Problem and Solution Overview

Our product is designed to make the scheduling of activities more portable, convenient and reliable. Many individuals, particularly those who are less comfortable with technology, prefer paper-based scheduling tools, such as post-its and planners, rather than electronic tools, such as Outlook or a Personal Digital Assistant. Pen and paper tools are flexible, reliable and easy to use. Their weaknesses, however, are that they are easy to lose, difficult to back up and are not accessible through a computer or the Internet. Our product will offer the best of both worlds, by complementing a digital pen and planner with a web site that can display and organize any event that the pen records.

Target Users

Rationale behind choice of users

We sought users who are representative of the target market for our application. In particular, we sought out people who were busy and had lots of activities to plan for. We also searched for people who represented different ages, careers and degrees of proficiency with technology.

Backgrounds of users

We conducted five interviews, two with undergraduate students, one with a graduate student, and two with young professionals.

One undergraduate is a sophomore in the engineering department. She has a moderate class load this semester, but also works in a student computer center three days a week. She is the vice president of a campus social organization and therefore has to plan a lot of events in advance. She is also a member of the mock trial team, and while this is of lower priority than class, work, and the social organization, it is still very important to her. She has a vision for her future and is constantly thinking about how to get there.

The other undergraduate is a 3rd year Haas business major. She is also very active in school groups, work, and a professional fraternity, all of which put a strain on her everyday schedule. She always carries her planner with her to keep herself organized, but at times she can find it overwhelming; she sometimes does not even have enough space to write everything so she uses post-its. She would love to use more high tech solutions, but they are much more difficult to use when compared to a simple pen and planner.

The graduate student is getting a master's degree in public policy and also works part-time doing research. She has a busy social, academic and professional schedule. She is married, so she has to share her schedule with her husband. She is in her mid-thirties. She considers herself to be "old-fashioned" and also has a slight distrust of electronic gadgets because she often finds them to be unreliable and too complex. She takes a lot of pleasure in writing things by hand.

One young professional works for a government agency. He was trained as an engineer and received a master's in business administration. He is in his mid-thirties and is married, so he too has to share his schedule with his spouse. He likes to think visually and does not like to use the computer for long hours because of health reasons. He does not consider himself to be particularly well-organized or to have a good memory.

The other young professional is an attorney at a federal government agency. She has numerous meetings to attend and many things to take care of at work, so having a solid scheduling system is important for her. She is in her early thirties. She has to use technology and computers for her work to some degree, but generally only embraces electronic gadgets if they are for entertainment, such as an iPod or digital camera.

Contextual Inquiry

Process and environment

All of our interviews were conducted in the homes of the users, often at their desks. The user could typically access any computer-based planners using a desktop or laptop and an Internet connection. He or she could also easily refer to calendars, planners or other paper-based materials as necessary.

Our interviews were typically conducted by two team members, although on one occasion there was only one available. One interviewer typically focused on asking questions, while the other concentrated on taking notes and making sure that everything was covered.

A typical interview would begin by asking the user to briefly list all the tools they use to schedule their time, from the most primitive (i.e. writing on your hand) to the most technologically advanced (i.e. setting up appointments in Outlook.) We would then have the user demonstrate to us how they used each tool.

For each tool, the user would bring the item out or lead us over to it. He or she would then go through the steps of recording activities and notes, and explain what sort of thoughts led to each process. We would observe how they entered data and ask questions about anything that we did not understand or found particularly interesting.

We typically concluded our interviews by thanking our users and presenting to them the idea of an Anoto digital pen-based scheduler. We would gather the users' impressions of the idea and ask for suggestions.

Common tasks and themes

Planners

All of our users had hand-written planners. They were typically used to record events with specific start times. Most also used it to record random thoughts and activities that were less time-sensitive, or kept a separate planner for that purpose.

Many users enjoyed planners because they could tailor them to their needs and preferences. For example, one user used different color pens to indicate the urgency of an event; another drew small picture icons to represent different kinds of tasks. A third highlighted items that were unfinished and crossed out items that were completed, while another crossed out items she no longer wanted to do and boxed the unfinished ones. Two users used the monthly overviews in their calendars to record hours of work for billing and compensation purposes, while two others exclusively used the weekly overviews. While electronic planners like Outlook often rigidly define how data is highlighted and entered, the users taught us that one of pen and paper's great strengths is its flexibility.

Because they devoted so much time to their planners, users did express some concern about the prospect of losing them. Aside from that, however, they seemed quite pleased with how their planners functioned.

Outlook and Lotus Notes

Two of our users accessed a computer-based planner, such as Outlook or Lotus Notes. Such planners allowed people to record tasks, plan calendars and invite people to meetings.

Those users who used Outlook or Lotus Notes particularly appreciated how meetings were organized in such programs. When a meeting is called, confirmation emails are sent out to all the prospective participants. If a participant clicks an "accept" button, his or her calendar is automatically updated with the meeting. The meeting host can easily see who has acknowledged receiving a invitation, send reminders, and inform participants of any changes.

Aside from this feature, however, Outlook-type programs were not enthusiastically embraced by any of our users. They always complemented their use of Outlook with a hand-written planner. Outlook-type programs were primarily used at work and to plan very time-sensitive events with clear start and end times. It was not preferred for less time-sensitive events or more general goals, and one user in particular felt that Outlook was a very public planner and required some semblance of professionalism. Planners were generally seen as far more portable, easy-to-use, and reliable.

Post-its

All all of our users used post-its to remember things. They were favored because they were convenient, highly portable and very visible. People tended to place them in prominent locations – on the inside cover of a planner, around a desktop screen or inside of a wallet, for example – so that the described events could be completed or recorded in a more permanent medium. One user made use of post-its only when his actual planner

was not readily accessible, and then transferred the contents of the post-its into the planner when he had access again. Another exclusively used digital post-its on her desktop for the purpose of general, long-term, non time-sensitive reminders.

The concept of making to-do lists visible

A key goal for every user was to tie up loose ends and ensure that all upcoming, important obligations would be looked at at appropriate times. The system typically centered around the planner. Upcoming events and obligations were recorded as promptly as possible. Finished events were crossed out or checked off, and unfinished events were either handled at some specific, regular interval, or were transferred on to a later time period. In this way users could ensure that everything that needed to be done was done, and that any upcoming obligation was recorded in a place such that a timely reminder of that obligation was inevitable.

Unique features of individual interviews

One user said that writing by hand, in addition to be being flexible and reliable, had a number of other purely psychological benefits. She noted that she remembered things better if she wrote them by hand. She also added that crossing out items on her to-do list gave her great comfort, because it made her feel as if she was making forward progress.

Another user records non time-sensitive tasks in a blank notebook, which functions as his planner. He sticks it with Velcro to the side of his desk at work, and every Friday afternoon he has an Outlook-scheduled time slot devoted to writing in his planner all the tasks he wants to do for the next week. This helps him to not think about planning responsibilities over the weekend, and gives him a fresh start on Monday.

Alternatively, a different user uses a whiteboard in her home to record tasks that are not time-sensitive. She likes this approach because the board is large and extremely visible in her room, and thus can her remind her of her long-term goals.

Task Analysis Questions

Who is going to use the system?

The users will be anyone who has many things to plan and who is not entirely comfortable with digital planning tools, such as Outlook or a Personal Digital Assistant (PDA).

What tasks do they now perform?

Users typically now organize their time with paper-based planners. With these planners, they can record upcoming events, keep track of finished obligations, and also take note of more general thoughts or goals that do not have a clear start time.

What tasks are desired?

Users seem to enjoy their planners, but they have a number of weakness that they would like to ameliorate. If the planner is not in their hands, the users lose the ability to check or revise their schedules. Moreover, because all of their scheduling is typically concentrated in one, highly portable item, losing that item would be a devastating blow. Users would enjoy the ability to backup their data.

How are the tasks learned?

Users learn how to plan through experimentation. People have very diverse methods of planning their time, even though many use similar tools, such as the portable daily planner. They try out a variety of approaches – for example, different symbols, different color pens, different strategies regarding the review and rescheduling of tasks – to see what works for them.

Where are the tasks performed?

The review and revision of planning tools can take place anywhere. Common locations include the home, in the classroom or at work. Since new appointments and activities may arise at any time, the planning tool might be accessed in inconvenient locations as well, such as in the middle of a high-pressure meeting, at a social event or while using public transportation.

What's the relationship between user & data?

The data describes the future and past of the user. It consists of discrete activities involving start and end times as well as general goals for a day or week. It may also include general ideas or inspirations, such as the name of a particularly good restaurant or the URL of an interesting web site that should be visited. The data may also involve information specifically tailored to the academic or professional pursuits of the user. Some of our users, for example, used corners of their daily planners to record work hours for the purpose of compensation.

What other tools does the user have?

In addition to the daily planner, users make use of PDAs, computer programs such as Lotus Notes or Outlook, post-its, scraps of paper and even their own forearms.

How do users communicate with each other?

Daily personal planners are typically not shared with another person. In situations where sharing was required – for example, in a marriage where the spouses may have competing obligations – a calendar was used to record and display just those events that were relevant to both of them.

How often are the tasks performed?

Planning is performed moderately to extremely often, depending on the user. Most users note items in their planners at least once a day, and check their planners multple times each day. The need to plan can take place at unpredictable moments. Many users set a specific time each week to carefully review and revise the data in their planners.

What are the time constraints on the tasks?

The time constraints on entering data into a planning tool can vary, but often are extremely tight. A user does not like taking a lot of time to record a entry when they are in the middle of a meeting, engaged in a conversation or immersed in work. Users, however, are often informed of things that they must remember and record at just those moments.

What happens when things go wrong?

The main problems with existing paper-based planning tools is that they may be left behind or lost. If a planner is left behind, the user must scramble to record upcoming events in a less convenient medium, such as their forearm or a scrap of paper. He or she must then strive to remember that record and input it into their primary planner later. Losing the primary planner, however, has typically been described as an absolute catastrophe. Users in that case have no recourse other than to buy a new planner and start all over from scratch.

Distribution of Work

- Student 1 - interviewed two users, wrote up contextual inquiries and task analysis
- Student 2 - interviewed two users, wrote up task analysis and functional summary
- Student 3 - interviewed two users, drew up interface sketches, and expanded inquiries
- Student 4 - interviewed one user and wrote up analysis of approach
- ALL - analyzed findings and conceptualized appropriate visions of interface design

Problem and Solution Overview

Problem

The problem is simple. **Ordering food in a sushi restaurant takes a long time.**

The process starts with the waitress, and goes something like this:

Waitress -> Takes an order -> Goes to Sushi bar to place an order -> Goes to cashier for record -> Waits -> Gets the food -> Serves the food -> Waits -> Goes back to cashier -> Gets receipt -> Goes back to customer

Sushi chefs have to wait until a waiter/waitress brings in an order. During busy hours, waiters can't go to the sushi bar right after he or she received an order because they have to get multiple orders and take them at once. Sometimes sushi cooks take a long time to read all of the waiter's orders, and often they interpret orders incorrectly.

Unorganized Food Making Process:

In a busy restaurant the process can be streamlined. When many orders are waiting, finding items that are common across those orders is necessary to quicken the process. A chef can make many of one item at the same time which will take less overall time then making all of those items separately. However, it is hard to find common items with the existing system because orders are written on many small papers.

Absence of Management System for Sushi restaurant:

Here are some more disadvantages to the current system:

- non-digitalized sales record – employee can steal money after trashing order paper
- lack of statistical data of sales, inventory – hard to analyze restaurant's current situation or hard to predict future sales because all the record is on paper (do not know when and exact amount of food materials to order from suppliers)

Solution

Sushi Restaurant Cashier – Digitized orders and various statistics of sales

Waiters/waitress – Fill out Anoto recognizable and pre-printed order sheet

Sushi Chefs – Sorted orders by table and grouped by common orders to speed up the process of the making food.

Target Users

Only full time employees were interviewed for this project. The following items were taken into consideration when choosing interviewees.

Size of restaurant: It is important to know the differences between how larger and smaller restaurants operate in order implement an adaptable system efficiently. Our choice of interviewees came from two different sized restaurants: a smaller one of 14 tables, and a larger one of 35 tables.

Working type: There may be different views among employees and employers. Our interviewees held the following positions: business owner, cashier, waiter, waitress, and sushi maker

Experience level: We wanted to view the problem from different levels of experience. More experienced employees could possible be too comfortable with the existing system and not want to change anything. Less experienced employees could have better ideas than more experienced ones.

Meet the Employees

We interviewed employees from two different restaurants which we will for now call Sushi Restaurant A and Sushi Restaurant B. Below are some descriptions of each employee interviewed:

Sushi Restaurant Owner A

- This person has 6 years of experience. He wants to have more time to start a new sushi fast food business but responsibilities of managing the restaurant keeps him busy. Additionally, he has been thinking of adapting to a computer management system.
- He wishes to provide customers with better service: serving food faster, more greetings and communication between waiters/waitress and customers. He values keeping a close track of inventory, sales statistics, and records.

Sushi Restaurant owner B

- She has 20 years of experience and owns 2 sushi restaurants. She wants to start a new business but has no time due to her responsibilities with her currently owned restaurants.
- She views shifting to a computer management system as a means of serving food faster, keep track of inventory more easily, a way to follow sales statistics, preventing employees from stealing money or stocked food (beef or fish), and reducing the number of employees needed.

Waiter/Waitress A

- This person has 3 years of experience.
- Dislikes the occasional miscommunication with the chefs/sushi makers because it leads to wasted orders
- Wants to serve food faster.

Sushi Chef A

- The chief sushi chef in the restaurant, has 11 years of experience.
- He values his tools which allow him to arrange orders (up to 10 pending orders at a time).
- He runs into miscommunications with the waiters and waitresses. Sometimes it verbal and sometimes it is written.

Sushi Chef B

- This person has 8 months of experience and is the assistant to the chief sushi chef.
- He prioritizes easy ways to arrange orders and check inventory.
- He deals with verbal and handwritten miscommunications with the waiters and waitresses.

Contextual Inquiry - Interview Descriptions

Process and environment

The interviews with the two owners were conducted inside the sushi restaurant on the table (we could have observed the daily routines of the owners since the owners frequently paused the interview to do their tasks – ex. Job interviews, cashier check etc). The interviews with the two sushi men were done at sushi bars inside the sushi restaurant, watching the sushi men working. Then we interviewed the waitress outside the sushi bar after she is done with her work (she was too busy to be interviewed during work). However, we observed how she works when we were interviewing the owner. Our interviews were conducted by two people: one person asking questions mainly, and the other typing the rough idea or answer from the customers using a laptop, and possibly asking follow up questions when the other person ran out of questions to ask (we thought silence might distract the owner from focusing on our interviews). The interview starts by asking the owner full order process to until the food is delivered to the customers, and what are the pros and cons to use papers to keep track of money in the cashier. We asked the sushi men that are the pros and cons for using order slips (paper) to make sushi. For waitress, we asked what are the pros and cons for using order slips (paper) to receive order and to communicate with the sushi man. Then the users (owners, sushi men and waitress) talk on and on; from here, we get lots of unexpected information. After that, we asked the 11 questions from the class. Finally, we discussed about the presence of Anoto pen and various concepts and applications using the Anoto pen with the users. We

received quite long and complex, but useful feedback from the users; we thought this will definitely help design our product better (user desires).

Common Tasks and Themes

A typical day in a sushi restaurant looks something like this. Waiters go to tables and writes down orders from their customers on an order slip (dual-paper). Usually the customers customize the orders by adding or subtracting particular ingredients. The slip on top goes to the sushi man, and the slip on the bottom goes to the cashier for calculating the total amount the customer owes. The chefs refer to the orders on paper (order slip) to make the sushi, possibly making multiple common sushi items together to save time. The chefs communicate by talking to each other to partition the tasks.

From the restaurant owners we gathered that usually a big sushi restaurant with 4 to 5 chefs can take about 10 orders at a time, whereas a small sushi restaurant with 2 to 3 chefs can take 3 to 4 orders at a time. When the cook is done making all the ordered items for one table, they ring the bell and the waitress brings the sushi to the customer table. After all the customers on a table are done eating, the waitress writes down the price for each ordered item on the guest check (the slip on the bottom) and uses a calculator to sum up and write down the subtotal and total amount due. To save time, memorizing all the items and their prices is a required step during waiter training (2.5 weeks to a month). At the end of the day, the owner of the sushi restaurant matches up the total amount of money in the cashier with the total amount summed up from the guest checks for the day to balance it all.

Unique features of individual interviews

The sushi slip was present but it is no longer used because of all the hassles: waitress puts the ordered item into a computer, and the data is transferred to the sushi man's touch screen and so forth. One of the owners seemed very interested after seeing the prototype of the product; he picked out many potential error sources to us. The other owner seemed enthusiastic about this product; she recommended adding some more features like: canceling an order, making additional order, letting the waitress use the Anoto pen and paper, instead of letting the customers use it and so on. One of the sushi men also mentioned that long time ago, sushi man directly received order. Because sushi men are expensive to hire, most sushi restaurants hired waitress to replace the job. Main sushi man, subsidiary sushi man, and helper were present in one of the sushi restaurants we went to interview, whereas only one sushi man and a helper were working in the other sushi restaurant. So where many sushi men are present, good communication (articulation) skill and partitioning the work according to their levels of skills were necessary. Lastly, the waitress as well as sushi men has his or her own customers; these customers come to the restaurant because of them – maintaining friendly relationship, hugging and so on. Therefore, one of the owner mentioned that reducing the number of waitresses is a negative effect (will not save the owner much money).

Concerns on the applications using the Anoto Pen

The following are notes of concerns that were brought up during the interviews:

- Have to train waitress
- Fast food works, but this is full service. The feeling of full service lost.
- The customers coming sushi bar are for leisure and talking. But if there's no waitress, they will feel awkward.
- It might turn out to be like Mexican restaurants, number card on table – no tip no waitress
- Ordering additional items (although only about 10%) – should customers write on the same slip again or on a different slip?
- How to cancel?
- Computer error – worries (must maintain stable) – backup needed
- Waitress, chefs, must have their own customers – friendly relationship, hugging – a lot of people look for that
- Where to put the monitor would be a problem
    - Sushi bar: can't be on the back, probably close by
- Main cook, subsidiary chefs, helper (different level of skills)
- Partitioning the work – dividing the work equally will be a problem
- Water may get all over the place
- Using PDAs: expensive, longer for waitress to be trained, and maintenance issues.
- Inventory cheating possible (stealing ingredients)
- Separate checks for dutch pay

Recommendations

The following were Recommendations received from talking to employees of Sushi restaurants:

- Work directly with one restaurant for testing
- Don't bother trying to replace waiters. This is a deeply engrained behavior and customers don't like filling in their own orders on paper. The restaurant feeling disappears.
- Waitress taking orders and using this system will work better than customers ordering themselves
- One monitor for a sushi bar is probably enough – communicate between chefs by word
- Prefer touch-screen; but if expensive, number pad would be sufficient
- Menu alphabetically ordered

Expected Benefits

There are a lot of benefits that our proposed system can bring about:

- A customer complains: "I've waited for 40 minutes" and then asks for a discount
    - System easily allows giving discounts to them if waited for too long
- Handwriting on slips is often unrecognizable; our system eliminates that

- Color Coding: we can use different colors for different items to streamline the process
- Increased productivity: customers always want their food as fast as possible
- Fishes are ordered everyday to retain its freshness. If the system is used for a month, or a year (for better statistics), it will be useful to set the amount to order each day.
- When selling the place, can exactly give the amount of "food cost" to the potential buyers
- Owners do not have to worry about waitresses cheating on cashiers (90% of restaurants with owners absent are being cheated).
- Remote access to restaurant statistics from home for owner.

Task Analysis Questions

We have interviewed 2 owners, 2 chefs, and 1 waitress from Matsu sushi and Damo sushi in Pleasant Hill, CA.

1. Who is going to use the system? The chef, the owner and the waiters are going to use the system.

2. What tasks do they now perform?The task is basically paper and pen based. The waitress goes to a table and takes down the orders on an order slip (dual paper). Then one paper goes to the chef and the other goes to the cashier. Chefs use these slips to fulfill orers. After the customers are done eating, the waitress notes the prices for each item ordered for the table and sums up to write down subtotal and total amount due. Later at the end of the day, owner checks whether the amount of money in the cashier matches up with the amounts written on all the order slips.

3. What tasks are desired?The owners want the process of making sushi or cooking to be as quick as possible. So a streamlined system to take orders is desired. Also other tasks the owners wanted were mostly concerning security issues. Waiters trying to steal money is a common problem – the waiter trashes or rips off the guest check and keeps money for herself. Consequently the owner has to be present at the restaurant most of the time to prevent stealing. So the owner wants a system that can secure the cash register without his or her presence.

The chefs want to make sushi as fast and efficiently as possible. They can do this by using a more systemized way to pick out common item orders to make them together, especially during the busiest hours. The chefs also want to improve their communication while working in the kitchen.

The waiter similarly wants to communicate better with the chef and the cook in the kitchen.

4. How are the tasks learned?Waiters and chefs receive formal training. In order to learn how to take orders and memorize the prices of all the items, waiters needs to be

trained at least 2 and a half weeks. The rookie chefs need to be trained to make multiple sushi items together with other chefs as well.

5. Where are the tasks performed?The tasks are performed at the floor (dining hall) for taking orders by the waiters, at the sushi bar or kitchen for making sushi, and at the cashier's register for writing bills.

6. What's the relationship between user & data? Chefs & data: Chefs refer to the data (order slips) to make sushi.

Owner & data: Owner refers to the data (order slips) to balance the cashier.

Waiter & data: Waiters refer to the data (order slips) to ensure that every item on the slip gets to the customer. Also she refers to the data to calculate total amount due by the customers.

7. What other tools does the user have? Owner – Computer monitor Chefs – Touch-screen Waiters – PDAs

8. How do users communicate with each other? The waiter lists off the names of the items ordered to the chefs or hands over papers (the order slip) to them.

9. How often are the tasks performed? Depends on the number of customers.

Approximately 1.2 orders per table

10. What are the time constraints on the task? Need to limit the time from when the customer sits down to when he receives his food.

Max time limit for Mastu sushi: 20 minutes Max time limit for Damo sushi: 10 minutes

11. What happens when things go wrong? There are several things that can go wrong:

- Waiters or chefs make a mistake and the incorrect amount or type of food is served to a customer.
    - If extra food is made, often employees or owner just eat it later (never give them out to customers)
    - If less food is made, it will often take extra time to finish the customer's order and hence a discount is given

Analysis of Tasks

Our application lends itself to three different categories of users: the waiters/waitresses, sushi makers, and the owner/cashier of the restaurant. Six tasks can be identified thus far which involve the waiters/waitresses, sushi makers, and the owner/cashier.

Easy:

(1) The first task our application requires is for the waiter/waitress to fill out a sushi order form on a customized sheet of digital paper. The waiter/waitress writes the quantity of each sushi and roll that customers want, identify the current table at which they are sitting (this information is needed when the waiter/waitress deliver the food or the bill to the customer), and check a 'Send Order' box indicating waiter/waitress completed to get customers' order.

(2) A second task our application supports allows the owner/cashier to view the total amount of money each table owes. This function will require software to optically recognize the number the customer wrote indicating the number of sushi rolls they wanted and convert it into an integer. Each integer will be multiplied by the price of the given sushi roll and summed up to reveal the total amount spent.

Medium:

(3) The owner/cashier will need to be able to alter his or her menu and prices from time to time. This could be a result of supply and demand for the different types of sushi and also the cost of ingredients that go into food preparation. A separate interface should be provided to allow the owner/cashier to simply change his or her menu without worrying about the dynamics involved with the digital pen, paper, and optical recognition.

(4) Functionality should be provided to allow the owner to view different various statistics based on information gathered from the order forms. Such statistics, for example, could include which item such as sushi or roll was the most popular last month, or which month brought in the most money last year.

Hard:

(5) Information on order forms that have been completed by the waiter/waitress should appear on the computer screen in some kind of queue fashion which would allow the sushi maker to determine the next table in line to receive their food. Once the food was delivered, the order form would be removed from the queue and placed on a separate list for further processing, see task (6).

(6) Information regarding how much each given table owes remains on this list until the customer has paid and left. All orders would be grouped by table number for the possibility of a given table ordering multiple times during one sitting. Additionally, functionality should allow this information to be exported to a separate format which would be used to process a receipt. Also, a method to distinguish individual orders and printing separate checks is needed for the customers who want to have separate checks on the same table.

Division of Labor

Student 1: Interviews, Questions, Images, Target User Group, Problem and Solution Overview and Task Analysis Questions
Student 2: Interviews, Questions, Images and Contextual Inquiry - Interview descriptions
Student 3: Interface Design and Overall Final Compilation
Student 4: Analysis of Tasks and Analysis of Approach

Target Users

Medical practitioners: administrators, doctors, nurses and physician's assistants, face the burden of transcribing all observations and orders. They represent one-half of our user base and the group that will be less directly helped by our tool. These individuals receive career-oriented training for 2-4 years at specialized schools, they then gain experience through clinical training at a hospital and continue their career here or some other healthcare institute. Their first duty is always to the patient and they generally feel happiest when they can restore an individual's health. As a broad generalization, they dislike paperwork and find that it can sometimes get in the way of providing the best quality of service. Filling out more forms, charts and orders means less time for them to care for patients and thus reduces their satisfaction. Specifically, the individual we picked to interview in this category is a clinical physician and fit into the general model. This person spent 4 years in medical school accompanied by 2 years of clinical rotation and is serving as a second year medical resident. He or she also complained almost 20% of the workday is used for paperwork. The doctor states that "considering the amount of data we put down, there is a very poor return."

Pharmacists are trained in fields including pharmacology, chemistry, pharmaceutical chemistry, physiology, anatomy, biochemistry and hepatology. Pharmacists are a critical source of medical knowledge in clinics, hospitals, and community pharmacies in general. They bridge the gap between patients and physicians to ensure that proper medical therapy is chosen and implemented in the best way possible. They have many roles but more traditional and common role is to provide general health advice and specific details to patients about disease states and medications. Jim and Tom, both hold a Doctor of Pharmacy (PharmD) degree from a prestigious university. They've both been working in pharmacies for more than 10 years now. In general, pharmacists enjoy advising patients on how drugs can help them keep them healthy. They dislike making anyone wait for medication and delays in reading prescriptions. The pharmacists chief priority of is quickly dispensing medication to patients. For the purposes of description the Walgreen's pharmacist will be referred to as Jane Smith. Jane works at the Walgreens pharmacy in Berkeley on Shattuck. She has been working there for a few years since graduating from School of Pharmacy at her university. At her university, Jane started her career as a student intern, then as a graduate intern, and finally receiving a pharmacist position at Walgreens. Although most of the responsibilities that her job entails were learned at school, the processes on how to fill prescriptions and deal with customers were reinforced by training from Walgreens. She is assisted by a pharmacy technician, who manages the administrative details of the job such as handling phone inquiries, entering patient purchases, and assisting with filling prescriptions.

Contextual Inquiry Interview Description

(Note: Gender pronouns are chosen randomly and we make every effort to preserve the anonymity of our generous volunteers).

The inquiry with the clinician took place at a county hospital. It occurred on one of the upper levels of the hospital where clinics are typically held. Two individuals from our group monitored appointments with the doctor mentioned in the "Target Users" section. We tried to be as discreet and respectful as possible when the doctor was interacting with the patient. We often asked questions when the physician left the room to fill certain forms (which is convenient for us since this was the actual task we wanted to witness and question dynamically).

All the patients we encountered already had medical identification with the hospital and hence a pre-existing chart. The unique identifier for any patient is an ink imprint of the patient's medical ID card. (A financial card is also used for identification purposes and billing.) When we arrived the waiting area was quite full and a long line streamed from the admit area. A nurse eventually calls the registered patients from the waiting area, into an exam room. He measures certain basic physiological values (for example, temperature and blood pressure) and asks for the patient's principle complaint – noting all information on their chart. After a short delay the doctor arrives and examines the notes on the chart the nurse has left for him. Comments, figures, measurements and almost any relevant observed phenomenon are recorded. If a procedure is performed there are additional specific forms which must also be filled. As possible differential diagnoses are narrowed down, experience and intuition yield a definitive diagnosis.

If the patient needs to be medicated, the doctor decides to write a prescription on a standard form. These 4.25"x 7.6" slips are first stamped with the imprint of the medical ID card in the upper-right hand corner. The doctor must still write the patient's name despite this stamp. The form is dated and at least eight pieces of information are used to verify the doctor's identity. Additionally, another vital piece of information is included: the diagnosis. Up to three drugs can be prescribed on one form. For each medication the strength, quantity, patient instructions and refills are recorded. We requested that the doctor "think-out-loud" as she filled out the form, though the task is quite mundane for this user. The physician noted that the prompts provided by the existing form are very helpful if you are new to the layout but she rarely uses them anymore because she is so accustomed to the form. She moved much more slowly filling out the medication information, noting the specific brand of drug to be prescribed. However, she did say that had she not been as conscious of her actions as she was now she may have proceeded more hastily noting only the generic drug name.

We inquired whether writing a prescription is the same in all other departments. The doctor mentioned that very often it is, with two noticeable exceptions. In-patient orders are written on separate forms and filled in a different part of the pharmacy. Additionally, new laws require narcotic prescriptions be printed on special paper that is difficult to duplicate. Speaking to several nurses, receptionists and doctors as we left, we received incredible support for building any sort of automation into the current system.

Figure 1: Doctor filling out a prescription at the hospital

(Also see attached prescription form – ONLY INCLUDED WITH PRINTED COPY)

We also visited the pharmacy at the same hospital where we talked to the physician. The area is divided into two parts, an in-patient pharmacy and an out-patient pharmacy. As the names suggest, the first is for people admitted to the hospital and the other is for patients who do not need to stay at the hospital. Jim (not a real name) works at the window in the out-patient pharmacy where patients come and drop off their prescriptions. They update patient records on a computer and give patients a call number so they can pick up their medication when the number is called. There is another computer located to the side where all the new prescriptions get queued. Another individual who fills prescriptions checks these entries and completes the transaction after a patient's number is called.

As we reached out-patient pharmacy department, we observed a huge crowd of patients waiting to consult with a pharmacist. Jim informed us that the pharmacy recently installed new software for patient records. Jim was struggling with it a bit and while printing a call number, he expressed that all the systems were independent of each other. When a patient arrives at the window, he would ask the individual for his or her medical record card, provided by the hospital. He accesses patient records with the ID number printed on the card. Then he looks up medication in the database and writes them along with directions. He prints the call number using a machine resembling ones found at the DMV and tells the patient approximate waiting time, usually an hour. He points to the comment box on his screen and told us that sometimes when patients misbehave, he would specify that it in the record. The next time the patient comes to the pharmacy, he or someone else would know how to deal with the individual.

The in-patient pharmacy, on the other hand, has a very relaxed and quiet feel. Tom (again not a real name) sat in front of a computer looking at scanned prescriptions from doctors and updating patient records. He told us that often it is hard to read the prescriptions due to handwriting and lack of clarity on the screen. He said doctors would scan the

prescription after consulting with the patients and the he would go through it and update patient's profile. Just as in the out-patient pharmacy, someone would then fill the prescription. The drugs are the delivered to the appropriate department.

When trying to set up an interview with a pharmacist at a franchise, we called different drug stores with pharmacies in the local area, asking to speak with the on-site pharmacist. Many times when we mentioned we were students at Berkeley trying to interview for a project, the operator would hang up or respond with a vague answer stating that the pharmacist was not available for questions. When we mentioned we were researchers trying to develop solutions for pharmacists, the Walgreens pharmacy did not hang up the second time. We were then transferred to the on-site pharmacist. While speaking with Jane, the on-site pharmacist, we gave a 30 second overview of the project, and asked if she would be interested in answering questions in person about her daily work. When she agreed, we set up a time that was convenient for her and also during a time when she was not expecting many patients. At the time of the interview, we went to the pharmacy and verified that Jane was the on-site pharmacist, and asked our questions.

Before going to our interview at the Walgreens pharmacy, we went to the Longs and Target pharmacies for comparison on the different work environments. In general, the layouts of all the stores were similar. They all had cash registers at the front, items for sale in the middle, and pharmacies at the edge of the stores. All the stores sold healthcare products, over-the-counter medication, and similar items in the same vicinity as the pharmacy. Both the Longs and Walgreens pharmacies were located at the back, while the location of Target's pharmacy varied, sometimes on the right hand side of the store or at the back. The over-the-counter medication and healthcare products are placed in the same area as the pharmacy so that pharmacist or pharmacist technician can easily direct patients to products or patients can ask questions on what to use. The Walgreens pharmacy had two separate windows: one window for dropping of prescriptions and another window for picking up prescriptions and receiving consultation. The pharmacist technician sat at either of the front windows, while the pharmacist worked in the back of the pharmacy where the drugs are openly displayed and stored.

Jane works at the pharmacy five days a week, and sometimes on the weekend. The busiest times are usually in the afternoon between 12-6 regardless of the day. Her usual turn around time is one hour (just like the hospital's pharmacy). But this can vary depending on how many prescriptions are in the queue. If a prescription is not urgent, the patient can usually pick up the prescription in 24 hours.

Jane currently fills prescriptions for patients at Walgreens in any of the following ways after the doctor has written the prescription that contains the patient name, drug name, and dose/quantity: (1) the patient can bring a hand-written prescription directly to the pharmacy; (2) the doctor's office can send an "e-Prescription" from their office by computer – the information sent contains patient name, address, phone number, drug name, and dose/quantity; (3) the doctor's office can call the pharmacy with the patient information, drug name, and dose/quantity. After the prescriptions are received by the pharmacy, the prescriptions are put into a queue and filled in the order they were

received. If process 1 is used and the patient does not have an existing file at the Walgreens pharmacy, the patient has to create a file in order to have prescriptions filled. If process 2 and 3 are used, when the patient goes to the pharmacy to pick up the prescription, the patient has to have a valid ID to match against the records sent by the doctor.

The computer at Walgreens contains its own patient database. It can check for drugs prescribed by the doctor that the patient specified after creating his or her account that should not taken. Jane contacts the doctor whenever there is a mistake in the prescription, either she cannot read the drug name, dose/quantity is not filled in, or her own patient records show that the drug is not suitable for the patient. The most common mistake is if generic or brand name or quantity is not specified in the prescription. In these cases, Jane calls the doctor to find out this information. However, the biggest concern is that the patient may not able to take the drug. The responsibility usually lies with the doctor, but if the patient does have a recent file in the pharmacy computer, the computer will check for such mistakes.

Jim and Janet both interact with patients and update their records. Both must deal with a busy environment on a day-to-day basis. As for the differences, Janet actually fills up the bottles while Jim has many others available to do the task. Additionally, Walgreens allow prescriptions from any doctor, whereas only the prescriptions written at certain hospitals are allowed at the hospital pharmacy.

List of Tasks

Easy:

(1) Making copies:

> In order to make copies of files or records, the user can typically walk to the copy room on any floor of the hospital. However, if the file or record is not on hand, the user may ask someone else to find and make a copy.

(2) Writing a prescription:

> At the end of a check-up, a physician will diagnose and prescribe medication for the patient. Using the standard form, the doctor identifies himself, the patient, the diagnosis and the drugs. All this information should be known already, so just writing it on the prescription sheet should be fairly trivial.

Medium:

(3) Detecting negative drug interactions when all drugs are known for a given patient:

Based upon the patient's medication record, a doctor, pharmacist or computer can be trained to determine which medications can be used safely together, minimizing side effects. Each medication is cross checked to determine whether their effects could cancel, add or multiply that of another drug.

(4) Making sure information gets where it should:

When the user wants information to be transferred to other departments, he must submit a record request form. Upon completion of the record request, the hospital passes the form down to the central filing room. From there, clerks locate the records and forward them to the destination department. Sometimes it is up to the patient to transmit instructions from one department to the other. The problem is that the messenger is not the person who wrote the directives; he or she is unequipped to verify information or answer questions.

Hard:

(5) Checking many records:

Looking at many patient records becomes extremely complex when all documents are written in pen-and-paper. The user must request the records for each patient from the record filing room. Although most of the forms are similar among patients, recorded data and observations may be made by several doctors in different locations on the various forms. Handwritten notes (especially made by doctors, trying to get to the next patient) can be difficult to decipher. Pulling out the information one wants can be nearly impossible if the sample size is sufficiently large. Complete patient charts can amount to more than 50 pages and any attempt to search the information by eye is going to be difficult.

(6) Designing a secure and informative medical document:

Deciding exactly what information to include on a prescription is a fairly difficult task. You don't want the form to be long and cumbersome but it can't be so terse the prescription cannot be filled. Security is a very important concern, especially when dealing with narcotics. How much identification information is enough to know the doctor really is who he claims to be? Even if every doctor is assigned 20 random unique identifiers, it only takes one lost or stolen prescription to obtain this information. (It should not be the job of the patient to safeguard the doctor's identity.) Though making the form understandable is no simple task, the difficulty mainly arises because of security and variability.

Task Analysis Questions

1. Who is going to use the system?

The primary users involved with the digital prescription application are doctors, pharmacists and patients. The doctors will write the prescription, which the Anoto pen will send via Bluetooth or dock. The information will be checked for proper processing and then automatically checked for discrepancies. Other healthcare workers will also be able to check the database for previously prescribed drugs and the corresponding diagnosis. When the prescription arrives at the pharmacy, it will automatically be placed in a queue in the pharmacy computer. The pharmacist will fill the prescriptions based on the queue. The patient will bring the paper copy or use personal identification to pick up the prescription at the pharmacy, where the pharmacist will provide the prescription and consultation.

2. What tasks do they perform now?

Doctors write prescriptions or send prescriptions electronically from their computers. They fill in detailed identification name for the patients, themselves and finally drug information. In situations where the prescription is lost or damaged copies must also be produced. If the pharmacy is setup for receiving electronic prescription, the pharmacist technicians put the prescription into a queue for the pharmacist to fill. Pharmacists can accept both paper and electronic prescriptions depending on the capabilities of the pharmacy. However, no matter how it is transmitted patients must bring paper copies of their prescription as verification. The prescriptions are filled based on an arranged queue. There are checks made somewhere during this process, currently this is a function of the pharmacy.

3. What tasks are desired?

Physicians want prescriptions to be secure, but not involve so much verification the forms become a nuisance. Ideally, only the most basic information should be necessary. It is desirable to have automated methods for checking prescriptions that do not require looking up information recorded on paper. Additionally, the doctor prefers not to rewrite the same prescription for the same patient. It is a time-consuming task and major annoyance when a prescription is lost. They would like to have an account of all prescriptions and be able to reissue one on-the-fly with little hassle. The pharmacists would prefer to have all their prescriptions sent electronically because it is easier for them to place prescriptions in the queue and keep electronic copies. Patients would prefer to have the prescriptions sent electronically so that they know the prescriptions will be filled and do not have to worry about losing the physical copy.

4. How are the tasks learned?

The more basic tasks: copying, reading and writing are of course acquired at a young age. Doctors learn to write prescriptions by witnessing the procedure as a medical student or resident. Oftentimes, if the forms are labeled appropriately no learning is necessary and the physician simply fills in the appropriate information.

Electronic prescriptions systems are taught by a third party who sets up a system to communicate with pharmacy computers. Doctors and nurses are trained on these systems. Pharmacists practice filling prescriptions as student and graduate interns, but they learn how to fill and use electronic prescription through corporate training from their respective stores.

5. Where are the tasks performed?

Doctors write prescriptions either at a hospital or another facility where he or she practices medicine. Pharmacists fill prescriptions in pharmacies that are usually located inside drugstores or in hospitals. Patients typically transport prescriptions between these two locations.

6. What's the relationship between user and data?

Doctors produce the data; this includes information about who the patient is, who the doctor is, the problem with the patient and the medication they require. The pharmacist executes the directives; they take and fill the prescription based on the parameters listed previously. If information is missing, the pharmacist will contact the doctor to fill in the missing data. The patient is the conduit for the data and the beneficiary of the product. In other words, they transport the prescription and receive medication.

7. What other tools does the user have?

Both doctors and pharmacists have computers in their offices and areas of work. The computers are not necessarily used to communicate with each other, and in many cases for doctors, computers are used for tracking appointments and contact information.

8. How do users communicate with each other?

The obvious communication channel for doctors and pharmacists is the written prescription. If the doctor's computer is setup to communicate information to a pharmacy, the doctor's office and pharmacy can send information such as prescriptions back and forth. There are hospitals where terminals allow for universal communication of data between departments, but usually patient databases are not extensive. Otherwise, doctors and pharmacists communicate over the phone when there is missing information in a prescription or if a prescription needs to be filled. Another instance when the pharmacist contacts the doctor occurs when the pharmacies own patient database shows that the patient cannot take the drug. Patients usually interact in person with both doctors and pharmacists (though phone conversations and e-mail are used as well).

9. How often are tasks performed?

Depending on the type of doctor and number of patients requiring medication, the number of prescriptions a physician writes varies tremendously. In most cases, however, doctors deal with prescriptions daily. The physician we interviewed estimated he would issue 20 prescriptions that day. Filling prescription is the essential function and job of a pharmacist. Pharmacists spend the entire day dealing with prescriptions but the actual number varies depending upon the pharmacy's capacity and number of customers. From our contextual inquiries we found both pharmacies dealt with hundreds of prescriptions a day. As mentioned above every prescription has the potential for generating problems and involves all the steps discussed. Patient variability is probably the greatest. Those with chronic diseases that must be medicated may go to a pharmacy very often. Others might only get medication once in several years for serious acute problems.

10. What are the time constraints on tasks?

    Doctors usually write a prescription at the end of an appointment, after meeting with the patient. The prescription is written quickly to allow the doctor to proceed to the next patient and the patient to have the prescription filled as soon as possible. From the interviews, pharmacists typically have a turn around time of 24 hours. One hour is possible depending on the urgency of the prescription.

11. What happens when things go wrong?

    In the very worst case allergies or interactions can lead to the death of a patient. More common and less severe problems result from oversight or mistakes by the doctor or misinterpretation of the physician's request by pharmacists. A typical mistake is if generic or brand name or quantity is not specified in the prescription. In these cases, the pharmacist calls the doctor to fill in the missing information. Additional problems can result from delays in treatment. If for some reason the patient is unable to get the prescription filled, he or she might have to go back and seek medical attention or have the doctor issue a new prescription.

Names and Assignment Allotment

- Student 1 - Clinician interview, interface design write-up and analysis of approach.
- Student 2 - Target users, problem and solution overview.
- Student 3 - (Hospital) pharmacist interview and list of tasks.
- Student 4 - (Franchise) pharmacist interview and task analysis questions.