of ceramics world, they were clueless of some of the menu options. We did receive couple of good feedbacks on the aesthetic design and the consistency of the user interface, there weren't any feedback based on the ease of use and affordance aspect of the prototype. Also, since it was not a fully functional prototype, users were confused whether a given menu option/button was not implemented or whether it had some design issues. Also, we believe that the heuristics list provided by us concentrated more on the aesthetic look of the interface and less on the navigation flow and feedback. Had we given a more functional prototype to the users, with a varied set of heuristics to evaluate, we might have received a better feedback with this technique.

The third evaluation technique involved expert evaluation, which involved ceramic experts and the advanced ceramic students exploring the prototype and providing verbal feedback. This evaluation technique was the most productive of all the techniques and we received a lot of constructive feedback on the prototype. Due to the nature of the evaluation, which was somewhat similar to the cognitive walkthrough, users were freely

trying out all the functionalities and trying to accomplish the assigned tasks. There were also some very good suggestions provided by the users on some of the design aspects like the kiln layout and adding more information about the kilns in the drop down menu. Overall they seemed to be very pleased with the whole idea of automating the kiln arrangement and looked forward to using a working version of the prototype.

Overall, the evaluation results were satisfactory and they helped us understand what things the user liked the most about the system and which were the improvement areas for our design. Given an opportunity to do the entire process again, we would have used a more functional prototype for our evaluation, as we believe that would have given more scope for the users to explore the prototype and would have helped to generate more quantitative results.

38. Appendix A: Task List

Please carry out the following tasks using the KilnLoader prototype:

Task 1 - Add a new user to the system

User information:

Name: Davy Jones

Email: djones18@uncc.edu

Permissions: default

Task 2- Add a new piece (ceramic teapot) to the system

Piece Information:

Picture: use preselected photo

Height: 6"

Width: 5"

Depth: 13"

Collection: ART 2040 bisque

How many: 1

Task 3- On the main screen, create a new kiln layout using:

Collection: ART 2040 bisque

Gas Kiln: #3

Task 4- Find the teapot in the layout

Task 5- Delete the teapot and recalculate the kiln layout without the teapot

39. Appendix B: Evaluation Feedback Form

Please help us evaluate our prototype by completing this questionnaire. We will use your feedback to determine how we can improve it:

- 1. How easy was the interface to use?
Very Easy 1 2 3 4 Very Difficult 5
- 2. How easy was it to add a new piece into the kiln?
Very Easy 1 2 3 4 Very Difficult 5
- 3. How easy was it to delete a piece?
Very Easy 1 2 3 4 Very Difficult 5
- 4. How easy was it to select a collection and a kiln?
Very Easy 1 2 3 4 Very Difficult 5
- 5. How easy was it to add a new user?
Very Easy 1 2 3 4 Very Difficult 5
- 6. How easy was it to view the kiln arrangement?
Very Easy 1 2 3 4 Very Difficult 5
- 7. How would you rate your overall experience with the system?
Very Bad 1 2 3 4 Very Good 5
- 8. Will you be willing to train other users on this system?
Definitely No 1 2 3 4 Definitely Yes 5
- 9. Will you be willing to use the system in the future?
Definitely No 1 2 3 4 Definitely Yes 5

10. What did you like the most about the system?

11. What did you not like about the system?

12. What additional features would you like to see in the system?

40. Appendix C: Discount Evaluation Form

Discount Evaluation of KilnLoader

By Group 3

Date

1. Visibility of system status

Always keep users informed about what is going on.

| Checklist | Yes | No | NA | Comments |
|---|-----------------------|-----------------------|-----------------------|----------|
| Does every display begin with a title or header that describes screen contents? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Is there a consistent design scheme across the system? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Do menu options appear in the same place(s) on each page? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Is there some form of system feedback for every user action? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Is there visual feedback in menus about which choices are selectable? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

2. Match between system and the real world

Speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms.

| Checklist | Yes | No | NA | Comments |
|--|-----------------------|-----------------------|-----------------------|----------|
| Are icons concrete and familiar? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Are menu choices ordered in the most logical way? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Do the selected colors correspond to common expectations about color codes? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Do menu choices fit logically into categories that have readily understood meanings? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Does the language employ user jargon and avoid computer jargon? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

3. User control and freedom

Provide a clearly marked "out" to leave an unwanted state without having to go through an extended dialogue.

| Checklist | Yes | No | NA | Comments |
|---|-----------------------|-----------------------|-----------------------|----------|
| If users can go back to a previous menu, can they change their earlier menu choice? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Can users move forward and backward between fields or dialog box options? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Can users easily reverse their actions? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

4. Consistency and standards

Users should not have to wonder whether different words, situations, or actions

| Checklist | Yes | No | NA | Comments |
|---|-----------------------|-----------------------|-----------------------|----------|
| Are icons labeled? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Does each window have a title? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Are field labels consistent from one data entry screen to another? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Does the structure of menu choice names match their corresponding menu titles? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Is the method for moving the cursor to the next or previous field consistent throughout the system? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

5. Recognition rather than recall

Make objects, actions, and options visible. User should not have to remember information from one part of the dialogue to another.

| Checklist | Yes | No | NA | Comments |
|---|-----------------------|-----------------------|-----------------------|----------|
| Are prompts, cues, and messages placed where the eye is likely to be looking on the | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

| | | | |
|--|-----------------------|-----------------------|-----------------------|
| screen? | | | |
| Have prompts been formatted using white space, justification, and visual cues for easy scanning? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Have items been grouped into logical zones, and have headings been used to distinguish between zones? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Are size, boldface, underlining, color, shading, or typography used to show relative quantity or importance of different screen items? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Do data entry screens and dialog boxes indicate when fields are optional? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

6. Aesthetic and minimalist design

Dialogues should not contain information which is irrelevant or rarely needed.

| Checklist | Yes | No | NA | Comments |
|--|-----------------------|-----------------------|-----------------------|----------|
| Are all icons in a set visually and conceptually distinct? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Does each icon stand out from its background? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |
| Are field labels brief, familiar, and descriptive? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | |

41. Appendix D: Cognitive Walkthrough Form

Cognitive Walkthrough for Ceramic Artists Application

Target users: This system is developed to support professional ceramic artists by facilitating the kiln loading process. Although, our intended users are all ceramic artists, those who deal with the largest number of pieces, such as teachers, would benefit most from the system.

Goal of the walkthrough: This activity will help us understand the problems that first time users can face while using the application.

Task description: The user needs to take load the pottery into Kiln#1.

Action List:

1. Enter the dimensions of the pottery in manual mode.
2. Choose 'Load piece' option.
3. Select Kiln #1.
4. Load the piece into kiln #1 and see where the piece is place into the kiln.

42. Glossary

Clay

Clay differs from the inelastic earths and fine sand because of its ability, when wet with the proper amount of water, to form a cohesive mass and to retain its shape when molded. This quality is known as clay's plasticity. When heated to high temperatures, clay also partially melts, resulting in the tight, hard rock-like substance known as ceramic material.

Cones

Full name is pyrometric cones. Pyrometric cones are used to measure the effect of the kiln's atmosphere on the glazes being fired. Cones are made up of refractory, such as silica, and melting agents; each type of cone is carefully formulated and manufactured for accuracy.

Extruder

Machine which forces plastic clay through a die to produce extruded clay shapes

Glaze

A ceramic substance, made from a combination of clay material and colorants (such as iron oxide and cobalt), suspended in water and intended to be applied by dipping, spraying or brushing on to a piece of pottery. The melting temperature of the material is usually several hundred degrees below the melting temperature of the clay body it is intended for use on. When fired, glazes become molten and form coherent silica structures, which result in a glass-like surface on the ceramic object that is fully vitreous, regardless of the state of the underlying claybody.

Kiln

A furnace or oven for burning, baking, or drying, esp. one for firing pottery

Potter's wheel

Potter's wheels (pottery wheels) have been used for thousands of years. Some have been powered by hand and others by foot, but all have had one thing in common: a heavy flywheel used to build up and store momentum and torque. One version, the kickwheel, is the most common form of human-powered wheel used by modern potters in the United States today.

Slab Roller

A slab roller is a mechanized but usually manually operated device for rolling out large uniform slabs of clay.

Slurry

Slurry is very, very closely related to slip. Both are liquefied clay, or suspensions of clay particles in water. Slurry tends to be thicker and is used to join pieces of leather-hard clay together.

Vitrification

Vitrification is process by which a ceramic body becomes fully solid and unable to be penetrated by water.