Augmented Reality

TPG4850 EiT VR-Village – PDT, NTNU

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Preface

This report, together with the prototype, is the result of a project assigned by the course TPG EiT VR Village. The project group is composed of four students from the Norwegian University of Science and Technology.

Our project was given by StatoilHydro, and our task was to research and develop ... Augmented reality This involved ... proof of consept...

We would like to thank our teaching supervisors Egil tjļand and Knut Reitan Backe as well as the customer representative Jens... for invaluable support and feedback throughout the entire project.

Trondheim, May 2009

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Summary of Project

SUMMARY!!!

Part I

Project Directive

CHAPTER 1

Project Plan

Project name: Augmented Reality (working title)

Project sponsor: StatoilHydro

Partners: NTNU

1.1 Project Background

In a science lab, core samples is important to analyze. To each core sample there is a lot of data, like from where the sample is taken, the depth, porousness, permeability and so on. This is a lot of important information, and should be stored as safe as possible, and simultaneously it should be easy to get the information if needed.

The idea is to store all the data in a database, and equip each core sample with a RFID chip. When this RFID chip is read by a device (for instance a transparent??) all the information stored is displayed at the screen, and the user can easily select the information needed.

The challenge is to implement the information in a clear and structural way, so it is easily accessible for the right persons. It should also be easy to store new data for new core samples. It should also be easy to make notes/edit the data while examination of the core sample.

1.2 Measurement of Project Effect

- 10% increase in speed of information access to certain details on a geological core sample
- 5% more complete set of data on each core sample

1.3 General Terms

- the customer is interested in a proof of concept in the use of augmented reality in the field of geology and analysing core samples. Therefore the customers main interest lies within the prototype and how it will function.

Date	Milestone
04.02	Finish planning the project and first draft of the project plan.
11.02	Finish the questionnaire and the interview questions. Get participants to the questionnaire and the interview from StatoilHydro.
18.02	Finish the interviewing and analyze the results from interviews and questionnaire. Finalize prestudy.
25.02	Presentation of group precesses. work with requirement secification
04.03	Finish the prestudy and requirements phases of the plan. Start work on system design. presentation of project work so far
11.03	Finish designing the system. Start implementation and documentation.
15.04	Finish implementation of prototype. Start testing the system.
22.04	Finish testing the system. Proof read the process report.
29.04	hand in process report. proof read project report
05.05	Hand in project and report.

Table 1.1: Project milestones

- The prototype may be constructed by the tools of our liking, and we can develop the software and hardware in any language we see fit.
- The customer is located in oslo and therefore all primary communication will be conducted by phone, mail and video confrences.

1.4 Planned Effort

- It is estimated that every person should spend 10 hrs per week devoted to this project.
- This sums up to a total of 150 hrs per person and 600 hrs for the whole group.

1.5 Milestones

Table 1.1 shows the major project milestones. These milestones are also described in Gantt diagrams found in appendix **??** on page ??.

CHAPTER 2

Organization

The group is organized dynamically. Depending on the phase we are in, the roles will shift and expand so that we can optimize our work. Giving the right job to the right person is our motto. We also have 8 common working hours pr week. This was decided because we can work more effectively when gathered, and it is easier to get to know each other better this way. See figure 2.1 on the facing page for a diagram showing how the group is organized. We are also aware of the fact that the student groups for the other projects in the village are not competitors but rather a helping hand when we are in doubt. We consider the village as colleagues and may share ideas and competence.

Main Responsibilities

Each group member is assigned an area of responsibility based on their qualities and study backround – at least as importantly – their wishes.

System development and Design

Responsible: Ahmed Adnan Aqrawi & Sindre Skjŋsberg

System developers are responsible for implementing the functionalities of the system as they are to be developed.

Psychological aspects of graphical design

Responsible: Karianne Kalseth

To provide guidelines for the design of the graphical user interface of the system by looking at the psychological aspects of this task

Staistical analysis

Responsible: Eivind Gausland

Responsibilities include analysising surveys and interviews, and an aid in mapping the needs the system has through statistical analysis

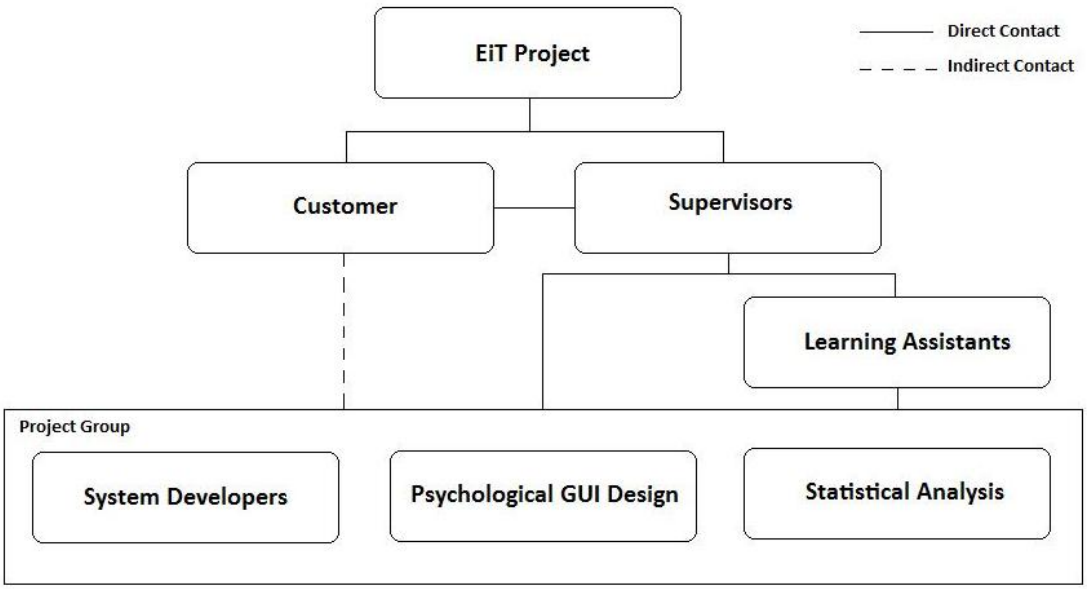

Figure 2.1: The structure of the project group

CHAPTER 3

Phases

3.1 Software Development Strategy

When developing software it's important to use a development strategy suited for the task at hand, and preferably one the members of the group are familiar with. The latter is especially important in a short-term project such as this, where time is a rare commodity. Based on this we've chosen to use Scrum.

- Scrum

Scrum is a project management method for agile software development where small teams produce software in an incremental fashion. The project will be divided into several iterations, or sprints, each of these resulting in a run-able functional build. To accomplish this each sprint includes all the major phases found in traditional software development; planning, designing, implementing and testing. Figure 3.2 on the next page illustrates the Scrum method.

TODO: Specifics on how we use Scrum; sprint lengths, scrum master, meetings, a pretty picture, will we use project and sprint backlog, customer interaction, and so on and so forth.

Why We Chose the Waterfall Model

We have opted to use Scrum over other more traditional development models such as waterfall, due to its strong focus on adaptability during the course of the project. This is a major advantage when working with technology and tools which are new to the group, making it possible for us to adapt our plans if unforeseen problems occur. Using Scrum also allows us to produce a working version of the system early, then add more functionality the following sprints with no danger of breaking what we've already produced.

3.2 Phase Details

In this section we describe the different phases the group will go through before the finished product/final prototype is developed. This is also the layout of the report, which indicates its flow.

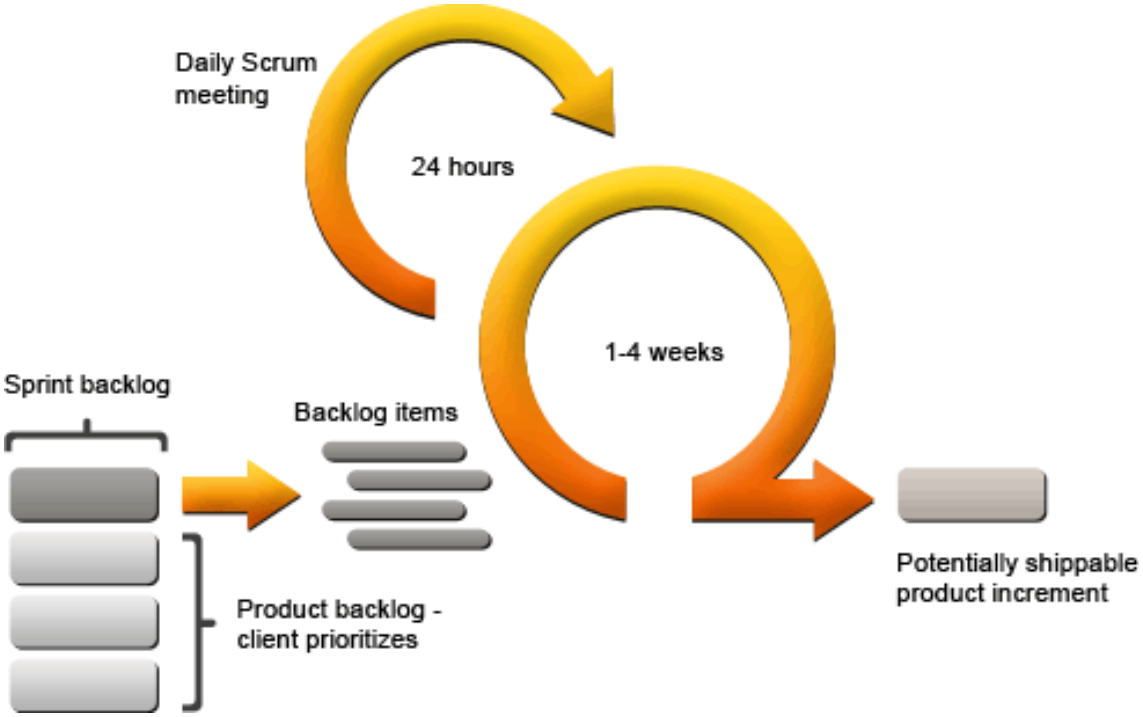

Figure 3.1: Scrum model. *Source: Reaktor Innovations/www.ri.fi*

3.2.1 Project Management

Phase	**Normal**	**Group 8**
Project management	10 %	5 %
Planning	10 %	13 %
Prestudy	15 %	18 %
Requirement specification	15 %	18 %
Design	15 %	15 %
Programming and documentation	25 %	10 %
Project evaluation	5 %	6 %
Presentation and demonstration	5 %	5 %

Table 3.1: Distribution of time spent per phase in percent

Here we discuss such elements as planning and resource distributions through out a project. The objective is to develop a clear goal and a path in which we wish to reach it. See table... for a rough estimate on the planned usage of time on each phase. This reflects what we find to be important and what the customer values from our efforts. Clearly we intend to use more time on implementation than research because of the practical nature of our task.

3.2.2 Prestudy

In the pre-study we aim at exploring the technologies that are available to us, and verify what we are going to use and why. This section will also entail market research to see both what needs the users have for such a system and what features they demand such that this product becomes useful.

3.2.3 Requirements Specification

In this phase of the project we will be developing a set of requirements that our system must meet in order to be a success. These requirements will be derived from our pre-study and the responses we gain from the user. Also we tend to preform use cases to gain further insight in the functionality the system will have and this will put our requirements into perspective.

3.2.4 Design

The design phase is where we start designing the architecture of our system, and in this manner we get to explore how the different parts of the system will communicate with one another. This is also where we specify how we intend to actually program the system. We will be looking mainly at these three elements

- The logical design phase concentrates on what the system is going to do, including performance requirements.
- The physical design phase is concerned with how the system is going to be implemented. This includes hardware and software requirements.
- The graphical design phase attends to the graphical needs of the system. here is where we design the look and feel of the system, and should be user tested to see if its intuitive to use.

3.2.5 Programming and Documentation

In the programming phase we are to show some key aspect of our program and what makes it so special. We are also to document these special cases that arise during implementation. We intend to document the implementation as we move forward.

3.2.6 Testing

After having implemented the system we intend to test the functionalities we have implemented by running tests on the system and users. Here we must test to see if the implementation is useful for the user and if the system is responding correctly, and suggest/implement changes. The tests will be documented in this phase as well.

3.2.7 Project Evaluation

Here we will evaluate our work suggest improvements and document our impressions. The main reason for doing so is to enable both the group members and readers to learn from these experiences.

3.2.8 Presentation and Demonstration

The presentation is intended to give the customers insight in what has been developed and what the development process has been like. We tend to inform of how we obtained their needs and how they are reflected in the system. The project overall success is never the less measured by the approval of the customers.

CHAPTER 4

Templates and Standards

- Organization of files: use of a group folder in which to store our work. The files are to be stored in folders that belong to each phase, and then further categorized into folders depending on activity. See chapter 5 on version control procedures for further details.
- Naming of files: one is to use the full name of what is included in the document or file with the use of a hyphen when in need of spacing and no uppercase letters.
- Coding style: all coding and comments made in the code are to be in English. Comments in the code shall be used only when necessary to further understand of what is happening in the code. Methods and objects will be named after their functions in the code.

CHAPTER 5

Version Control Procedures

The group will use a common, well-organized SVN repository for file storage. This ensures a complete history of all file versions and makes handling conflicting changes easier.

In order to keep the repository tidy and easy to browse, a set directory structure has been defined. Every group member must stick to this structure when committing any new files to the repository. An outline of the structure follows:

`/` Repository root

- `doc/` All files related to the report document
  - `latex/` All files related to the LaTeX document
    - `meeting/` Meeting minutes
    - `report/` The LaTeX files that make up the document
      - `*/` A directory per phase
    - `template/` Document templates
  - `misc/` Temporary files and files that are not used in the LaTeX document
    - `*/` A directory per phase
  - `timer/` Contains a file per group member for logging hours spent.
- `impl/` All files that are part of the implementation

CHAPTER 6

Quality Assurance

in this chapter you will find routines and agreements we have within the organization as to how the workflow shall be conducted during the project.

6.1 Time of Response

The time of respone to emails is a maximum of 24 hours to all who contact us. When it comes to contacting the customers we have agreed to use Egil Tjļand (Subject supervisor) as our middleman, and he is to forward communications with the customer. An oral weekly update is given to our supervisor this is to ensure that we get the help and advise that we need.

6.2 Routines for Producing High Quality Internally

To increase productivity we will no more than two people working on the same task, and to ensure quality we as a group will be working on the same phase at all times as well. This way we will be all focused in one mind set and we get to exploit our resources by preforming multi-tasks.

6.3 Meetings

Meeting with the supervisors are weekly on every Wednesday where we will discuss our progress and get some feedback from our supervisors. Meetings with our customers shall be arranged through our supervisors and documented for further use.

CHAPTER 7

Risk Management

Table 7.2 on page 17 shows any risks the group has uncovered along with the severity of said risks. In the table there are two columns labeled C and P. This is short for consequence and probability.

No.	Activity	Risk factor	C	P	Strategy and actions	Deadline	Responsible
1	All	Group disagrees in important matters	H	L	**Reduce**: Use the group contract to handle and avoid big fights	Continues	Group contact
2	Programming	Lacking programming skills in used language	L	M	**Reduce**: The resource person will provide extra reading material for those who need it	Continues	Resource person
3	Prestudy	Anne Marit cannot attend the Enterprise 2.0 conference	L	H	**Accept**: The group members attending at the conference will give Anne Marit a recap	24. September 2008	Project leader
4	Planning/prestudy	Documentation from Tekna not ready in time	N	M	**Reduce**: Be sure to ask for the needed documentation as early as possible	Continues	Document responsible
5	All	Communication problems with Tekna	L	L	**Reduce**: Agree upon time of response	Continues	Customer contact

Table 7.1: Risk analysis – *table continues on next page*

No.	Activity	Risk factor	C	P	Strategy and actions	Deadline	Responsible
6	All	Group members getting sick	M	H	**Accept:** Make sure the group does not depend on one single person.	Continues	Group contact
7	All	Missing student computers at 4th floor of P-15.	H	H	**Transfer:** Bring own laptops	Continues	Project leader
8	All	No access to group rooms at 4th floor of P-15	H	H	**Avoid:** Find somewhere else to work	Continues	Project leader
9	All	Schedule is too optimistic	H	M	**Reduce:** The group should analyze and if necessary adjust the schedule at the weekly meetings	Continues	Project leader
10	Developing	Product does not correspond with what Tekna inquired	L	L	**Avoid:** Use user surveys, prototyping and make sure product decisions agree with Tekna's vision	Continues	Project leader

Table 7.2: Risk analysis – *continued from previous page*

Part II

Prestudy

Summary

In this phase we have mapped the needs and wishes of both the user and the customer. We have also attended a web meeting and established contacts with the customer in order to really understand how this solution will help them, and to understand in which way it should be developed. We have also compared their requests with similar solutions to extract the essence of such a tool. After doing so we confirm and build upon our findings by asking people in the target group. We send out a detailed survey to collect more detailed information and map specific attributes that are requested by the users. After seeing the big picture we are to discuss what type of technical solution is appropriate.

The users' requests surfaced during the interviews. These interviews contained some general questions with the purpose to see what are the interests in this type of solution. The general opinion is that there is a need to collect and view information in a more efective way. This is no surprise for us after having talked to our customers, but it is good to get this confirmed. Thereafter we conducted a detailed study exploring which functions are required...which resulted in...

After having had a meeting with the customers representatives to discuss technologies used and our options in developing such a system, we found that we had two ways of implementing a solution. We could either develop a system that focuses on the architecture so that it can be built upon later, or we could build a system that focuses on the visual and works like a shell that only shows how things should look and feel. We concluded that the latter is a more appropriate representation of a prototype, and that it is somewhat meaningless to develop an architecture because it most likely will be built from scratch again when it is to go into production.

CHAPTER 8

Introduction

8.1 Objectives

Our main goal of the pre-study is to get a clear understanding of which functions and functionalities that should be part of the solution. This will be done by getting to know our customer and our target group better. We are to find connections between existing augmented reality systems and the customer only to confirm these with the users. We are to use interviews and questionnaires to map the desires and expectations the users have to such a solution.

CHAPTER 9

Market Analysis

In order to help the project group make educated decisions as to what functionality to include in the finished product, a market analysis is conducted. In this analysis we map the needs and interests of the target audience.

An important part of the market analysis is technology research. We study the current trends in augmented reality and how businesses use them in order to strengthen their position in the market. We also try to get an idea of the critical success factors; what drives the users to come back time after time? Understanding this helps us in creating an application that is more likely to succeed.

Collection of empirical data is performed using fairly straightforward methods like face-to-face interviews (see section 9.5 on page 25) and an extensive survey published among petrolium technology students (section 9.6 on page 26). Both these techniques can be executed quickly and return nearly immediate results. These results can then be interpreted and, through collaboration with the customer, rendered into a requirements specification.

9.1 Who Are and What is StatoilHydro?

9.2 Questionnaire versus Interview

In this section we will look at surveys versus personal interviews and the differences between them.

The interview is a method well suited for situations where you have a very specific target group, because you do not have to interview a lot of different people but still get a valid range. An interviewer also has the advantage of being able to probe the interviewee on his impressions and observe his body language. Interviews are, however, rather time-consuming.

The web survey is a method that has become very popular lately. A web survey is posted on a website and potential respondents are usually contacted by e-mail. The web survey is faster and can collect many responses in the time it would take to do one interview. Also, after the survey has been created and published there is no upkeep. The system takes care of everything. When the survey is closed, statistics are generated automatically. On the other hand, surveys have lower response rates, and if they are too long the completion rates fall. They are also vulnerable to respondents answering without reading the questions and answering the same to all

the questions.

In our project we used interviews as a gauge for attitudinal behavior of the target group. This was to get insight into what the main focus areas are. Then we used the results from the interviews to create a survey targeted at a larger population.

9.3 Our Impressions

9.3.1 Augmented Reality

Augmented reality is a concept where one views computerized data on a real-time image. This can be understood as a method of combining real life images with virtual reality, where computer graphics objects are blended with real time footage. The listed feature are a requirement for an augmented reality system:

- Combines real and virtual,
- Is interactive in real-time,
- Is registered in three dimensions.

The interesting aspects of AR is the way in which it changes the interaction with the virtual world. The user interaction is no longer an interaction between a user and the computer screen but rather an interaction with ones environment, which opens a new dimension of computer interaction. Some of the current uses of AR are on television in advertisement, sports and so on. One can also find that AR is present in some outdoor applications with the help of GPS technology, where one can get information about ones surroundings as one moves in the environment. One can also combine AR with stereoscopic technology where one is able to gain depth perception in the 3-dimensional objects one uses in the virtual world

9.3.2 Earlier work with Augmented reality

During our research on the topic of AR we have perceived some of the earlier work in this field and found that augmented reality is often used in a militant and combat situations research, but we where given a hint to look into an earlier more civilian/industy related project, namely the Spinnstube project. Where a static augmented reality platform was developed with the help of a glass surface and the use of a projector that projected the digital image onto this surface. Since the surface is see through it gives the user the opportunity to view a real time object and gain digital information projected on the glass/see-through surface. This project also combined this technology with a stereoscopic view of the projection. The biggest limitations on this project is the fact that its view is very static and therefore limited. This will differ from our approach in which we aim at a more portable and dynamic system.

9.3.3 See-through screen and the use of a web-cam

The concept of a see through screen has been in development for quiet some years now, but is not commercialized yet. This implies that we are not able to obtain

such technology on the open market to use in our project even though it would be optimal. Instead we intend to use a normal touch screen and combine this with the use of a web-cam to stream real time footage of what is behind the screen. This way we would be able to simulate the feeling of a see through screen. This approach is cost effective and should hold up strong for our purpose, mainly a proof of concept. Once the see through screen is available on the market one can then invest in such a solution and extend the research.

The trouble with the web-cam solution is that the image one gets is a feed from the camera and in contrary to when looking though glass ones view does not change when tilting ones head, instead one must tilt the camera because it holds the view perspective. Nevertheless it is still a decent approach which should prove interesting to see develop, and it is a cheap way to investigate how useful such a system can be before any larger investments in high-tech equipment.

9.3.4 Identification Technology

sindre har noe her!!

9.3.5 Graphical user interface and psychology

Karianne sin bit kommer her!!!

9.4 Development and programming platform

Given that our solution will have some way of identifying a certain core sample, we will need a way to connect to a database to retrieve relevant data. This opens up the possibility of using several database platforms. Then we will have to present this data on a user interface and this opens up for several languages to use and several tools to consider in the development phase. Below we discuss our options and argument for which choice is right for this project.

First of all one must remember that what we develop here is a prototype. Therefore it is only a proof of concept and should not necessarily match the development tools used in StatoilHydro. On the other hand given that we use the development environment that the customer uses we prove to them that this concept is easily applicable to their existing system.

9.4.1 Choice of Database

StatoilHydro being a large company uses many of the current standards that are available and has data stored on different platforms therefore it should not matter which type of database to use. The most standard types are an Oracle and Mysql database platforms. In our case it does not matter which we use because they both have the necessary requirement for our needs basically attaching data to a given key, which in our case is the ID number of each core sample. Given the fact that the team members developing this prototype have a reasonable amount of experience with the Mysql platform it should be a safer choice in the case of error handling.

9.4.2 Choice of Programming language

Here there are several consideration to take into account. One being the performance of the language and how important it is for our system that it reacts quickly. The second is how applicable it is for prototyping an interface i.e. how easy is it to create graphical object with the language.

When considering performance we could say that it is of course important if this where to be an end product and that the data system would be much larger than that of our prototype and then we should consider that the system should not waste time on a development platform that is slow. But given the circumstances our solution is much more focused on the visual aspects of than that of performance. In this way we can eliminate using any low level languages which are really efficient in runtime because this is simply not one of the requirements of this solution. Now developing a graphical prototype would imply the need for a platform that enables easy drawing and animation options. That being said the most relevant platforms would then have to be Adobe Flash, Adobe flex or Microsoft's Silverlight. These tools all have their advantages and flaws. Flex being a very useful tool demands more programming than Flash and uses more of an object oriented structure. This would be useful if we where to use it to remember certain variables and use inheritance and so on, but our solution only needs a tool of pure graphical nature and therefore Flash would be more appropriate even-though it is outdated by Flex. Silverlight is just an equivalent, and since the group members are more familiar will Flash it is best to choose as the development tool to lower and limit the risk of failure.

9.5 The General Opinion

9.5.1 Interview Design

The objective of the interviews is to find the general needs of the potential users...

Target Group

The targets for the interviews are...

The Questions

We start with general questions about...

For some information on how to create and execute interviews we consulted [**?**].

9.5.2 Execution and Results

9.5.3 Analysis of Results

9.6 A Detailed Study

9.6.1 Survey Design

Target Group

The Layout

The Questions

9.6.2 Execution and Results of Survey

Having finished analyzing the interviews we conducted, we used the results to make a new questionnaire, intended for a larger population. The interview was used to check ...

9.6.3 Analysis of Survey Results

9.7 Conclusion

conclude!!