Title
iCHASE: An Internet Computerized Household Activity Scheduling Elicitor Survey

Authors
Lee, Ming S.
Doherty, Sean T.
Sabetiashraf, Ramesh
et al.

Publication Date
1999-11-01

iCHASE: An Internet Computerized Household Activity Scheduling Elicitor Survey

UCI-ITS-AS-WP-99-1

Ming S. Lee [1]
Sean T. Doherty [2]
Ramesh Sabetiashraf [1]
Michael G. McNally [1]

[1] Institute of Transportation Studies
University of California, Irvine; Irvine, CA 92697-3600, U.S.A.
mmcnally@uci.edu

2 Dept. of Geography & Environmental Studies
Wilfrid Laurier University
Waterloo, Ontario N2L 3C5, Canada

November 1999

Institute of Transportation Studies
University of California, Irvine
Irvine, CA 92697-3600, U.S.A.
http://www.its.uci.edu

*i*CHASE: An ***i***nternet **C**omputerized **H**ousehold **A**ctivity **S**cheduling **E**licitor Survey

Ming S. Lee*, Sean T. Doherty**,
Ramesh Sabetiashraf, and Michael G. McNally

Institute of Transportation Studies
University of California, Irvine
Irvine, CA 92697-3600
USA
Tel: (949) 824-6571
Fax: (949) 824-8385
Email: mingshel@uci.edu
sabeti@hotmail.com
mmcnally@uci.edu

* Corresponding Author

** Centre de Recherche en Aménagement et Développement
Département d'Aménagement
Université Laval
Pavillon Félix-Antoine Savard
Québec (Québec)
Canada G1K 7P4
Phone: 418-656-2131 ext. 4463
Fax: 418-656-2018
E-mail: doherty@grimes.ulaval.ca

Abstract: The primary goal of activity-based models is a fundamental examination of the behavioral process that results in revealed travel behavior. To reveal this process, a new computer program, *i*CHASE, has been developed to collect data for a study of the determinants of travel and activity behavior in households. This data is inherently dynamic, since respondents record planned activity schedules and then update these schedules, on a daily basis, fully defined in time and space. The resultant data will facilitate the identification of fundamental inter-relationship among a comprehensive range of revealed travel and activity participation variables, leading toward the identification of what are the critical variables, relationships, and rules that govern that behavior. It is believed that an internet-based travel survey, particularly one as rich in resultant content as *i*CHASE, will significantly reduce data collection costs, improve data quality and quantity, and allow for continuous data collection.

Keywords: Activity survey, activity scheduling, travel decision processes, interactive survey method, and GIS

INTRODUCTION

An activity schedule defined by Axhausen (1) represents "the joint choice of the time, duration, location, mode, and route for a sequence of activities drawn from a given set of aware activity needs". These choices are defined by Doherty and Miller (2) as resulting from an activity scheduling *process* involving the planning and execution of these choices over time, within a household. Household activity scheduling extends the context of activity scheduling by considering the effect of the interaction among household members on each member's schedule. In the past decade, models of household activity scheduling became a focal point among researchers as the objectives for travel demand modeling changed. Currently, emphasis of transportation policies is travel demand management (i.e., efficiently using existing facilities to fulfill people's needs for activities rather than increasing the means for travel). New policies require the evaluation of how people would temporally and spatially adjust their travel behavior, when the supplies in the activity/transportation systems were changed (3). In light of these policies, the modeling of household activity scheduling as interdependent decisions becomes more important to practical demand modeling than ever before.

There is a large body of literature (e.g., 4, 5, 6, and 7) in the field of activity-based analysis noting that the inefficiency of existing models is resulted from the lack of more in-depth research on the nature of human activity behavior. Over decades, the community of activity analysis had to rely on observed activity/travel diaries for research.

Researchers were not able to explore the dynamics of activity scheduling, since the travel diaries only recorded the outcome of decision making, not the process. Axhausen (1) noted that more data need to be collected from households if models addressing new policies are to be developed. Lawton (8) also noted the inefficiency of the current data collection methods and stated, "We should seriously evaluate the use of more carefully chosen, smaller samples, using direct contact and paying for cooperation (their time). Data collection needs to be automated (laptop, etc.), and we need to design interactive stated response experiments that key directly from revealed data at the same collection time."

The Computerized Household Activity Scheduling Elicitor (CHASE) program developed by Doherty and Miller (2) is one of the efforts dedicated to advance methods for collecting data of household activity/travel behavior. The program was installed on laptop computers rotated among surveying households to record weekly household activity schedules. It broadened the dimensions of household activity/travel survey by questioning the entire decision process from pre-travel planning to post-travel schedules in a week long span. It also provided to be a highly efficient tool with a relatively low respondent burden. Its potential to become a standard household survey practice is further illustrated by the fact that two international versions are used by researchers for small scale survey in Quebec City, Canada (in French) and in Zurich, Switzerland (in German). Despite the efficiency of the program, several areas for improvement have been identified (see next section). An enhanced version of CHASE has been developed.

The new program, *i*CHASE (*i*nternet Computerized Household Activity Scheduling Elicitor), allows respondents to use their own computers to input data and upload them to a server. In addition to hardware and software enhancement, significant advancement is made in terms of recording the scheduling process in its natural form. The purpose of this paper is to describe features of *i*CHASE and issues related to computerized household activity survey. After a brief review of the original CHASE program, the design of *i*CHASE is described.

REVIEW OF THE ORIGINAL CHASE

The main objectives of the original CHASE were to explore a household's activity agenda from which all activities are drawn and to track the entire process of when and how activities from the agenda are added, deleted, and subsequently modified in a week long period. These were accomplished through a household interview, self-completing data entry of a weekly activity schedule through the CHASE program, and a follow-up interview. 40 households from Hamilton, Ontario, Canada were recruited to participate in a pilot survey. Up-front interviews were conducted on weekends (before Sunday evening) and lasted 1.5 to 2 hours. The program was installed on three laptop computers rotated amongst households on a weekly basis. Laptops were dropped off on Sunday evening and picked up the following Sunday evening. In the pilot survey, follow-up interviews were arranged for collecting laptops and reviewing if users recorded complete schedules for the week. No additional questions were asked.

The up-front interview

The purpose of the interview is to obtain information on household demographics, available transportation modes, and residential information along with the household's activity agenda. A household's activity agenda is the set of activities in which the household members participate on a weekly basis. Table 1 lists the activity classification used in CHASE. Based on this table, household members were asked to describe, in their own words, the specific activities of each type that they perform, along with their attributes, such as frequency, locations, and involved person.

Data obtained from the interview were entered by the interviewer into computerized database forms. This database is linked to the CHASE program so the alternatives reported in the interview can be included in common Windows elements such as pull down lists. Later in the schedule reporting session, users can select one of the alternatives without typing in texts.

Schedule tracing via the CHASE program

After the up-front interview a laptop was left at the surveying household and respondents were trained to use the CHASE program to report their weekly activity scheduling process. Figure 1 shows the main user interface. This interface was built upon a day-planner software component that displays schedules in a calendar format with time scale on the left. Participants were asked to login the program at least once a day for the entire week. On Sunday night, they would add activities anywhere in the calendar (from Monday to Saturday) that they have already thought about doing before launching the program. On Monday, they would enter data through the program what they had done for the day. Respondents were then asked to review the activity lists for the following days (Tuesday to Saturday). If any changes to these future activities were known at this moment, they should report the changes. The same process will continue every day until Saturday.

Areas of improvement

Despite the efficiency demonstrated in the original CHASE survey, several areas for improvement have been identified. First, a laptop computer needs to be placed in a household for the week-long duration of the survey and field workers were required to deliver laptops and carry out the up-front interviews. In order to expand sample sizes and reduce costs, such an approach would need to be augmented through the use of home-computers and/or remote access to the program. The interview also needs to be computerized. Second, although the calendar-like interface greatly accelerated the process of entering activity schedules, it is not known if such an interface biased the decision process. It is reasonable to suspect that, if a time table is presented to the respondents, they might be tempted to “fill-up” the gaps by inserting plans they wouldn't have made under normal circumstances. To be more specific, when they see their activities laid out on the time dimension, it may encourage people to arranged things better, resulting in more scheduling steps which they would not otherwise have made. Third, CHASE does not allow the respondents to leave certain attributes undetermined in the pre-travel plans, except in the case of mode and travel time information. In reality, people’s plans may often remain only partially elaborated. Modifying the program to allow for this would enhance the opportunities for understanding the nature of activity scheduling process. Finally, the program would benefit from the inclusion of an interactive map component to assist the entry of activity locations and spatial choices, previously specified by zone number only using a map booklet.

*i*CHASE DESIGN

Evaluation of system architectures

The most urgent improvement over the current CHASE approach is to reduce the cost and human resource associated with using laptops as survey instruments. One potential way of resolving this dilemma is to conduct the survey via Internet. Although the use of Internet is not yet as prevalent as other media such as telephones, the associated cost and time for obtaining larger sample of households is much less than using laptops. Currently, there are two distinct remote computing system architectures that may be applied to CHASE-like computerized household survey: Web-based and Fat-client systems.

Web-based architecture

A Web site is established which requires a Web server. The survey application will be written in HTML, JavaScript, and Java and will run on the server. Respondents access the server and interact with their data records residing on the server.

The advantages of this model include: (a) any computer with connection to the Internet can be used as a client; (b) users can use existing Web browsers to access the survey; (c) the system can be platform independent; (d) no installation is required at the client side; and (e) it is possible to increase sample size with no real associated cost.

The disadvantages of this model include: (a) applications running on the Web server aren't full featured; (b) interactivity between the program and the users is slow and limited; (c) Java applets running on browsers' Virtual Machines are not stable and require a considerable amount of time to load onto slower computers; (d) data need to be frequently transferred back and forth between a client and the server with users waiting for the next batch of data to come in prior to proceeding with the survey; and (d) the data transfer speed of clients' Internet connection becomes an important factor dictating the time required for the entire survey session.

Fat client architecture

In a client/server system, a client that performs most of the data processing operations is referred to as a "fat client". The fat client approach is suitable for screen intensive applications with interactive data entry. Such applications would suffer performance degradation if processing were performed on a server and passed across the network. To implement the survey application in a fat client system, the survey program will have to be installed in respondents' computers and connected to a server via Internet access.

The advantages of this model are: (a) fat client systems enable full-featured applications on the client side for fast data entry; (b) downloading and uploading data can be performed only at the login and logout so network traffic can be kept at a

minimum (reducing the time required for the whole session); (c) the survey program can be written in a variety of programming languages, thus, the resultant program can be highly stable. A disadvantage of this approach is that interviewees need to install the survey program in their computers and some of them may be reluctant to do so, thus, sample size may be limited.

Final system specification

The common relationship between a pair of client and server in the World Wide Web is that the client is requesting services *from the server*. In this context, clients may be willing to bear with the slow processing speed and instability of the server program. However, in a survey application, the server is inversely requesting services *from the clients* (survey respondents). Thus, if the processing speed is slow or the instability of the program frustrates the respondents, they might be dropping out of the survey. Thus, the speed of data entry and the stability of the program are the key criteria for choosing a system for computerized household survey. The fat client approach fulfills both of these requirements. The downside is that clients will have to install the program in their computers. This can be amended by streamlining the self-installation process and providing un-installation utility to the program.

*i*CHASE features

*i*CHASE maintains the basic structure of the original design, but substantial changes were made to address the areas of improvement described in the previous section. The surveying process is divided into three self-completing data entry stages: set-up, pre-travel, and post-travel. Fully computerized user interfaces are built for each stage. The set-up stage essentially replaces the role of the up-front household interview. Tracing of the scheduling process is accomplished in the pre-travel and post-travel stages. In the pre-travel stage before the surveying week begins, and on a daily basis thereafter, respondents will be asked to list out activities that they have already planned for any day of the week. In the post-travel stage at the end of each day in the week, respondents finalize their executed schedules for the preceding day (using the pre-plan as a basis) and update pre-travel plans for the subsequent days. The process of post-travel reporting and plan updating will continue until the respondents finish reporting executed schedules for the last day of the surveying week.

A Geographic Information System (GIS) is integrated within *i*CHASE to collect data on activity locations. Users can activate this map component when they can not describe in words addresses of the activity locations. When recording of the locations is finished, the map component will be hidden from the user again in order to avoid giving respondents unnecessary geographical cues during planning.

The fat client system is adopted as the system architecture for *i*CHASE. A pilot survey using *i*CHASE is scheduled to be executed in December, 1999. The program will be distributed and installed in respondents' computers and connected to a server via Internet access. Resultant data will be uploaded through this connection. Follow-up questions can be sent to households by email. The entire surveying process can be administrated at a remote site so the number of samples can be increased with a moderate cost.

Set-up stage

Figure 2 shows the set-up interface. When users log into the program for the first time, they will be directed to this interface. The set-up interface contains several tabs. Each activates a form for entering background information of a specific category, such as Personal Info, Household Info, Frequent Locations, Activities, and Vehicles. Data entered to these forms will be automatically written to the main database linked to other interfaces used later in the pre-travel and post-travel stages.

On the forms of Personal and Household Info, common Windows elements (e.g., pull down lists, radio lists, text fields) are used to reduce the time for entering basic demographic data. The Frequent Location form requires a respondent household to build a list of frequently visited locations (Figure 3). This list will be available to respondents

when they need to indicate activity locations. They can easily select one from the list without typing in texts. In addition, the list enables researchers to grasp respondents' action space and to gain better understanding of their spatial behavior. The Activities form is intended to explore household activity agendas. This form itself contains subordinate forms (Figure 4). Users will first select activities in their agendas from the pre-defined activity list (see Table 1). They will then be guided through each sub-form to indicate, for each activity in their agendas, various attributes, such as Frequency, Locations of Activities, and Involved Persons. The Frequency sub-form contains entry fields for the frequency of an activity (number of times per day, week, month, or year), the typical duration of the activity, the days of the week that it is typically performed on, and the earliest start and end times for the activity. Locations of Activities sub-form is used to indicate locations where a specific activity can take place. On the Vehicle sub-form users enter the make, model, and year of the vehicles in the household.

Pre-travel stage

Figure 5 shows the interface for pre-travel planning. This interface does not include a time scale as in the original (see Figure 1). The intent is to minimize the potential "fill-up" bias (i.e., encouraging unnecessary planning by showing respondents time tables). Activities planned for the future appear in the boxes, in sequence only, showing their attributes. Before the surveying week begins, respondents will be asked to

report the list of activities they have planned. Each member in the household will have a separate sheet to work on. Parents will be asked to complete young children's schedules. Users are expected to add activities via the Activity Information dialog box in Figure 6. Note that users can leave attributes as "unknown" if they are not sure about them at that moment. The "Any day" list of activities in Figure 5 is meant to capture activities that have unplanned day(s). This menu remains as fixture on screen, whereas the remaining days can be viewed by scrolling when needed.

Post-travel stage

At the end of each day in the week, respondents will be asked to finalize their executed schedules of the day and update pre-travel plans for the subsequent days. Figure 7 shows the graphical interface for finalizing the schedule for the current day. Activities planned for the current day are listed without time scale on the left hand side column. Any Day activities are listed in the same fashion on the right hand side column. The current day schedule is placed in the middle with a specific time scale. Users would first select the activities from the left and right lists that were actually executed in the current day and specify their attributes with the dialog box in Figure 6. Then they can use the ">" and "<" buttons to move these activities to the current day schedule, where they are displayed along the time dimension for the first time. It is noted that displaying the current day's schedule along a standard time line (as in the original CHASE survey) is not subject to

the "fill-up" bias at this stage, as these activities have already been executed (i.e. "fill-up" biases only affect pre-travel plans). In fact, displaying their past plans in time scale format help to remind the user of changes that occurred and missing activities, which is the intent. It also provides a chance to resolve any apparent conflicts in the timing of activities. After the user has finished entering activities for the current day, they will be taken back to the main interface (see Figure 5) and asked to review their plans for the subsequent days and update them if changes have been made (e.g., a new appointment has been scheduled for one of these day). The process of post-travel reporting and pre-travel plan updating will continue until the respondents finish reporting executed schedules for the last day of the surveying week. During the schedule tracing sessions, if particular scheduling changes are made, dialog boxes will pop up to question respondents when and why they made such decisions. The program is also built with logic that ensures schedules are entered correctly and there are no missing data. When gaps or overlapping happen in a schedule, the program automatically prompts users to fill in all time slots and resolve conflicts.

When a new location is encountered during the day, users can activate the New Location dialog box (Figure 8). They can specify the locations by typing in either addresses or street intersections (i.e., Know Approximate Location). They can also activate the GIS component to bring up the map view for location indication (Figure 9). After the location of interest is found on the map, clicking on the location will write the

coordinates of the location to the main database. When recording is finished, the map component will be hidden from the users again.

PILOT SURVEY

*i*CHASE will be tested in a pilot survey with target sample size of 50 households in December, 1999. The program will be recorded on Compact Discs and send to households willing to participate in the survey. A Web site allowing program download will also be established to recruit participants with faster Internet connection (i.e., downloading the program might take a considerable amount of time). *i*CHASE program will be packaged and delivered with user-friendly installation and un-installation utility programs. This is intended to reduce participants' reluctance of installing the program in their computers.

After logging in for a particular day, users will be automatically instructed to connect via the Internet to a server hosted by the survey administrator. Data can then be uploaded. This connection also provides an enhanced ability to monitor respondents' progress through the survey. Notification may be sent by email or otherwise to encourage accurate and timely completion of their schedule.

SUMMARY

A new computer program, *i*CHASE, has been developed to collect data on household activity scheduling process. This paper describes the results of initial programming in terms of design and functionality. The program design allows respondents to use their own computers to input data and upload them to the survey administrative server. Significant advancement in survey design is made so that data recording process is streamlined and the unbiasedness of the resultant scheduling process data is preserved. The next phase in development will involve a pilot survey of a small sample of household to evaluate its performance.

REFERENCES

1. Axhausen, K.W. The data needs of activity scheduling models, Paper presented at the International Conference: Activity based Approaches: Activity scheduling and the analysis of travel patterns. Eindhoven University of Technology, The Netherlands. May 25-28, 1995.
2. Doherty, S. T. and E. J. Miller, E. J. A computerized household activity scheduling survey. *Transportation*. (forthcoming).

3. Karash, K. H. and C. Schweiger. Identification of transportation planning requirements in federal legislation, Final report prepared for John A. Volpe National Transportation Systems (Distributed in cooperation with Technology Sharing Program, U.S. DOT). 1994.
4. Recker, W.W., McNally, M., and Root, G. A model of complex travel behavior: Part I: Theoretical development. *Transportation Research A*, 20, 4: 307-318. 1986
5. Axhausen, K. and Gärling, T. Activity-based approaches to travel analysis: Conceptual frameworks, models, and research problems. *Transport Reviews*, 12, 323-341. 1992.
6. Gärling, T., Kwan, Mei-po, and Golledge, R. G. Computational-process modeling of household activity scheduling. *Transportation Research B*, 28B, 5, 355-364. 1994.
7. Kurani, K. S., and R. Kitamura. Recent developments in the prospects for modeling household activity schedules. A report prepared for the Los Alamos National Laboratory, Institute of transportation studies, University of California, Davis, California. 1996.
8. Lawton, T. K. (1996) Activity and time use data for activity-based forecasting. Paper presented at the Activity-Based Travel Forecasting Conference, New Orleans, June 2-5, 1996.

LIST OF FIGURES

TABLE 1 Generic Activity Types Used to Define a Household Activity Agenda

BASIC NEEDS	WORK/ SCHOOL	HOUSEHOLD OBLIGATIONS	SERVICES	JUST FOR KIDS
Night sleep	Work	Cleaning/maintenance	Doctor	Tag along with parent
Wash/dress/pack	School	Meal preparation	Dentist	Play, socializing
Home prep meals	Daycare	Chauffeuring	Other professional	Homework
Bagged lunches	Volunteer work	Chauffeuring and passively observing	Personal (Salon, barber, laundry)	With babysitter
Restaurants (family, spouse, alone)	Special training	Attending to children	Banking	Other just for kids
Delivered/picked-up meal	Other work/ school	Pick-up involved person	Video store	
Coffee/snack shops		Other errands	Library	
Other basic needs		Other obligations	Other service	

SHOPPING	RECREATION/ ENTERTAINMENT	SOCIAL	OTHER
Minor groceries (<10 items)	Exercise or active sports (aerobics, fishing, cycling, walking, etc.)	Visiting	Tag along travel
Major groceries (10+ items)	Movies/theatre	Hosting visitors	Pleasure driving
Housewares	Other spectator events	Cultural events	
Clothing/personal items	Playing with kids	Religious events	
Drug Store	Parks, recreation areas	Planned social events	
Mostly browsing	Regular TV programs	Bars, special clubs	
Convenience store	Unspecific TV	Phone/e-mail >10 min	
Pick-up meal	Movie video	Helping others	
Other shopping	Relaxing/pleasure reading/napping	Other Social	
	Hobbies (crafts, gardening, etc.)		
	Other rec/entertainment		

Source: Doherty and Miller (2)

FIGURE 1 CHASE Main Screen with Example Entries

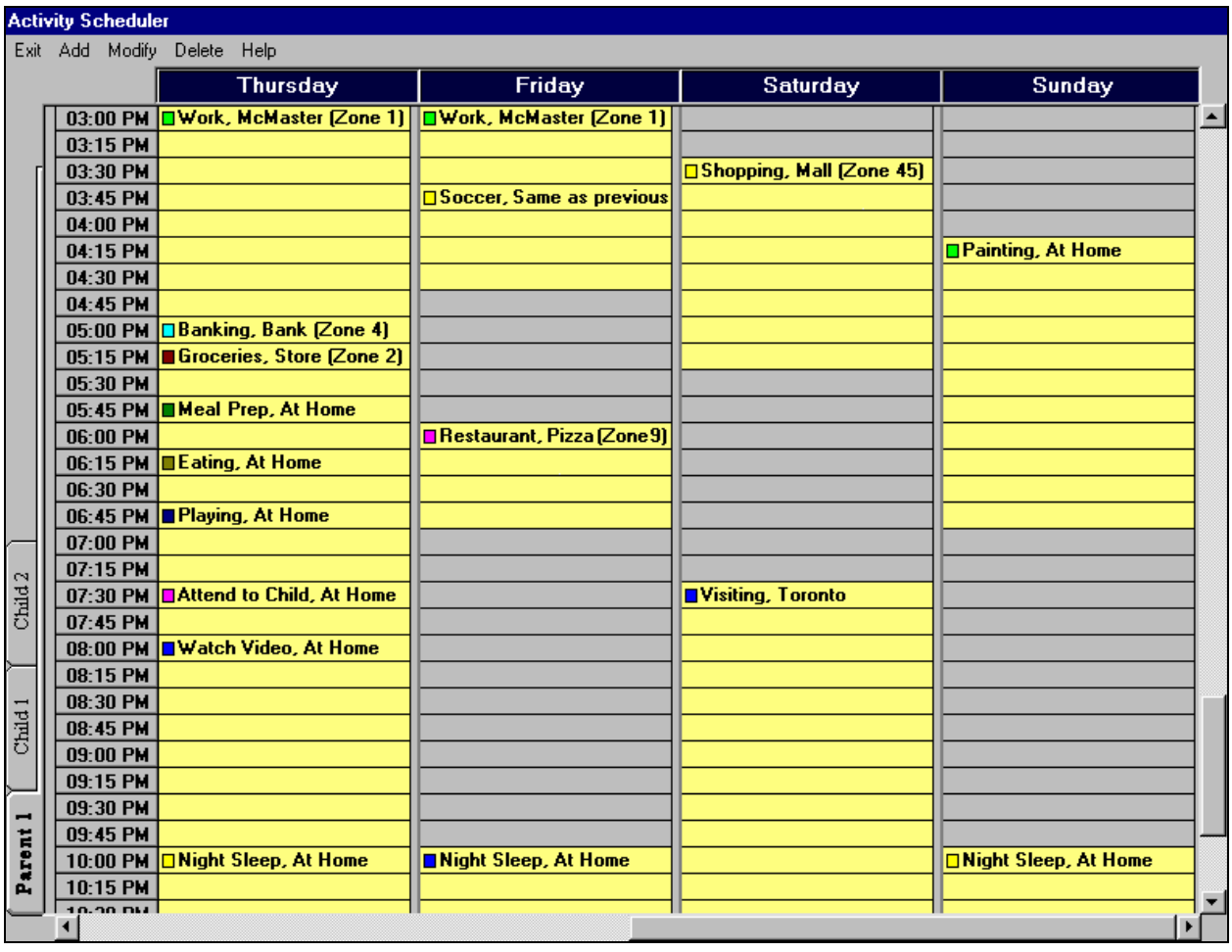
Activity Scheduler
Exit Add Modify Delete Help
Thursday
Friday
Saturday
Sunday
03:00 PM Work, McMaster (Zone 1) Work, McMaster (Zone 1)
03:30 PM Shopping, Mall (Zone 45)
03:45 PM Soccer, Same as previous
04:15 PM Painting, At Home
05:00 PM Banking, Bank (Zone 4)
05:15 PM Groceries, Store (Zone 2)
05:45 PM Meal Prep, At Home
06:00 PM Restaurant, Pizza (Zone9)
06:15 PM Eating, At Home
06:45 PM Playing, At Home
07:30 PM Attend to Child, At Home Visiting, Toronto
08:00 PM Watch Video, At Home
10:00 PM Night Sleep, At Home Night Sleep, At Home Night Sleep, At Home
Child 2
Child 1
Parent 1

FIGURE 2 Set-up Interface

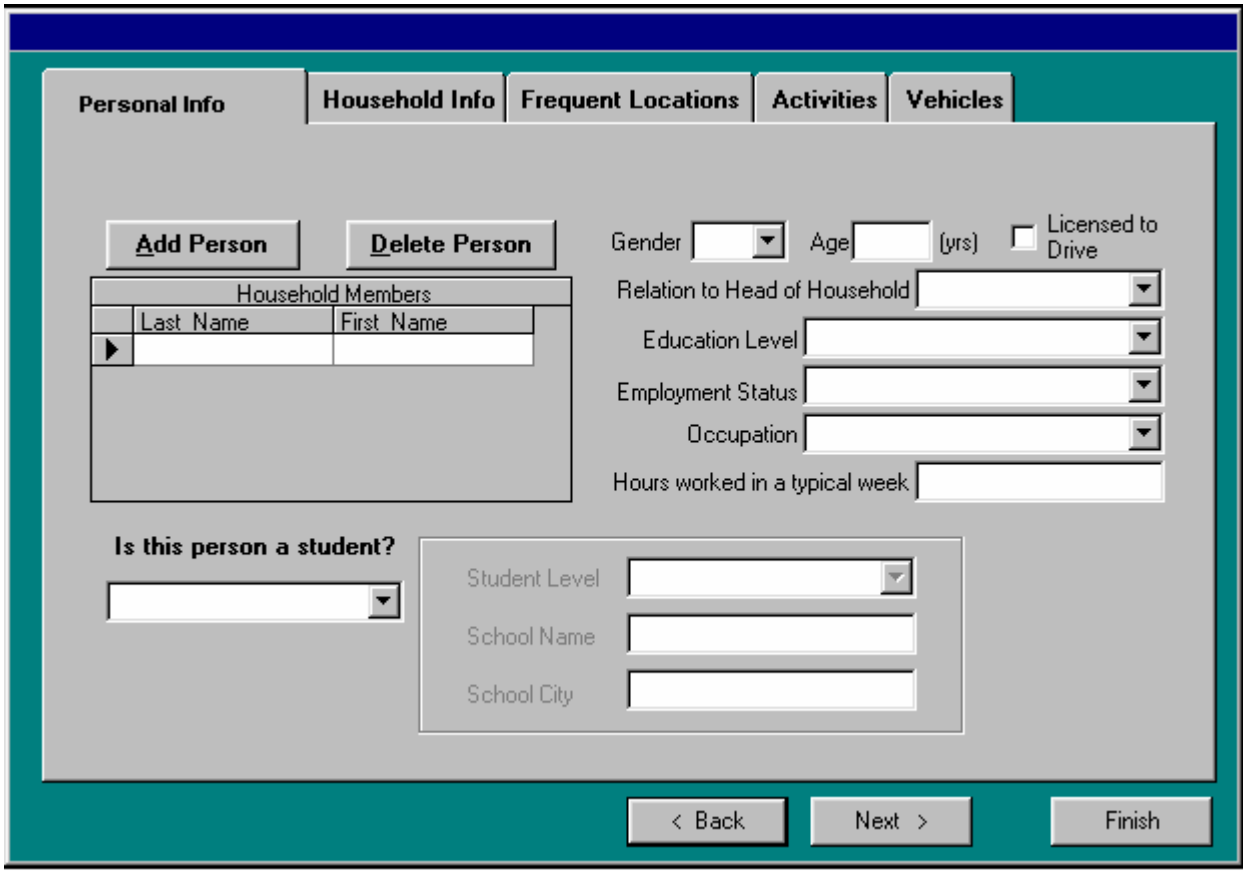

FIGURE 3 Frequent Location Form

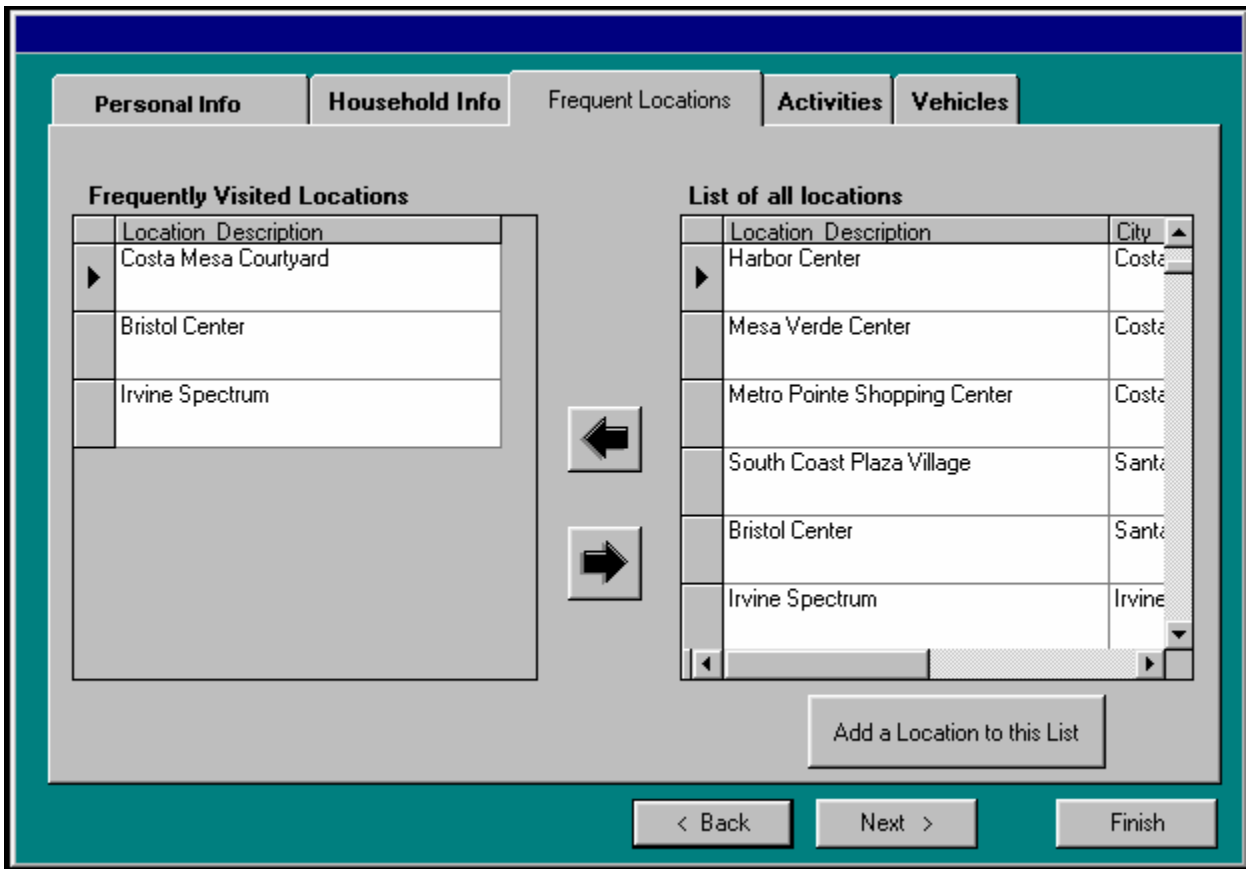

FIGURE 4 Set-up Activities Form

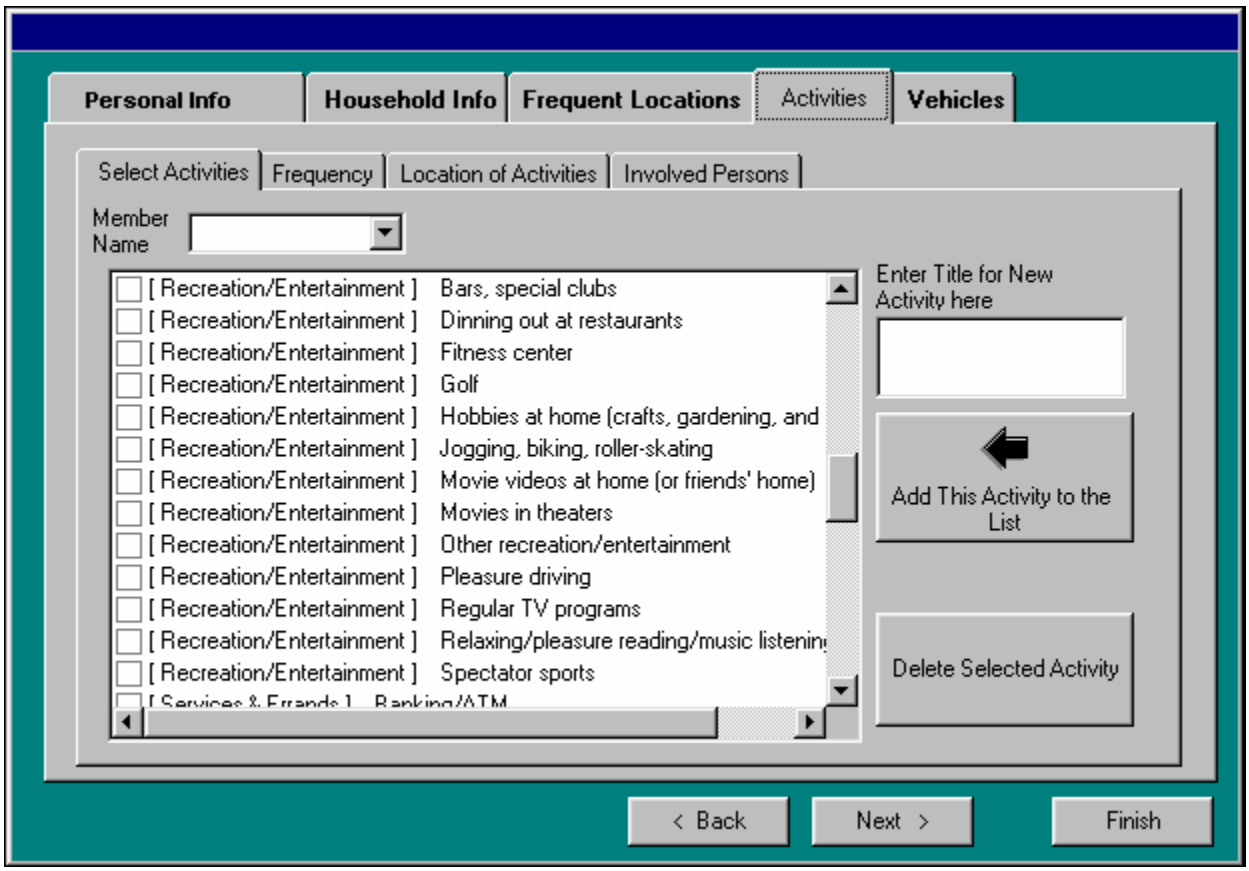

FIGURE 5 Pre-Travel Planning Dialog Box

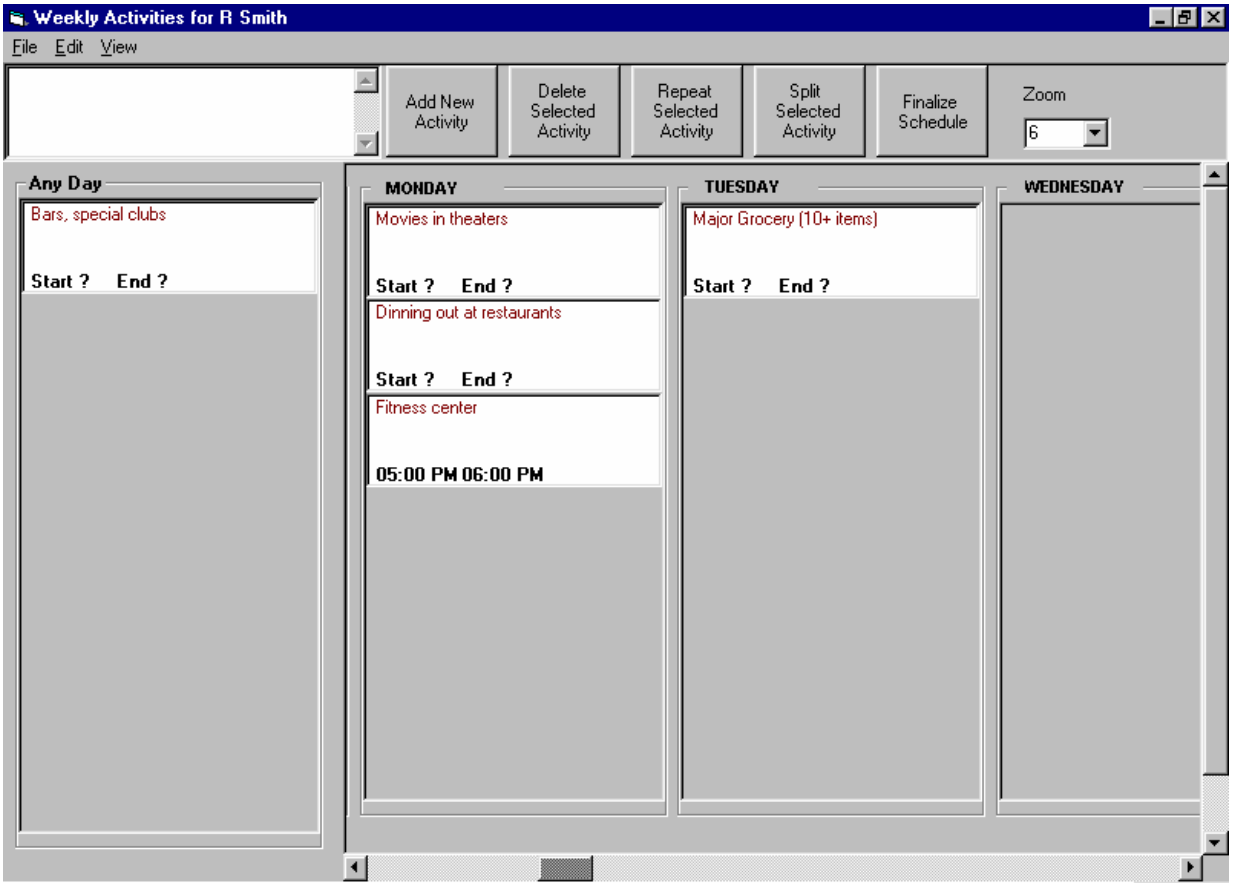

FIGURE 6 Activity Information Dialog Box

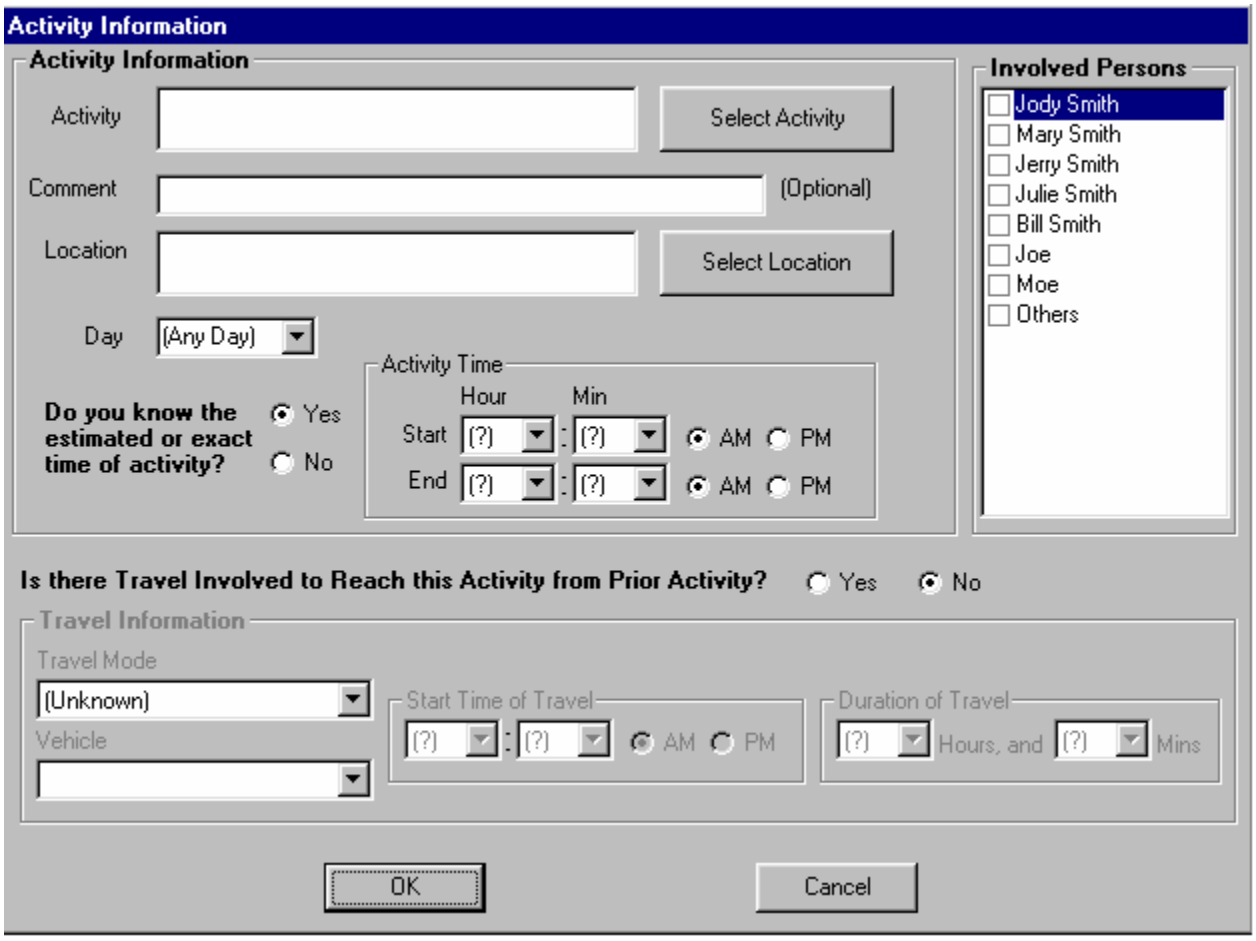

FIGURE 7 Finalize Schedule Interface

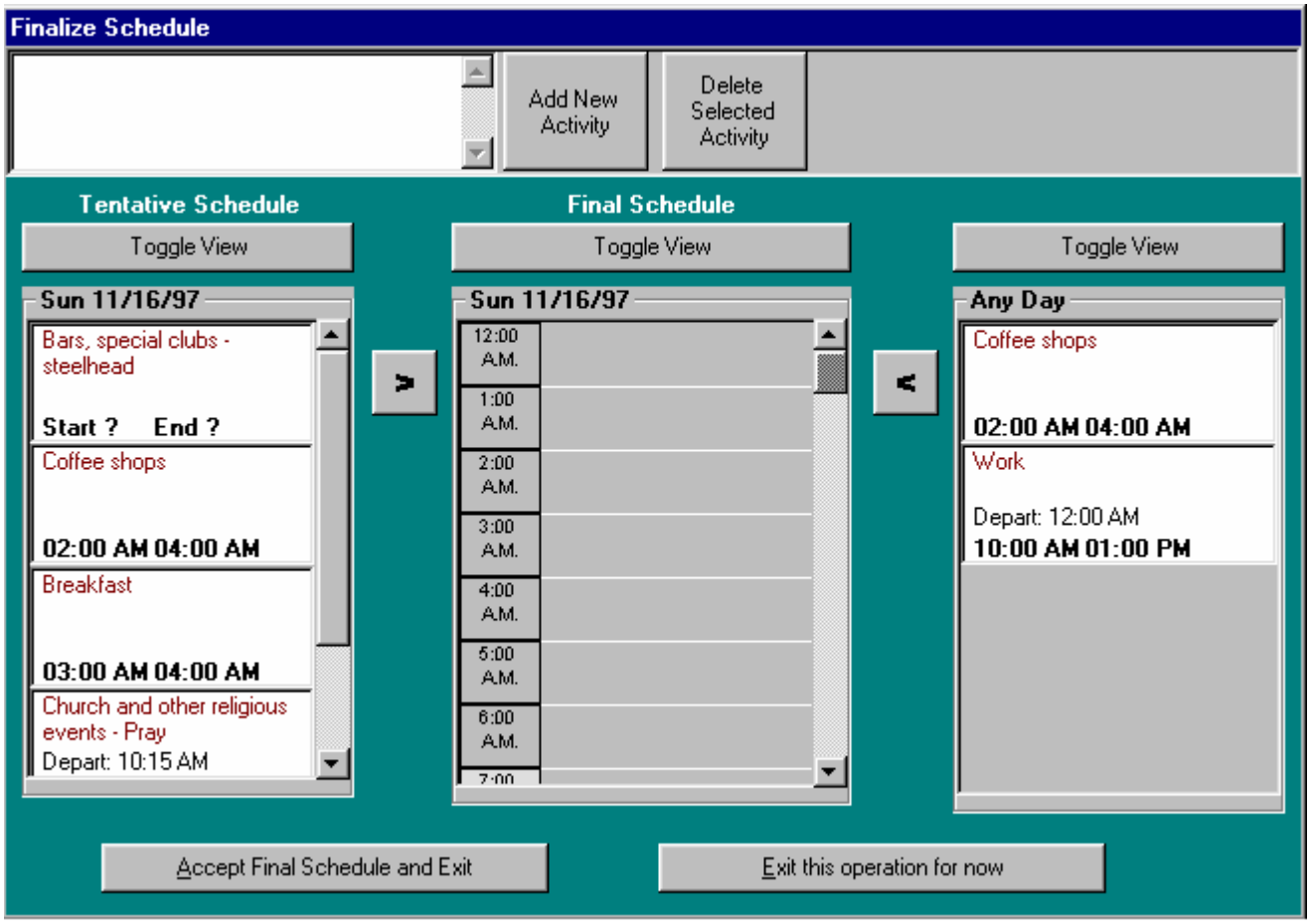

FIGURE 8 New Location Form

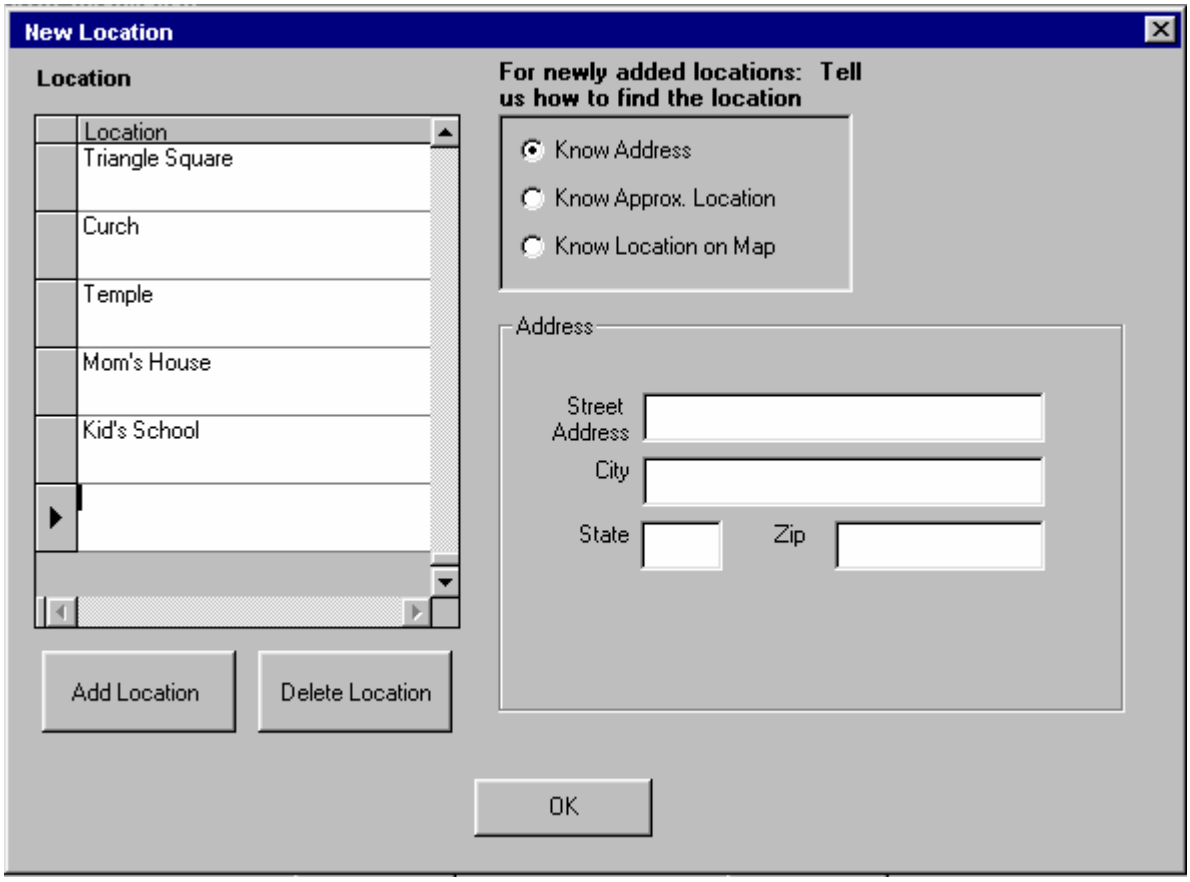

FIGURE 9 GIS Component