Introduction

Before considering the final design, it is imperative to go through the advantages and disadvantages of the different components that we considered to choose the most applicable and reasonable design to fit our user profile. In our design, we chose components over the design alternatives because we noticed that these components in one way or the other appeared in all the alternatives that we thought of. This option gave us the possibility to further understand each component and help improve the final design. The different components we considered were the Map Interface with GPS, the In Car display unit, Touch-sensitive interfaces, Voice Recognition and a Voice Assistant, which can be classified into three main groups, the **Map Interface**, the **Voice Interface** and the **In Car Display**. Each of these components was explained in great detail in the second stage of the project. Here we chose to narrow our choice down to the Map Interface and the Voice input by the Dispatcher, due to few reasons which have been elucidated in detail later in the write-up. First we shall consider the advantages and disadvantages of the components so we get a clear idea while the trade offs are being discussed as to why we chose one component over the other and also why we decided to use one particular design over another.

Map Interface

The map interface provides the dispatcher with a real time view of the stingerette dispatching area. At present the dispatcher works with a Microsoft Excel spreadsheet and does not have an idea as to where the vehicles are in the dispatch area. This often causes quite a bit of confusion and pick ups are made by vehicles which are going in the opposite direction to which the user intends to reach. This causes the user to wait for all the drop offs to be made and is then dropped off to his/her destination. To avoid these situations and ensure smooth operation of the service, a map interface has been considered. There are different designs of the interface that have been considered and all of them have their own set of problems and advantages over each other. The strong and weak points of the various designs considered have been elucidated and these would help us ion finally choosing our intended design alternative.

Advantages:

The map interface provides a clear spatial arrangement of vehicles and calls, giving the dispatcher a real time view of the whole operation. This helps the dispatcher gain control over the operation which is what the stingerette drivers preferred over the present system. At present the dispatcher calls out the address and the driver closest to the area of the call radios in and makes the pick up. This often leads to confusion and chaos. This interface also provides the dispatcher with information about vehicle status, so she has an idea whether the vehicle is occupied or not. This form of display helps the dispatcher by reducing his/her memory load, which is under constant strain in the present system.

Disadvantages:

The display takes more space than the present operation. The present operation just involves a normal desktop machine and two phones nest to it (One to contact the drivers and one to receive calls from the users of the service). The problem with this would be that the dispatchers work area will have to be increased to accommodate the screen with the map interface whichever it may be. The dispatcher may take some time to get acquainted with the map interface due to which she might make a few more errors than normal. The dispatcher may find it difficult to distinguish between two calls, which are placed close to each other on the map (resolution). The area of the dispatch being quite large and due to the normal screen size it will be difficult for the dispatcher to differentiate between two calls which are placed close together. Since we're using the GPS system in all the map interface designs there might be interference in communication due to weather, buildings, trees, etc…but that shouldn't interfere with the system to a large extent. Low resolution may not be able to resolve position between parallel, nearby streets.

Map Interface with Light Pen/Stylus

Advantages

The simple intuitive input reduces the typing work of the dispatcher, which is one of the main stress causers. The multiple possible inputs (keyboard, mouse), give the dispatcher freedom to work with more than one form of input stressing on increased user preemptive characteristics.

Disadvantages

Smaller display requires panning and zooming into, which is annoying for the dispatcher in situations when he/she handles a bunch of calls. Apart from this the constant movement of the arm from one end of the monitor to the other could be taxing for the user. The constant shift from the stylus to the keyboard could also prove to be a source of irritation for the dispatcher.

Map Interface with Voice Recognition

Advantages:

This is a more natural input as in the dispatcher doesn't have to type out the information she receives making the process much faster that the present one. This process also helps reduce the workload of the dispatcher thus reducing the stress on the user. Requires no typing skills or speed as the dispatcher has minimal amount to enter via the keyboard. The minimal amount being numbers on rare occasions when the voice system cannot recognize certain entries.

Disadvantages:

The system is heavily prone to external noise; i.e. this system would be heavily dependent on the environment and any annoyance in the form of noise could disrupt the working process. The system usually requires a training period and thus limits the users and increases the potential for errors. The service has a syntax, which will have to be followed to make the required input. This would require some form of training for a period of time. It will require the dispatcher to explicitly control the microphone and also state the call data in a formal manner bringing in the aspect of multitasking which might complicate affairs and increase chances of error.

Map Interface with Large Display

Advantages

Large display makes it easy for the dispatcher to clearly make out and select various buildings and streets. Using the touch sensitive display as the sole input device saves time normally spent in shifting between input devices (e.g. Keyboard and mouse). Having both the call listings and the map on the same display reduces time spent in switching between displays. This system is very intuitive and would require minimal training.

Disadvantages

One of the main disadvantages of this system is that it needs more space. The monitors are essentially really large and would hog the entire workspace. Also large arm movements would be required to operate the interface and may tire the dispatcher quite easily. It also involves standing for extended periods of time which is not suitable for this kind of job which involves constant attention and few periods of rest. One other disadvantage is the fact that the large monitor may affect the vision of the user because the process would involve close proximity to the interface.

Voice Interface

One of the greatest complaints from the dispatchers was the number of times they had to answer the phone to take calls. The call volumes are variable and sometime reach such high levels that the dispatcher does not have time to pass on the call information to drivers before the next call arrives. Another problem they face is turning away students when the number of outstanding calls is too high. While that task itself makes the dispatchers feel uncomfortable about it and sometimes leads to them having to endure abuse from the callers, its greatest problem is that the dispatcher has to divert their attention from the actual job of dispatching at the time when their job is most critical. In order to combat this we have come up with some designs of an interactive voice-based system that will answer phone calls automatically and thus allow the dispatcher to concentrate on the actual task of dispatching. However the Voice interface has its own set

of advantages and disadvantages which have been discussed below. The individual designs of the Voice Interface system also have their own set of advantages and disadvantages which are very important in themselves as they helped us in choosing one of the three design options.

Advantages:

A voice interface to handle the incoming calls would free the dispatcher of attending the huge load of phone calls. Multilingual capabilities (English, Hindi, Chinese, Spanish, etc…) make it easier for international students to use the system. Speaking would be a more natural user input method.

Disadvantages:

This interface might slow down the use because the accessing the menu option takes time. The voice interface would not only be a huge task especially as it has to be very efficient and robust. The personal touch of a human operator is often preferable to a very friendly-sounding machine! Since the voice interface would have a fixed pattern of interaction, callers could get frustrated if there are errors like substitution, rejection, insertion, deletion in the system.

Voice Recognition

Advantages:

Relatively fast interaction time reducing the workload of the dispatcher as well as increase the efficiency of the service. It is a more natural user input and allows the user to enter data himself/herself. Unlike the menu or text entry options, does not require any lighting from either the caller's environment or telephone instrument. It does not require a touch-tone phone as there is no typing or entry through a touch phone required when this system is used

Disadvantages

The user is prone to error by mistakes in natural language recognition. Not many people are native speakers of the English language so the current system might not be able so perform with much the same result as before. Recognition of various accents and dialects is a problem as people from different backgrounds may have problems interpreting the common accent. Having to repeat the information because the system did not understand it may cause caller irritation and may reduce the efficiency of the service. The system must be able to recognize locations using both the location's full name and the short form (College of Computing = COC). The system will also be affected by noise in the caller's environment. Any additional input or sound which is not recognizable by the system could lead to a request to repeat the entry which would be irritating for the user of the service.

Voice Interface with Text entry

Advantages:

This would minimize the cost and technology involved in using voice recognition also would allow more accurate entry of data since the callers directly input the text details with a touch-tone phone. One could benefit as more privacy is provided, as other people will not be able to hear the caller's destination. Irrespective of how noisy the surroundings are, the system would work.

Disadvantages:

There are different keypads in the market with different layouts of buttons and this might confuse callers and make it tedious for them. One would have to be a spellings-wizard and know the exact spelling of the address. The system would also require lighting in either the caller's environment or the phone keypad so that the keys are visible. The phone would have to be a touch-tone phone. True multilingual support is very difficult as they are only a limited number of options a text entry system can provide. The users can hear the options in their native language but must enter the information in English. This would lead to a substantial amount of confusion. Also calls are made at very urgent times, for e.g. when the service is about to close. During these situations if the user is encountered with an error he/she stands a chance of missing a ride back home.

Voice Interface with Hierarchical Menu system

Advantages

This system would be quite an accurate, with no voice recognition or text entry errors possibility. This reduces the irritation factor as far as errors are concerned.

Disadvantages

It would be a very time consuming and tedious process to go through the various options provided by the Hierarchical menu system. High recall is required on the callers' part to remember the various menu options. To use the building number option the user must either remember the building codes or have access to a campus map. Similar to the text entry system the user of the service stand a chance to miss the last ride back home leaving him/her stranded at the call location. This system would require a touch tone phone with lighting in either the phone keypad or in the caller's environment.

In Car Display

A design to reduce the radio communication between the dispatcher and the drivers is to provide a device inside the Stingerettes to display the details of the calls that each driver

must attend. In the current system the only form of communication between the drivers and the dispatcher is through a radio whose frequency is shared by all the parking and transportation radios, including parking enforcement and the Stinger busses. This system is highly unreliable and is very often affected by weather conditions and ambient noise.

We proposed to install a small interactive display device in each vehicle that will show the driver which addresses he has to go to. The device would show the driver the pick-ups and drop-offs and this will minimize the amount of information he has to hold in his memory. There are several implications to designing and building an in car display. The display should not distract the driver while driving and the driver should be able to get all the required data in a glance with out having to take too much of his concentration off the road. The size of the display is also important, as it should not block the drivers view. The display should not have any light requirements as vehicle interiors typically have very low ambient light levels.

We did consider using head mounted displays and projected displays on the windscreen but decided against them as they would be a too great a distraction and might block the drivers view. We finally decided on small backlit displays mounted on the dashboard console as they do not distract too much or block the drivers view. Again these designs have their own set of advantages and disadvantages. All of them have been discussed and thought upon. The final design might or might not include this option due to its overwhelming distractive feature. This decision will be made in the trade offs between the various design alternatives.

Advantages

The in car display reduces the radio communication needed between drivers and dispatchers since the display would show the necessary information constantly. The radio communication is often a source of wrong call inputs into the system as the dispatcher cannot perform both the activities of taking the call from the users and communicating with the dispatcher. This would also reduce the memory load for the drivers by displaying all call information. Privacy is ensured, as the information cannot be picked up by simple radios. Incorporating a map inside the vehicle would give a visual representation of the calls to be answered which could help the driver in knowing the pick up and drop off locations but also the current position of the other Stingerette vehicles for better coordination.

Disadvantages

The device could distract the drivers while driving which can even prove to be disastrous. The cost involved in making the display unit would be more than providing a simple radio. Some drivers could be techno-phobic and might refuse to use it. In fact one of the users during the initial part of the project was quite happy with the present system of radio communication. People generally take longer to understand maps than text and this might pose an issue considering the size of the display and the amount of lighting inside the vehicle. This only causes more distraction and could lead to hazardous results. The

touch screen property of the device may also lead to errors for users with low dexterity or thick fingers and again the size and amount of lighting inside the vehicle may not favor the use of a touch screen device.

Map Display

Advantages

This interface reduces the amount of communication required between the user and the dispatcher. At present a very distracting radio communication is being used which frequently causes wrong entries due to the multitasking which the dispatcher is subjected to. It also gives a visual representation of the calls to be answered hence enabling the drivers to determine the fasted possible route to the source of the call.

Disadvantages

Users generally take longer to understand maps than simple text addresses. The drivers being not so well versed with maps might find it hard to deal with the sudden change to the map interface and may get unnecessarily distracted which could lead to hazardous results. Audio cues may not be heard due to the traffic noise and other occupant conversations which would hamper the proper functioning of the system. Drivers still have to use the radio to pass on information about the pick-ups and drop offs made which slightly undermine the utility of the design.

Touch screen display

Advantages

This system consists of a simple text data output that will not distract the driver. This system provides the driver with easy to understand text output which tells him the present pick ups and drop offs to be made. This option provides the Stingerette service with the alternative of not using the distractive radio device.

Disadvantages

Touch screen may lead to errors for users with low dexterity or thick fingers. Also it may be quite tough to start using it immediately, because of the complexity of the device. It also has the chance of breaking or malfunctioning due to rough use. This device will be substantially more expensive than the radio device which might be a reason to avoid this alternative altogether.

Trade Offs and Selection

The three basic components which we talked about earlier in the introduction have their own problems and strong points, but to choose between the components it is imperative

to discuss the effect they would have in the presence of each other. We decided with careful parley that we would do away with the In car display due to some obvious reasons and some others which are not so obvious. The reasons have been discussed at length and have given us an adequate nudge to keep it aside in the final design.

The standard scenario which the Stingerette service works in is the situation in which the service user calls the dispatcher and requests the drop off to the location intended. Assuming all the components discussed are a part of our system the user first interacts with the voice assistant. Then he/she gives the information that has been asked for and her call is logged onto the database. The dispatcher then reviews the call made as the display appears on the screen. The she relays this information to the driver nearest to the location using the call listing interface and the driver views this information on the In car display. He/She then makes the pick up and relays the information back using the component located in his vehicle and it gets logged onto the database and gives the dispatcher a visual output. This scenario occurs, assuming the voice assistant is a part of our system. Now the problem with this scenario is the possible trouble which could arise when the user is unable to convey his/her location and destination due to some human error. There are situations in which the user, due to absentmindedness gives the wrong address and wants to change this information. In such a case, the voice assistant could prove cumbersome to interact with. Also the voice assistant is a much longer and tedious manner to interact with the system.

Assuming the scenario when the Voice assistant is not a part of the system and the dispatcher interacts with the user and enters the information by clicking the points on the Map interface with the help of a stylus/light pen. The average number of calls received in one day by this service is around 250, which is quite a bit of work for the dispatcher if she has to keep clicking points on the interface with the light pen/stylus. So a better option would be to select the position on the map using a mouse. The other design in the map interface which we thought of were the large display monitors which hog quite a lot of space and cause fatigue as they would involve large arm movements as well as constant standing. So due to the nature of the job and the number of calls we decided to do away with this design. This brings us down to one design in the Map interface component which included the two monitor system which gives the dispatcher a real time view of the dispatching area as well as a view of the call listings which can be updated with every call. A description of the presently chosen interface has been described later and will show the tasks which are involved in the system.

Now we have narrowed down our design to the Map Interface with two monitors and the Voice input by the dispatcher and the only component left is the In Car display. The In car display can prove to be both hazardous and time consuming as the non computer savvy drivers might not be able to use it with ease. The drivers have to be very attentive as the roads around the campus are always traffic clogged and the chances of accidents are always high. The display unit could be very helpful but in situations when the driver is unintentionally drawn towards it, a mishap might occur. Providing the driver with distractive devices is unnecessary when the radio communication carries out the service

with a good amount of accuracy. So we decided to entirely take the In Car display out of our final design.

The tradeoffs gave us a good indication about what we should use and what we shouldn't and taking all the above factors and scenarios in mind we narrowed the final design to the Map interface with the keyboard and mouse being the input devices along with the Voice input which the dispatcher uses to enter numerical addresses. Since we have chosen our design components, we describe in detail the working of the present system and have included snap shots to facilitate the same.

System Prototype

After laying down the advantages and disadvantages and discussing the trade-offs, it is necessary to highlight the final design. The final design consists of the Map Interface with GPS, the Voice input system which detects the input given by the dispatcher, a standard keyboard, a mouse, two phones (one to interact with the drivers and the other to take caller information) and the radio which the drivers carry to communicate information to the dispatcher.

We will discuss the working of the design in detail and discuss the implication that we deduced from Parts 1 and 2 and how our designs met these implications. This should help justify the reasons for choosing these design components and making them a part of our final design. These steps should also help us in laying a foundation for our evaluation process in Part 4 of the project.

The system would include a dual monitor display with a keyboard mouse and all the Stingerette vehicles fitted with GPS tracking technology. The dual monitor system has the Map interface on one monitor and the Call listing details on the other. The Map interface as discussed earlier gives the dispatcher a real time view of the dispatching area. The Call listing helps the dispatcher efficiently log and handle the calls that come in during the operations hours. The Call listing interface is connected to a database and once the information has been entered in it, it gets directly logged into the database. This ensures that all data is saved and can be accessed at any point in time.

Figure 1: The whole arrangement of the proposed system.

The standard task starts with the dispatcher receiving a call from the user of the service. Once he/she gets the information of where the caller wants to go and the location he/she should be picked up from, he/she clicks on a spot on the map to input the pick up location. On doing this the dispatcher gets a pop up dialog box, which asks him/her to enter the house number, if outside campus or asks him/her to confirm the click if its an in campus building. The moment he/she finishes this task a dot appears at the pick up location, which indicates the location of pick up. When the dispatcher clicks the next location it automatically detects the position as a drop off location and denotes it with a different color. Again the procedure followed is similar to the Pick up information entry step. On successfully entering the pick up and drop off information the dispatcher has to enter the number of passengers. The default value is set to 1. One these three things have been entered the call is then transferred to the call listing area. In case the dispatcher makes an error, he/she is provided with a cancel button, which cancels the whole process and gives him/her the option of picking location points again. The figures shown below are those of the Pick up, drop off and the entry stage for the number of Passengers. The interface has been split into two and provided as different pictures to give a better idea of how the interface looks.

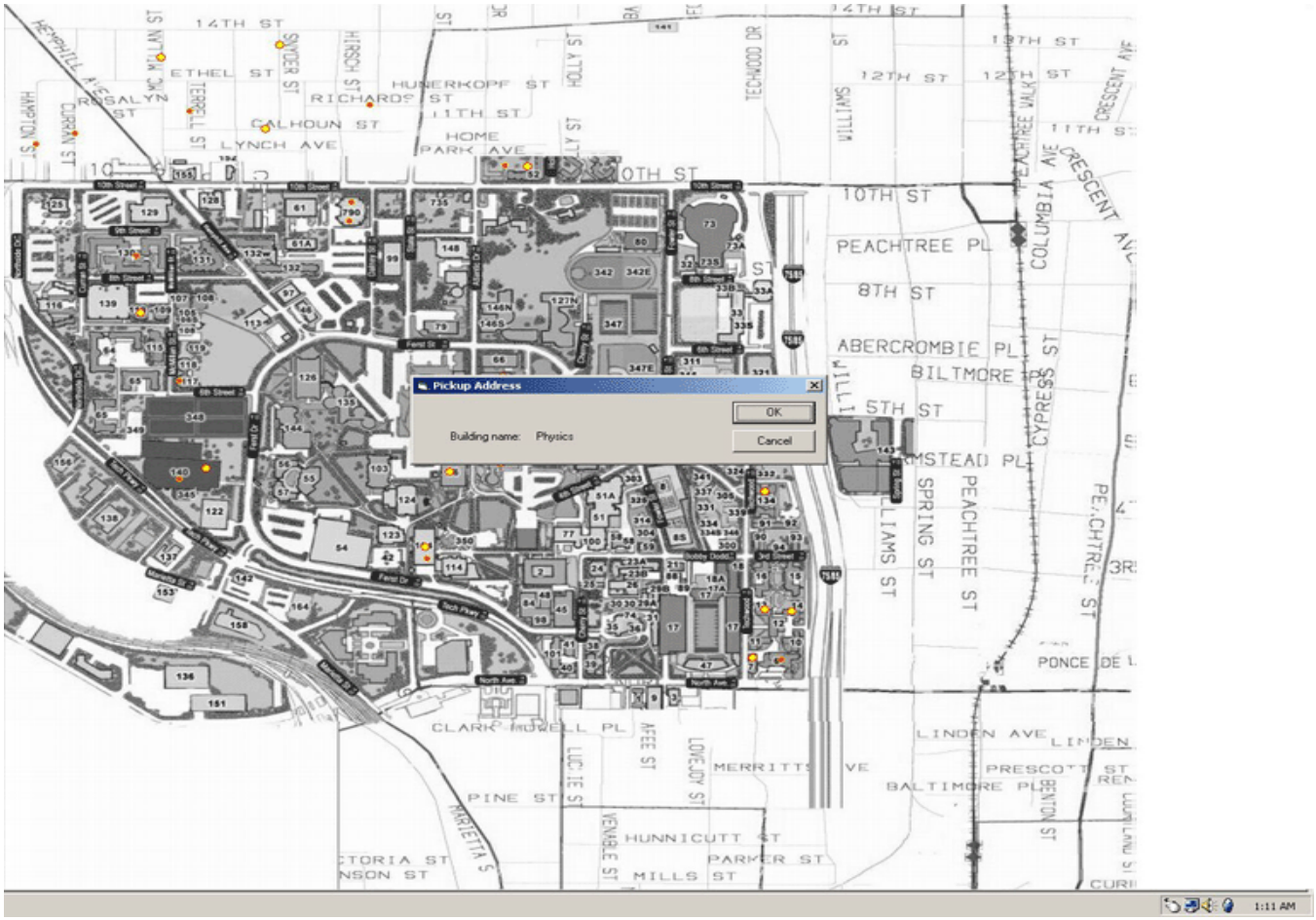

Figure 2: The Interface shows the Pick Up dialog box which shows the Pick up information of the caller

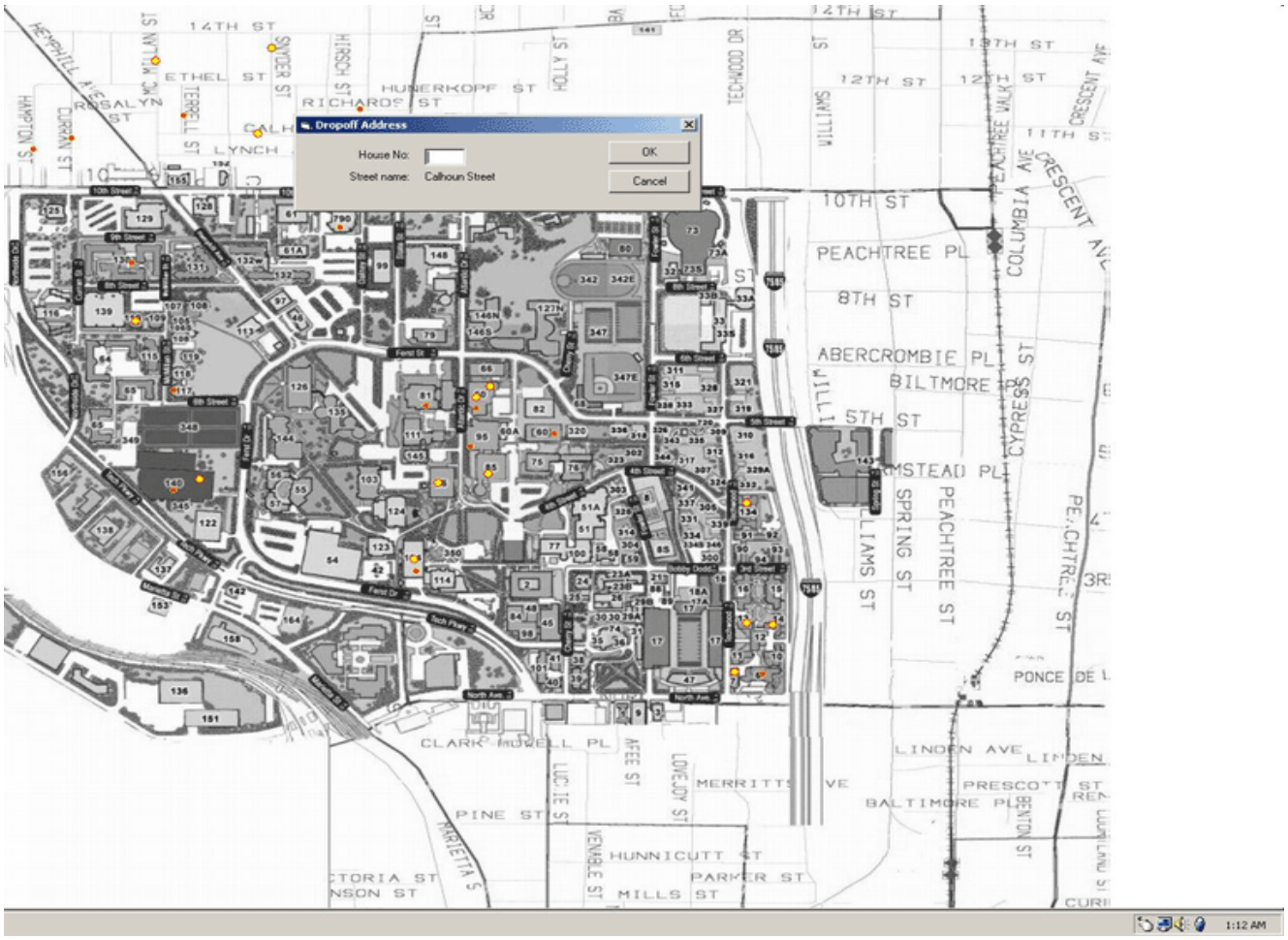

Figure 3: The Drop off information box is seen after pick up Information has been entered.

Following this the map gets a yellow dot at the place of the drop off and then the no. of passengers dialog box opens, asking the dispatcher to enter the number of passengers present at pick up location.

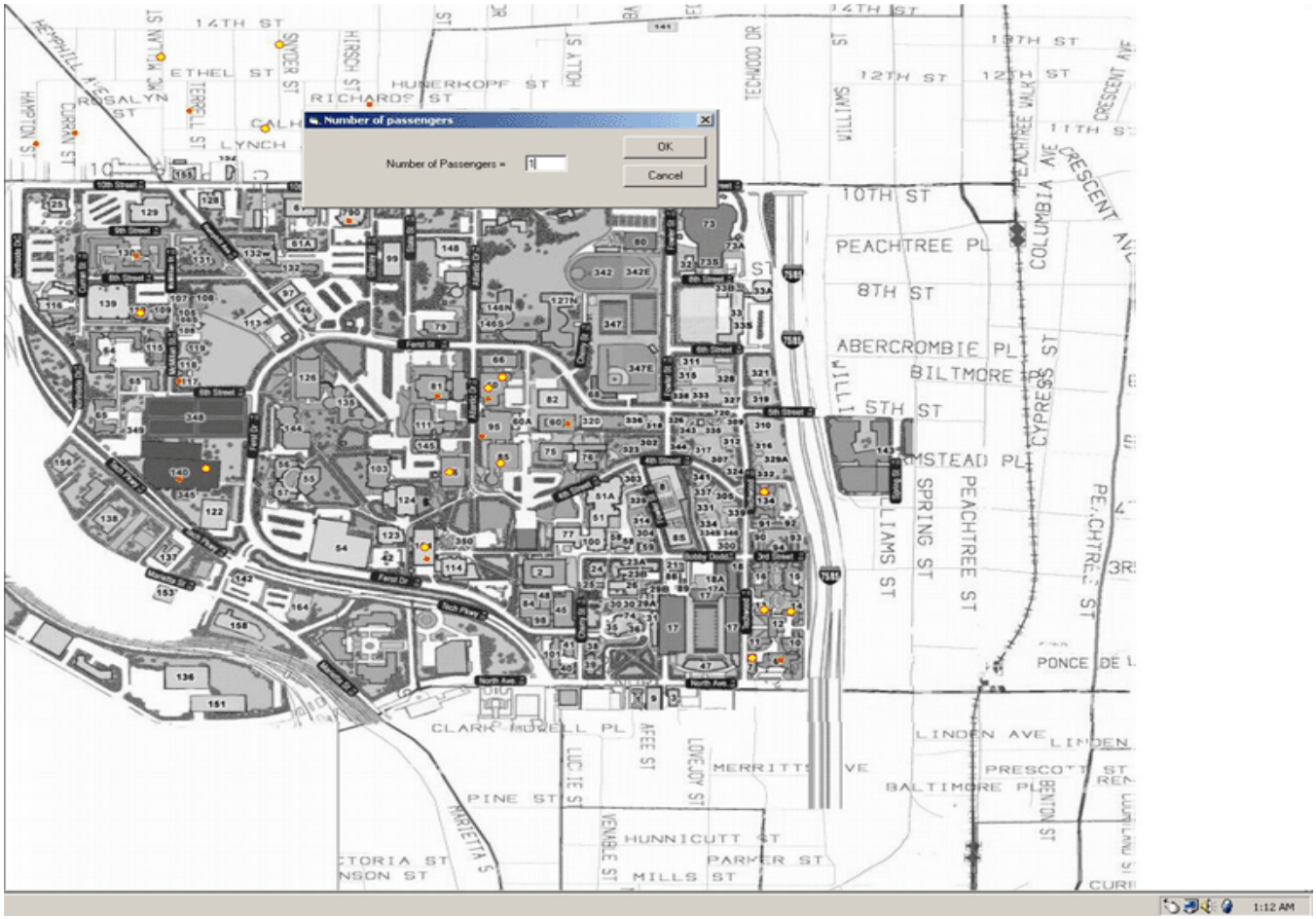

Figure 4: The Map interface asks the dispatcher to enter No. of Passengers. The yellow and red dots show the pick up and drop off points respectively.

On entering this information the details get transferred to the call listing area. The call listing area consists of a frame, which shows the outstanding calls and individual driver information such as the drop offs to be made and the number of passengers in the vehicles. The dispatcher can transfer information from the outstanding calls region to the driver area by choosing the driver no. or name. Then she relays the information to the driver and asks him to make the pick up. The entire call listing interface is shown in the next figure.

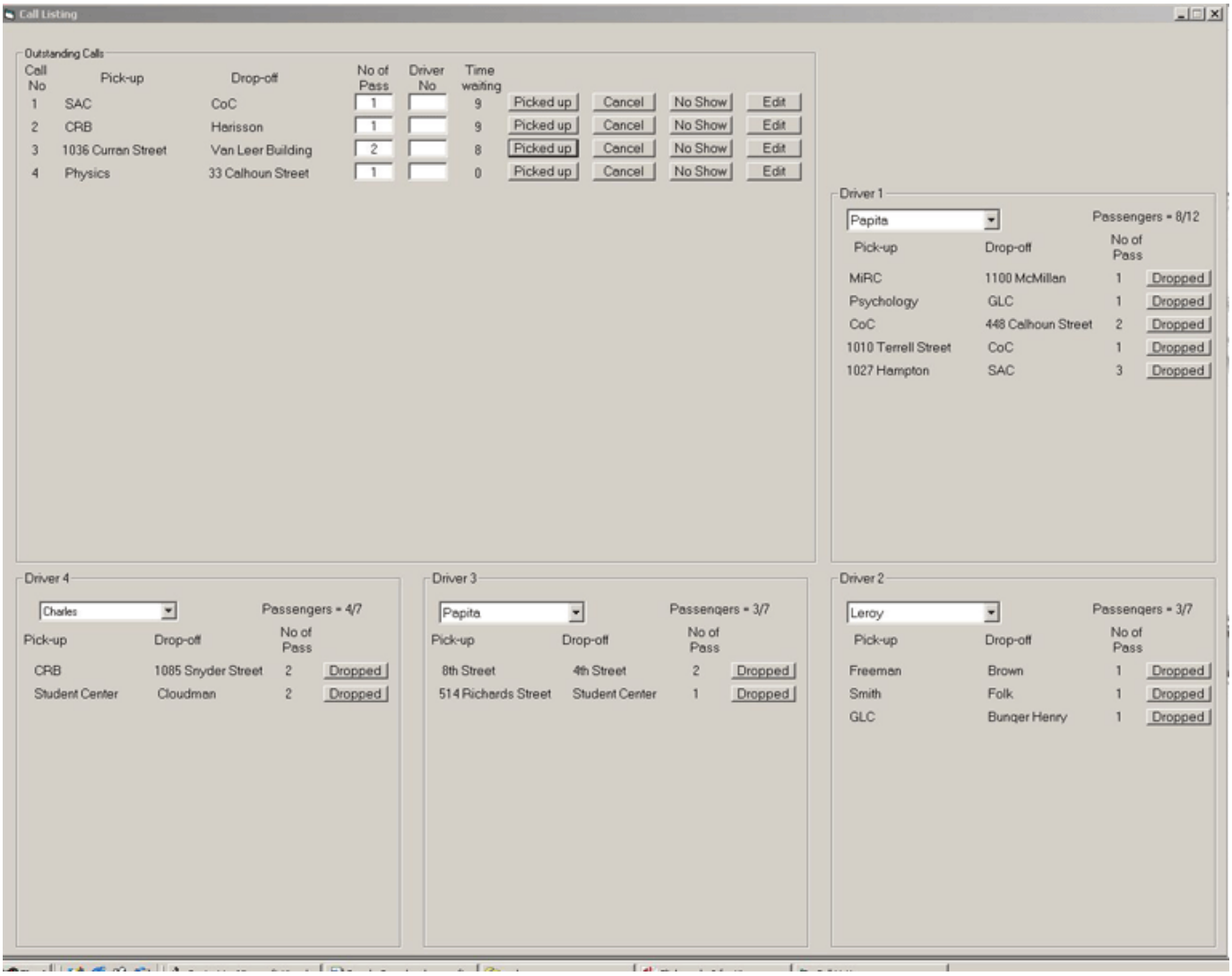

Figure 5: The Interface after the locations and No. of Passengers have been entered. The frames show the outstanding calls and individual driver drop off information.

Once this is done the dispatcher checks the map for the driver closest to the call location and informs him/her to make the pick up, via the radio. Following this step the dispatcher logs in that particular call in the individual vehicle call listing and once the driver informs the dispatcher that the pick up has been made she clicks the "Picked Up" button and that gets logged into the database. In case of a no show the driver informs the dispatcher in the same manner and the dispatcher clicks "No Show". Once one call task is complete it disappears from the interface and the next call replaces this one in terms of numbers. The call listing area thus, basically shows the outstanding calls.

The map interface has **tool tips**, which will continually help the dispatcher in identifying the streets when he/she moves over them with the mouse. Also when the dispatcher moves over the dots on the map interface the tool tip provided gives the address information of the point. The figure shown below is when the tool-tip is activated. The figure is a small part of the map interface, which has been taken to highlight the tool-tip feature. The tool tip also helps the dispatcher by showing the pick up location and the drop off location.

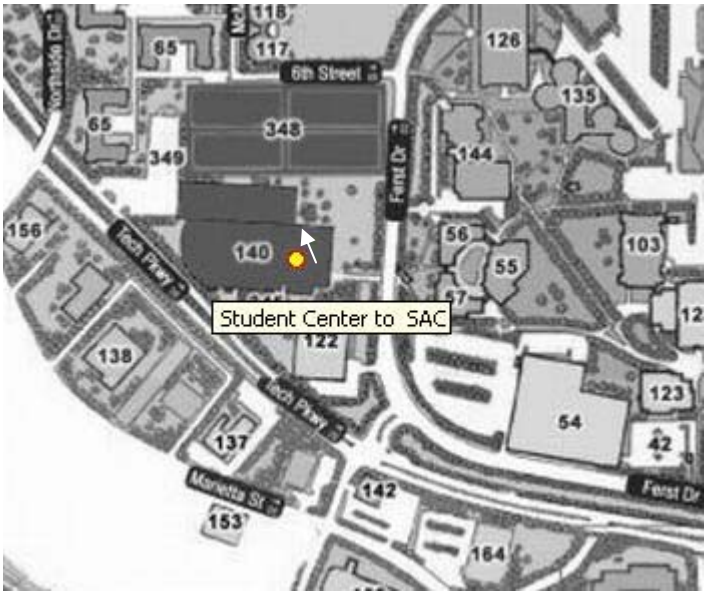

Figure 6: Tool Tip feature of the Map Interface

The map includes **color-coding** for pickup and drop-off locations. When a pick up location is clicked the pick up point is marked with a red dot with a yellow outline. Once a drop-off location is marked a yellow dot appears with a red outline to mark the difference between the two locations. The color schemes of red and yellow were chosen because against the gray-scale background these colors are visually prominent.

The map also shows the current positions of the Stingerette vehicles using the **GPS tracking** feature (which is being faked in the prototype). The dispatcher sees the vehicles moving on the map interface, which gives her a pretty good idea as to which direction the vehicle is moving in. This helps her in deciding which vehicle should make a particular pick up so this ensures that the control is entirely in the hands of the dispatcher which the drivers prefer.

In a situation when the dispatcher needs to make changes to the entered call data he/she can use the option of the **"edit"** button on the call listing screen. We were thinking of using a zoom and pan option but this feature would only increase the tasks of the dispatcher. The map interface is quite clearly visible and comfortable to work with and the usability tests will establish whether these features are necessary or can be done without. The Monitors which we think would be suitable for the operation are 17" and above so that the map is clearly visible to the user.

Implications vs. Design Comparison

Apart from discussing what the interface does and how it has been made we should also discuss what the implications of the first two parts were and how we've incorporated adequate measures to counteract and take care of these implications. The table below shows us the manner in which our present design takes care of the implications from the first and second stages.

Implications we deduced from Part 1 and Part 2	How our design meets this implication
• The dispatcher has a training period in which they are taught the operation of the system	• The ease of learning secondary to the efficiency and ease of use.
• Since the user works at the end of the day and handles a lot of tasks with variable motivation levels we infer that flexibility, ease of use and robustness of the interface are very important.	• Flexibility: the dispatcher can either use the map interface or the call listing area or voice input to enter the call data. The keyboard is also an option.
• The system must be user pre-emptive, user initiates actions; the interface of the software is more flexible.	• The dispatcher has the option of entering data in text format and also through Voice input.
• The interface must allow substitutivity by allowing short cut menu operations while entering data.	• The off campus streets require only house numbers to be added. Call listing works on a series of shortcut operations, which are very easy to use.
• Recoverability is critical, as the dispatcher sometimes has to often change data and any system downtime will badly affect system performance.	• The call listing logs the data in the database, which can be accessed at any point in time as also the "edit" feature, allows the user to change

	information after it has been entered.
• The system must also reduce the amount of typing required by the dispatcher by automating some of the logging functions like time entry, address entry, etc…	• This is where our design will make the most impact; the interaction is more by clicks and voice and less of text. Automatic entry of time also is an improvement over the current interface that is being used by the Stingerette.
• Provide the dispatcher with information on the locations of the vehicles, vehicle occupancy and boarding and destination locations.	• The GPS tracking technology would enable this implication.

Evaluation Plan

The project involves a detailed usability test, which would need IRB approval; in addition the group members will complete the NIH online certification. Once that process is complete we will be ready to conduct the usability testing process.

The process of testing will include two sets of users, the dispatchers and the miscellaneous testers. The Dispatchers are the actual users of the interface whereas the miscellaneous testers are included to increase the participant sample. The current Stingerette has only two regular dispatchers and one or two other occasional dispatchers who fill in during the absence of either of them.

The goal of the evaluation is to gather evidence that can help us evaluate the design and understand the areas for improvement. At present the prototype has been built on the knowledge we have gathered from the first two stages and the evaluation would involve gathering data from the actual users of the system to determine whether the steps we have taken are goal driven or vary in any minor sense.

In this stage we are just going to outline the plan for the evaluation and testing phase, which will be carried out with the approval of the IRB in the fourth stage of the project. The general approach to the evaluation has been stated below and we wish to follow them as closely as we can.

The General approach to the evaluation:

- Includes collection of both objective & subjective data
  This includes data like "completion time" and "preference". The data on completion time gives us an idea whether our design helps the users complete a given task faster than the present time required in conducting the task (an objective data). The test for preference gives us an indication whether they prefer one method to the other in carrying out the task given to them (subjective data).
- Includes using multiple measures, within a type
  This part includes "reaction time" and "accuracy". Reaction time is very necessary to be tested as the design includes a Map Interface. The no. of clicks required for an operation should also be kept to as low a number as possible. Accuracy is also an important feature, as we have to consider that clicking a wrong area can increase the number of tasks to be carried out by the user.
- Includes using quantitative measures wherever possible
  Preference scores (on a Likert scale of 1-7) are considered in this part. The test will include a preference score scale, which will help the users to indicate how preferable the new system would be over the present system.

The goal of this evaluation would be extract all the required data necessary with minimum possible interruptions, hassles, time, etc…

Data as Evidence

The data as evidence has to include the following features:

Relevant: Appropriate to address the hypotheses.
E.g., measuring "number of errors", time taken for each call starting from the incoming call till the end of entering data into the system, noting whether the time taken is shorter than the current system, check if number of tasks the dispatcher has to carry out are fewer than the current system, and if not check if the time taken for the same number of steps is lesser.

Diagnostic: Data unambiguously provides evidence in one way or the other.
E.g., whether the interface gives the dispatcher the control to take a decision about assigning calls to the appropriate driver, who in turn will be closest to the call location so that callers are not made to wait for a long time – which is after all the main purpose behind the project.

Credible: data has to be gathered carefully and the amount of data collected should be adequate enough to make a conclusion. Two groups of users will be used. The dispatchers' group consists of two regular users and two occasional users. The Miscellaneous users' group will consist of random evaluators who will be given

information beforehand about the tasks of the dispatcher and the working pattern of the Stingerette system.

Corroborated: Do more than one source of evidence support the hypotheses?
E.g. After the process of evaluation of the new interface by both sets of users, we will compare the results obtained with those our evaluation of the current system which we did in Part 1 of this project and observe if the new system is better most of the counts we have considered. Also the objective and subjective data will be compared and analyzed whether they tally with each other apart from being better than those of the current system.

Location of the testing of the interface with the users:
Observations may be in lab (COC room 209) and if we will be able to use a specially built usability lab, then we would do the observation there. In addition, we are going to deploy the interface at the Stingerette office after we obtain permission from the Stingerette authorities.

Types of Data to be collected

Demographics: Information about the participants, used for grouping or for correlation with other measures. E.g. **Handedness**, which would depend whether, the monitor with the map should be on the left or right side of the user. **Sex** of the user might be significant for the color-coding on the map (though tool tips are given) since 8% of the males are colorblind. **Age** is important demographic data since poor vision might be a factor; level of **education** more specifically how computer-literate they are and how well acquainted they are with an **aerial layout** of Georgia tech may be important (the users will however be provided with the map of Georgia tech so that they need not memorize the layout).

Quantitative data: Measurable data like time taken for each call to be completed, number of errors while entering data, number of clicks required to complete one call, number of tasks involved in completing one call and time each caller waits for pick up to be made.

Qualitative data: Observations or descriptions that are not quantifiable in nature like user satisfaction, approaches to undoing any error once committed, number of irritated responses, number of times they frown or show displeasure or satisfaction through their expressions.

Collecting Data would include capturing the session: This part of the evaluation is very important as it helps extract raw data, which aids analysis and evaluation of our system. It includes steps like Observation and note taking, which has to be logged in a systematic manner. This could include tables, forms, pictorial representation and think-aloud responses. Software logs are also a part of this session. It includes characteristics as to how long the caller had to wait for his pick up to be made and how long he had to be a passenger in the Stingerette vehicle. This data would be extracted from the database, which is directly linked to the call-listing interface.

Pre-session activities

The user will be given a form which will require him/her to fill in information like their name, age, sex, address, phone numbers (home/work), email address (to have data for analysis and also to contact them in future if need be), qualitative data like how proficient they perceive themselves to be in using of computers – their computer skills (objective data- whether they have experience with MS Office tools or programming skills, multimedia skills and if so then how many years…), do they play interactive computer games!(that might suggest a possibility of an underlying interest and enthusiasm and in using the map interface as opposed to a conventional keyboard text entry format). We would familiarize the user with the tasks of a dispatcher and give them a map of the campus and surrounding areas (that Stingerette covers) and leave them to work by themselves. We would try to make them feel comfortable and relaxed and not do anything to intimidate them or even try to influence them to give us a favorable response; we would just play neutral and polite.

During session activities

We would refrain from interfering with their session. If they seem to be indefinitely stuck having no clue of how to proceed we might ask questions like" What are you trying to do."-"What made you think."-"How would you like to perform…" "What would make this easier to accomplish."?-Maybe offer subtle hints but if we have to interfere and directly help them out then we would make a note of this and would consider it as an invalid session. We would have **Think Aloud** sessions for the user where he/she would describe verbally what he/she is thinking while performing the tasks like what they believe is happening, Why they take an action, What they are trying to do and have an audio (preferably video) recording of their speech on taking their consent of the matter.

Observation of the users will be **both direct and indirect**. The direct observation will include watching them in by us being in the same room. The drawbacks would be that it can seem to be intrusive and since the users would be aware of our presence, they may not be too free in going about with the interface, they might even try to rationalize every now and then for errors and might look at us for help too every now and then which would interfere with the timing of the benchmark tasks. Also we might get to see the session from one aspect of the room only. We may use 1-way mirror to reduce intrusion. The advantage of this method is that it is cheap, quicker to set up and to analyze. The Indirect observation will include Video recording with cameras focused on screen, face & keyboard and this would gives archival record, but can spend a lot of time reviewing it and reduce intrusion, though it doesn't eliminate it

Post-session activities

Questionnaires: At the end of the session of the user with the interface, we would interact with the user to obtain their feedback through questionnaire. The questionnaire

would be **both written and oral** in a sense that the oral might follow the written – the oral would be spontaneous and would occur if the circumstances initiate the conversation, for example if the user begins to share or give feedback, we would take note of it and lead him/ her to elaborate as needed. The written questionnaire would contain the questions that would be common for all the users.

We will gather data about the **screen** (layout, color coding, mapping, resolution of the map (whether adequate or not) whether they are comfortable with the dual monitor type of layout, **graphic design** (size, shape and text on the surface of buttons like whether the language used was comprehensible and natural, the style, size and color of the font on the buttons whether legible. We would collect data on the **terminology** used in the entire interface whether it is natural and helped them comprehend the functionality of the controls. We would gather data on whether the interface met all the **capabilities** that a dispatcher might expect from it or if there are some situations where the design of the interface might make it difficult to execute a task. We would ask whether the user found it difficult to **learn** and if so any specific reason for it like the layout, button types, whether there was consistency throughout, whether they could predict the functionality of the control before clicking/using it, whether they could synthesize the response of an action on the interface and whether the interface seemed familiar (here we would also would like to gather data whether they are more comfortable with a Windows/ Macintosh/Sun system and try to analyze if this might be a reason for their preference to the changes in the controls that they specify). We will also like to have subjective qualitative data like their **overall impression** of the interface. The **question formats** will be both **closed and open**. The closed would require answers restricted to a set of choices which would be specified by us whereas the open ended question would be more like a discussion session where the users will be asked to give their inputs on areas where they would like the interface to change. The closed format would include questions that accept answer based on the Likert Scale of 5 or 7 since above that it is hard to discern and doing an odd number gives the neutral choice in the middle.

The open format would ask for unprompted opinions and this is good for general, subjective information, though it might be difficult to analyze rigorously but will help with design ideas like "Can you suggest improvements to this interface?"

We also intend to conduct a **debriefing session** (group session) among the dispatchers if possible so that we get collective feedback. Questions like "What did you like best/least?", "How would you like us to change the layout or any other aspect?" etc. would be asked.

After running the tests with all the users, we would process the data into useful information and make conclusions about the interface.