DESIGN AND EVALUATION OF GIS BASED REAL TIME MUNICIPALITY MANAGEMENT SYSTEM (RTMMS)

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ABSTRACT

This paper is based on of GIS based Real Time Municipality Management System (RTMMS).RTMMS is used for analysis of Municipality Management issues, like solid waste, water drainage situation, waste disposal, recycling and many more. It is the need of the time to improve municipality system through proper planning and management which is possible by using RTMMS. GIS is integrated successfully as the management tool in every sector and also in municipality management issues. The focus of this topic is to only check that how much RTMMS system is effective for visualization of water drainage situation in the area of Lahore and how much beneficial for the decision making process. Usability evaluation is the key factor for testing the model before presenting it in the market.

For testing the system statistically it is needed to capture the data with respect to user performance. Statistical results from the user end and experts review will prove the RTMMS \ credibility. This study will prove the RTMMS \ efficiency, interesting feature, likability, group feedback statistically through the statistical software. That why the main focus of the study is to define the design and of the RTMMS and evaluate the system's usability to identify how much it's beneficial for the user.

Keywords: RTMMS, Municipal management, Geographical information system, Participatory GIS

1. INTRODUCTION

The municipal management situation of the most cities of the developing world is very unsatisfactory. More attempts are taken for handling the spatial context/situation in order to improve the decision making process. Municipality management is a more important for the healthy environment of any society. And the best practice for resolving municipality issue is to use of the Geographical information system. Government and the municipalities can use this technology to plan, visualize and manage the ground situation.

GIS has the system designed to capture, store, manipulate, analyzes and presents all type of geographical data (Wikipedia). Most of the service data in the municipalities and local government are geographic. GIS is the tool that is effective supported decision making process in the municipality and now can be making as the instrument in the form of RTMMS.

Usability evaluation results in technology acceptance and testing of the product use and effectiveness. Evaluation based on the user centered and some part with the experts. Experts of different sectors receive feedback from general users and decision makers.

The municipal management by the real-time system used for the city municipality planning , in which the common men , relevant authorities and managerial level team take part through the web access. Successful design and implementation of the RTMMS system for the e-participation require the functional requirement, technology, and operation (Butt 2012).

Study also focuses the Usability Evaluation process which is important for testing the product with respect to user satisfaction and effectiveness. Pre-testing of the model is essentially important after quality assurance. Usability evaluation is more reliable when it is done by the right people. Approaches that are used for the verification and testing of the product may involve user perspective as well as the expert reviews of that product type. Experts usually check the technicality and the design of the product but the user always checks the usage of the product. Although this evaluation process is very important but also has its pros and cons at the same time.

2. AIMS AND OBJECTIVES OF THE RTMMS MODEL

RTMMS is developed with the help of open source technologies.

RTMMS can address the data sources and users who is the part of participatory GIS. It Locates where the remote user identify the problem, kind of problem, and the source of problem. It cans highlights concerning municipality, outcome of the effective process by the municipal authorities (Figure 3). Different user access the RTMMS platform to visualize the working frame-work Clear the efficiency situation what has be done and what going on. RTMMS play important role for Improve the quality of the current work and produce the output that's not clear before.

The research also focused on to evaluate to what extent the RTMMS system will be usable and fully comparative that's why need the following practice for system testing and evaluation.

3. METHODOLOGY AND WORKING ENVIRONMENT OF THE RTMMS

RTMMS make it possible to the e-participation of the users at the same GIS framework. RTMSS helps in data exploration and decision making tool for the e-participators on the different location. It is a complete web-based solution and more beneficial than the desktop GIS Technology. The traditional desktop GIS and traditional Web GIS cannot make the interaction and share spatial data on run time. That's why RTMMS is the best practice for municipality management (Butt 2012).

Access of the information required for the policy making, physical presence of the collaborative meetings and well designed system efficiency and effectiveness (Evans et al. 1999; Ventura et al. 2002),

The review of the RTMMS system that they all focus on the GIS technology as the major part and also includes the augmented form to manage the multi-way communication among the RTMMS web users just like the argumentation map (Rinner 1999).

RTMMS is the multi functionality GIS based Collaborative participation System, which integrate the different information technology tools to support the e-participation while the meeting. During the meeting and after the meeting it receives feedback, remote user input and collaborative output for the decision making (figure 1).

RTMSS provide the support in two forms: 1) asynchronous RTMMS user participation that supports any time web based discussion and input 2) Real time collaboration and GIS process that apply on the digital tools to share and explore spatial data. This model support the frame work with the functionality like related information,   user meeting management, collaborative web-based interaction and spatially based discussion

The figure 1 the projected information center to manages and provide the public and all group use the RTMMS access the information related to the ongoing participatory meeting for the municipality management planning , get the public share information, meeting output, and all the finding in the result of the meeting. All the matter and find the spatially exploration solution allow the online participants to explore the spatially

4. EVALUATION PROCESS FOR THE RTMSS MODEL TESTING BY THE USER-CENTERED APPROACH

The main objectives of the usability evaluation are listed below. General public accept this prototype for use or not?

How the non experts of the RTMMS prototype use this system?

Who are the target users for the RTMSS prototype?

What are the expert reviews about RTMMS prototype?

4.1 Main Indicators

The main indicators used for the usability evolution are given in Table 1 along with their evaluation description.

Our Approach**:** Results of all approaches used for evaluation, totally depends upon the user's previous knowledge and experience while testing the website. As different users test it according to their requirements and interests so it is important that whether they found it according to their needs and expertise or not. Evaluate RTMMS system by all of above.

4.2 Work Flow

In the figure 2 all the working way for the evaluation of the RTMMS shows. As the second phase of this research we clearly define the use of the Real time municipality management model, methodology and use and now time to evaluate this model by the people of different background. The evaluation process for the RTMMS model done by the tree technique that is sufficient to test the model. All approaches mention for the RTMMS evaluation model is defined below.

1. User testing
2. Expert testing
3. Software testing

The user testing is only work when the user test the model and give their feedback about the system use. For that purpose focus group is the best practice for the test on user, also check the user attitude after working on the RTMMS system. Secondly the experts are the people who are already know the system technically and conceptually and have the experience like these web based application give their authentic reviews that take a more importance. And at the end we take the software testing in which software work while the system use that application and give result statistically like the chalk mark and loop 11 method.

4.3 Data Acquisition:

For Evaluation purpose, 40 users from different categories have been selected. All users are having academic background as Under Graduate/ post graduate or M. Phil/PhD. Similarly, different participants are having IT expertise at different levels. Participants were called for discussion after training them about the system. The objective in following this procedure is to target the user from the beginners to experts. All users will be asking questions about the system, and their feedback will be ranked in numbers. This method is adopted for the evaluation of the Participatory GIS Prototype RTMMS used for decision making.

4.4 Testing Criteria for the Evaluation

4.4.1 Target market:

Target market shows the user category with respect to the profession either the users are business men common men decision makers and experts of the different sectors.

Age: Age of the user is important for the data, we hire people of different age to see our application used for every age category, so minimum age of our user is 23 and the maximum age is 44 that show all of our users are young, familiar about the new technology.

Gender: Gender is also important factor while using usability testing ,women and men both take part for testing and prove that the application equivalent beneficial for the both sex.

Education level: Education shows the user profile in the sense of literacy level .testing process is affecting by it so hire the people from most highly profile like graduate, post graduate and M.Phill /PHD

IT expertise: It expertise is the key requirement for testing the RTMMS prototype because if the user have some IT knowledge he/she learn and perform easily that leads to the better evaluation of the application.

Web surfing experience: Web surfing experience is better to find in the users and check how much the user expert in web surfing.

4.4.2 Testing by the User:

Focus Group:

Focus groups are the best tool for evaluation. This model facilitates a small group of participants and briefly describes and shows the usage of RTMMS Concept. All users are encouraged to give an honest opinion freely. User will be allowed to give feedback and suggestions without any hesitation.

Focus group acts as the social tendency in which the people agree with the most popular opinion of the group, people can either follow others or using their own. This technique is also called group think. People give the practical exercise before evaluations.

For the easiness the user will be called for discussion in four different sessions and 10 users in each session. In every session group of the 10 people sit at the meeting and discuss about the RTMMS. And raise one topic about the system and note the remarks. User can be satisfied with the prototype either fully or partially. After taking feedbacks from users give marks to the application against the variable assigned.

All the focus group study will be done through Discussion. Mark the user answer on the Likert scale for data collection.

- System Advancement
- Ease of use
- Performance satisfaction
- Enjoyable

4.4.3 TESTING BY THE SOFTWARE:

Chalkmark Prototype User Interest Area:

To quote the site: Do people know where to click? Quickly run a test on your UI prototypes to answer any nagging questions about usability.

Chalk mark provides the means of sharing an image to user to gather feedback on where the user would click to perform a task. From a usability testing perspective, this is the same concept

as a reverse card sort, which means the terminology and navigation is tested to ensure whether users know where to go to accomplish a task.

The method for sharing images is easy, the test image is uploaded to Chalk mark. Next, a survey URL is produced by Chalk mark which usability researchers can share with testers via email, or on a web site. A researcher provides a brief description of the task that needs to be accomplished, and the tester clicks on the image where they think that task would be. The clicks are recorded by Chalk mark, and a real-time display of a heat map showing the location of the clicks is provided to the usability researcher. The time each click takes is also recorded. Reports can then be downloaded by the usability researcher as a PDF file.

Pros – Records clicks and displays real-time data. A major advantage is the ability for usability researchers is to provide Chalk mark invitations to actual users via email or on a website.

Cons – Unfortunately, researchers are unable to ask participants the 'why'• of where they clicked, which is a critical component of reverse card sorts

Loop11 testing:

Loop is a unique usability testing tool in that it allows UN moderated remote usability testing using actual users. A researcher provides a simple task to a user, for example, finding a particular type of gift book for a relative on a book site, and then tracking user interaction. The data is presented via reports of task completion rate, time on task, common fail pages, paths and a nice detailed path analysis for each user. Loop11′s results will be accurate, or at least as accurate as the real users are.

4.4.4 TESTING BY THE EXPERTS

In this method the Experts Check the Website usability according to their expertise, technical experience and expected goals towards the website.

Inspection evaluation by the usability Experts:

The goal of inspection evaluations is to have usability experts separately. Experts of the Testing system inspect RTMMS according their expertise. The research shows that as more experts are involved in evaluating the usability of the product, the greater the number of usability issues will be identified. However, for every true usability problem identified, there will be at least one usability issue that is not a real problem. Having more evaluator does decrease the number of misses, but it also increases the number of false positives. Generally, the more expert the usability specialists are, the more useful the results are.

To Evaluate RTMMS we arrange a workshop for the experts to review RTMMS Model Design, Prototype, Real Time Map sharing functions, integrated database, security etc.

All experts belong to heads of the companies for which the RTMMS model is designed or the specialist of the usability, GIS experts and computer scientists for which RTMMS model is the target. This process of evaluation of the product through experts is known as "Discount usability engineering method" because of its dramatic cost benefit ratio. Its extra burden of cost is on the

developers. This process does not increase the user satisfaction but decreases the frustration. All experts' review relies on the expert's expertise of judgment rather than the feedback from the user (usability evaluation). The projects with the medium and large budget call experts, somehow can apply on all type of projects. Few hours of an efficient expert can provide the satisfaction, loyalty on the RTMMS model.

Limitation for the inspection

1. Check the cost
2. Experts experience in review testing
3. Time constraint
4. No of sessions
5. More the session more bug free System.

Experts RTMMS Review by the following constraint:

➢ The interface of The RTMMS
➢ Prototype of RTMMS
➢ Web Mapping Functions.
➢ Meet the ISO & IEEE Standards
➢ Integrated Database
➢ Access Control Security

Usability testing comparison user testing verses experts:

Expert testing is important as the user testing. Some overlap found in both and some feature are common. So there is some comparison that show the difference between both approaches. People use expert testing before usability testing. Both are equally important for RTMMS system testing But the best approach is to integrate both approaches.

Experts Review versus user testing

This is shown in Table 4 at the end of the paper.

5. RESULT AND DISCUSSIONS

RTMMS model will improve the public participation and municipal team participation for resolving issue related municipality and more effective planning. Reduce the gap between the general public and municipal authorities. By the RTMMS the spatial data access is possible at anytime, anywhere using web-link. Furthermore, it makes possible to provide a virtual platform for spatial discussion related to municipality management to all users, who can access the prototype interface from their work with its functionalities i.e., convenient web based mapping, maps co-browsing, seminar recording, video streaming, easy project documents sharing, and screen sharing (Butt 2012).

RTMMS also used to check how the local government staff and other higher authorities handle the citizen complain regarding the municipal service and make it possible for the quick respond. RTMMS make sure the quick accessibility to the user for the municipality related issues. The overall decision making process will be collaborative and improved.

In the figure 4, authors try to show and calculate all the statistics that need to prove how much RTMMS system efficiently and effectively working and also check the system functionality aspects for the user of the different group of the society. As we check the RTMMS model not only the decision maker but also take the different group like common user, business men and also experts group. All the results calculate by the different techniques like the chalk mark and loop test, focus group and experts testing gives us the dynamic results that show in figure 5. In addition, the RTMMS model is more effectively and efficiently work for the experts and decision maker rather than the other two group business men and common people. This model targets and can be useful in many fields for the management like municipality and others. Results show the RTMMS system is user friendly, effective, and interesting for the municipal management

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Fig 1. RTMMS Model Functionality

Usability Testing Techniques

User Testing

Software Testing

Expert Testing

Focus Group

User attitude

Chalkmark

Loop

Experts Review & Specialist recommendation
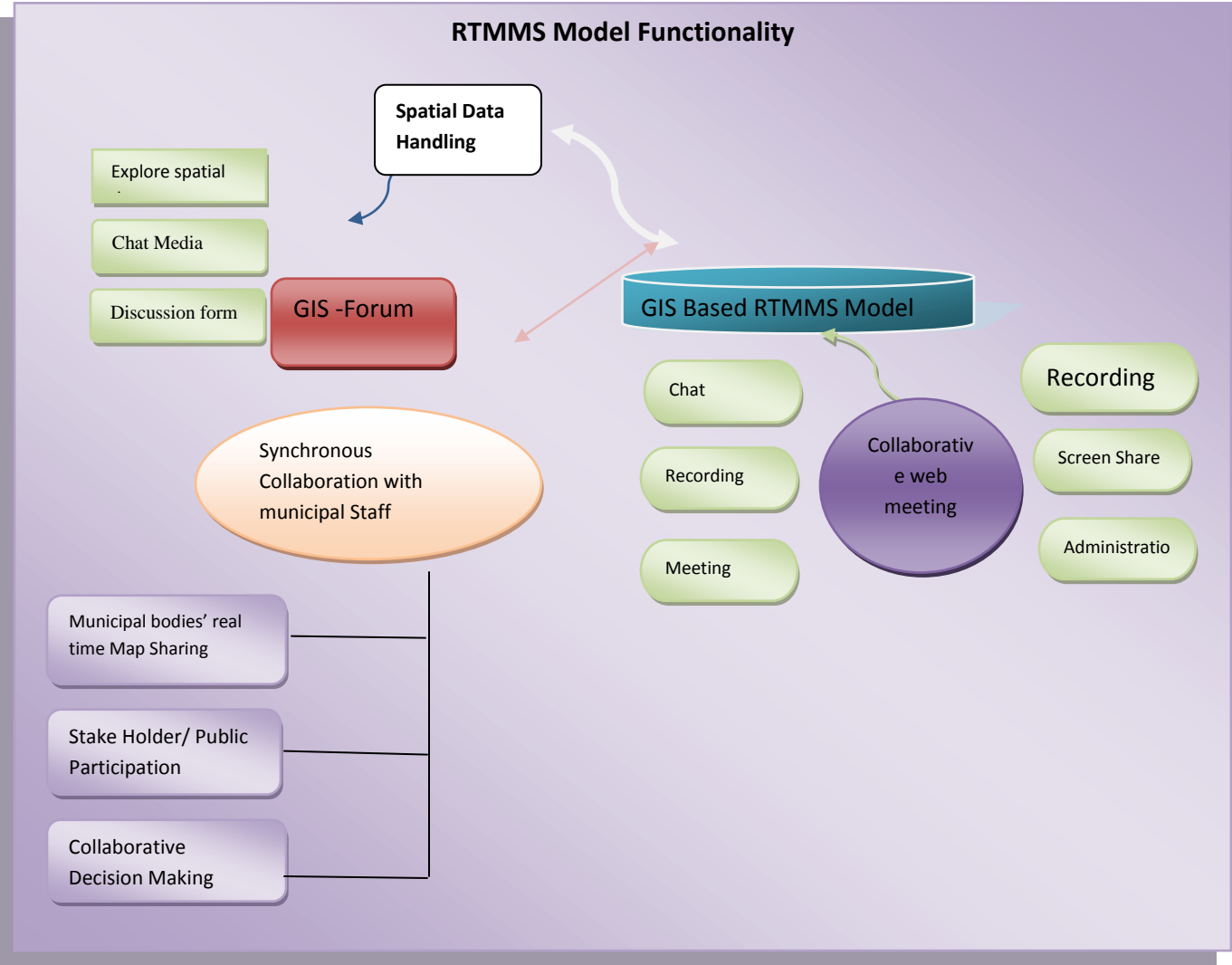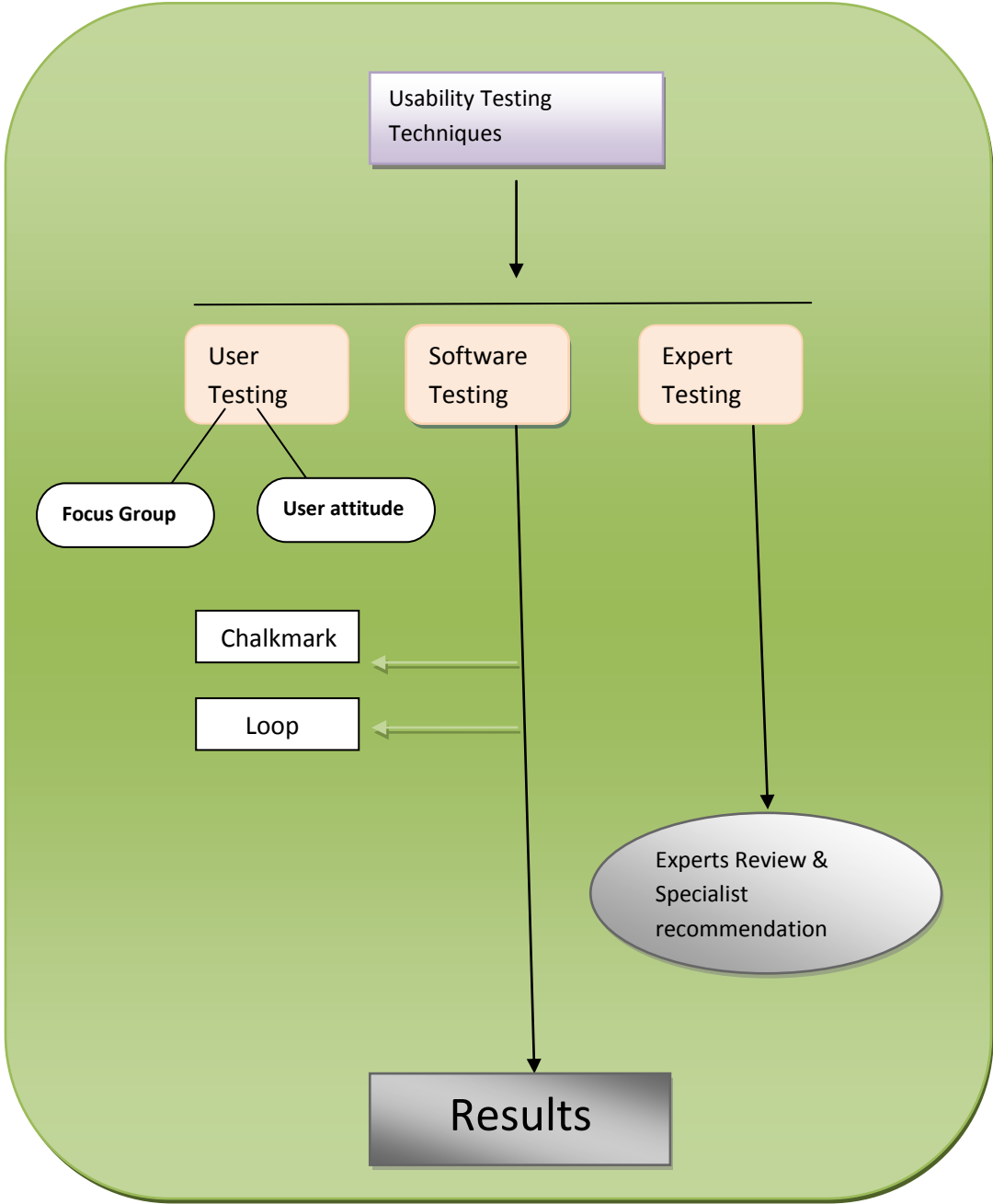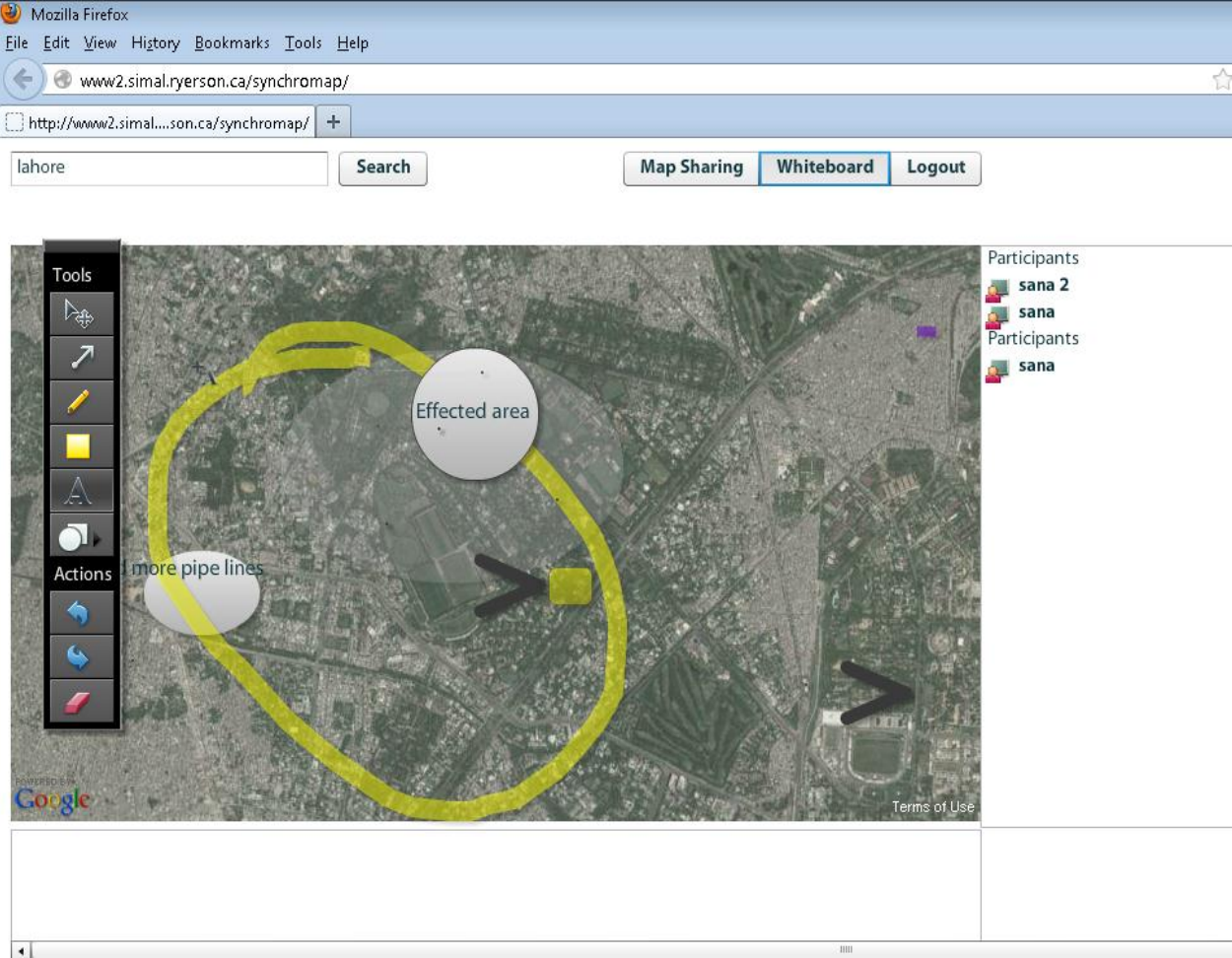
Results

Fig 2 Usability Testing Techniques

Fig 3. No. of user online and sharing the same situation at the remote places

Fig 4. Statistical Rresults
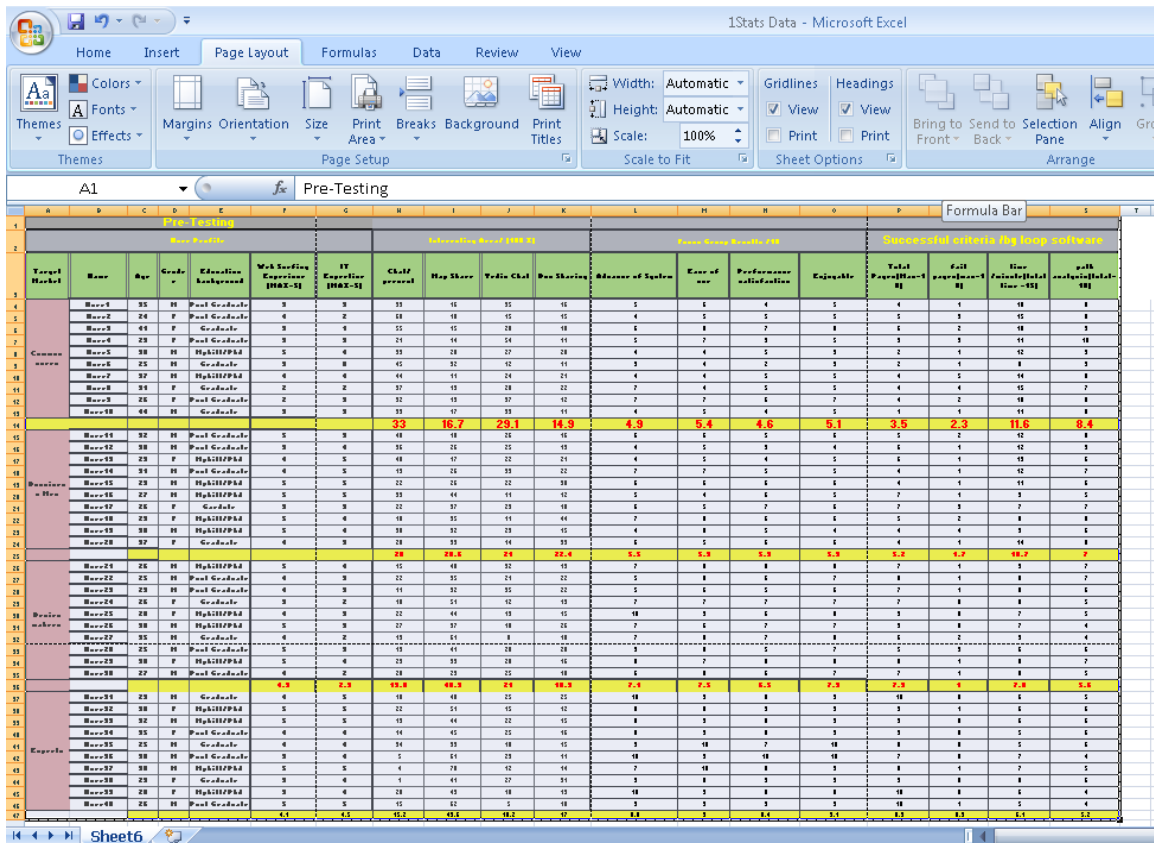

Fig 5. User Groups

User Group	Interesting Area/ (100%)				Focus Group Results /10				Successful criteria /by loop			
	Chat/ percent	Map Share	Vedio Chat	Doc Sharing	Advance of System	Ease of use	Perform ance satisfacti on	Enjoyabl e	Total Pages(M ax=10)	fail pages(m ax=10)	time /minute(total time =15)	path analysis(total=10)
Common users	33	16.7	29.1	14.9	4.9	5.4	4.6	5.1	3.5	2.3	11.6	8.4
Bussiness Men	28	28.6	21	22.4	5.5	5.9	5.3	5.3	5.2	1.7	10.7	7
Decien makers	19.8	40.3	21	18.9	7.1	7.5	6.5	7.3	7.3	1	7.8	5.6
Experts	15.2	49.6	18.2	17	8.8	9	8.4	9.1	8.9	0.3	6.1	5.2

Table 1. Main Indicators

Evaluation criteria	Evaluating indicators	Data collected
Area of interest	Chat	How many percent user use the chat tool in one session and get the data in percentages
	Map share	Percentage of the user used map share tool
	Video chat	Check the video chat session percentage in one session
	Document sharing	Percentage of the document sharing and by which group.
Focus group discussion	Advancement of the system	Check the system advancement by the user and get the result through the discussion after experiment.
	Ease of use	After experiment check how much the system is easy to use for user.
	Performance satisfaction	Evaluation of the performance satisfaction after experiment.
	Enjoyable	Is the interface enjoyed by the user?
Successful criteria	Total attempted pages	Total pages visit in the given time
	Failure loading pages	No of pages loading fail in using system
	Time taken	How much time take for the specific task
	Path analysis	Check the path analysis to reach a specific page.

Table 2. Criteria for User Testing

Focus group Discussion topics	Strength									
Advancement of the system	1	2	3	4	5	6	7	8	9	10
Ease of use	1	2	3	4	5	6	7	8	9	10
Performance Satisfaction	1	2	3	4	5	6	7	8	9	10
Enjoyable	1	2	3	4	5	6	7	8	9	10

Table 3. Expert Indicators and Status Review

Experts Indicators	Status Review
Integrated user interface	The integrated user interface is the important part of RTMMS model and support the HCI
Real Time Prototype	The synchronic prototype ,working on the same screen at the different locations
Web Mapping Functions	Electronics illustrations of the maps on the internet for the maps production process. Have all the tools that need to create the attractive maps.
Meet the ISO & IEEE Standards	The international quality standards for testing the application. Check all the process like documentation, process assessment model and technique used in RTMMS model.
Integrated Database	Integrated database refer to the combining database RTMMS model so that the user edit information.
Access Control Security	Front end and back end data security level. Protect system form the unwanted use through restrictions.

Table 4. Experts Testing versus User Testing

Experts Testing	User Testing
RTMMS Inspection through experts and specialist.	Include user of the Application like student researcher, common men, business men, decision makers, IT/ GIS professionals.
Quicker approach	More time to plan and conducting
Experts review tend to find high level obligation, consistency and design rules	User testing check the task flow and system working.
Experts give the authentic results	But the user can misuse some task
expert belong to the same field for which product design	People from different areas can test
Identify the potential usability problems	Check the usefulness efficiency, credibility and system effectiveness
Expert review testing more accurate	There is some Miss usability issue