DEPARTMENT OF
APPLIED PHYSICS AND ELECTRONICS
UMEÅ UNIVERISTY, SWEDEN

DIGITAL MEDIA LAB

Understanding Web Users Behaviour From A Web Video Camera

Anas Abu-Hamam [1]
Dept. Applied Physics and Electronics
Umeå University
SE-90187, Umeå Sweden
e-mail: anas@abu-hamam.de

H. Li
Dept. Applied Physics and Electronics
Umeå University
SE-90187, Umeå Sweden
e-mail: haibo.li@tfe.umu.se

Apostolos A. Georgakis
Dept. Applied Physics and Electronics
Umeå University
SE-90187, Umeå Sweden
e-mail: apostolos.georgakis@tfe.umu.se

DML Technical Report: DML-TR-2003:02

ISSN Number: 1652-8441

Report Date: December 1, 2003

[1]This work was supported by the European Union Research Training Network (RTN)"MUHCI: Multi-modal Human Computer Interaction (HPRN-CT-2000-00111).

Understanding Web User's Behaviours From A Web Video Camera

1 Task Specification

To develop a Real-Time system, which can capture and track the web user's head motion. Based on the head motion information, the system should be able to identify whether the user is interested in the current homepage or not. A future system property would be to find out in which area of the homepage the user's interest is moving.

2 Introduction and background

With the increasing use, acceptance and necessity of the internet, and the increasing mass and transfer volume of products, through the internet, more and more companies are focussing on how to improve their services and relationship to the customer, and above all else to estimate what actually each visitor individually wants.

If we look at a typical shopping scenario, most of the sellers can see and understand what we want. Therefore they naturally start to offer us the wanted list of products according to our behaviour. The example shows us, that the need for such a system, that understands what an internet user wants from the visited eShop or homepage is as necessary as the eShop itself. **[4]**

One of the main goals of this project, is to find a way to interact with the user through an active browser, which can offer the user some certain help or instructions and gets the needed feedback from the user as well.
An active browser has elements of the page, which can be controlled and changed after the page has loaded, enabling them to react to user's input. This involves using a scripting language to tell the browser how to respond. An active browser also involves executable contents. They allow a page to change and respond to the user than just displaying static information. **[5]**

3 Application Scenario

The scenario is not much different from our typical usage of the internet. With the exception that the user gets some help offered from the program. One of the main tasks the program has to offer is help. Help which is divided into several steps and has got many aspects.

An essential point is to make the user understand, what kind of benefits she/he would gain from using the program. Which will be explained as follows:

- Background of the program (Introduction)
- System requirements (Technical)
- Benefits of using the program (Advantages)
- How to use the program (Instructions)
- Privacy and information security (Responsibility)
- Start of interaction (Human Computer Interaction)

Background of the program

The program is a kind of plug in, that will understand the user's behaviour from his/her head movement with the help of the web camera.

System requirements

A Personal computer with an Intel processor, Windows Operation System and a Web Camera.

Benefits of the usage

The plug in will help the user to get his/her favourite homepages presented according to their behaviour. Which will save time and patience. On the other hand it would be also comfortable for the user, because in this case, the user does not have to use the mouse or the keyboard to tell the computer what he/she wants.
It will be also an advantage for the seller to prepare the homepage for each and every individual user and raise the quality of service.
In fact it will be a both-sided benefit.

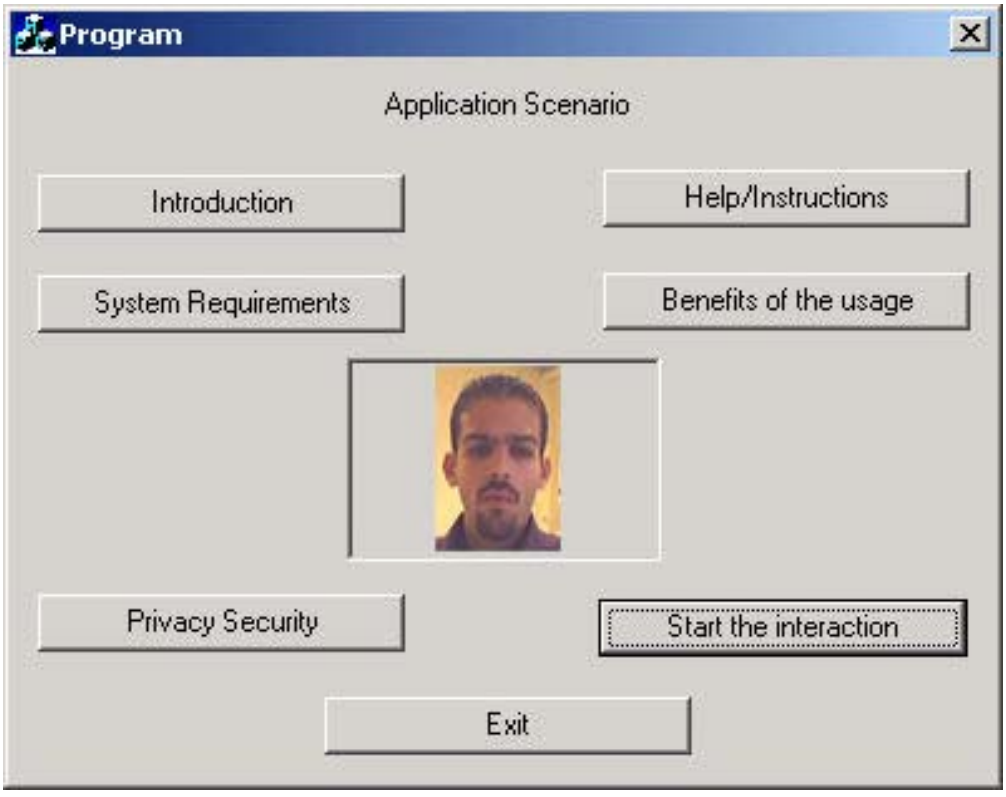
How to use the plug in

A user manual will be presented as instructions to follow. Step by step how to use and how to run the program.

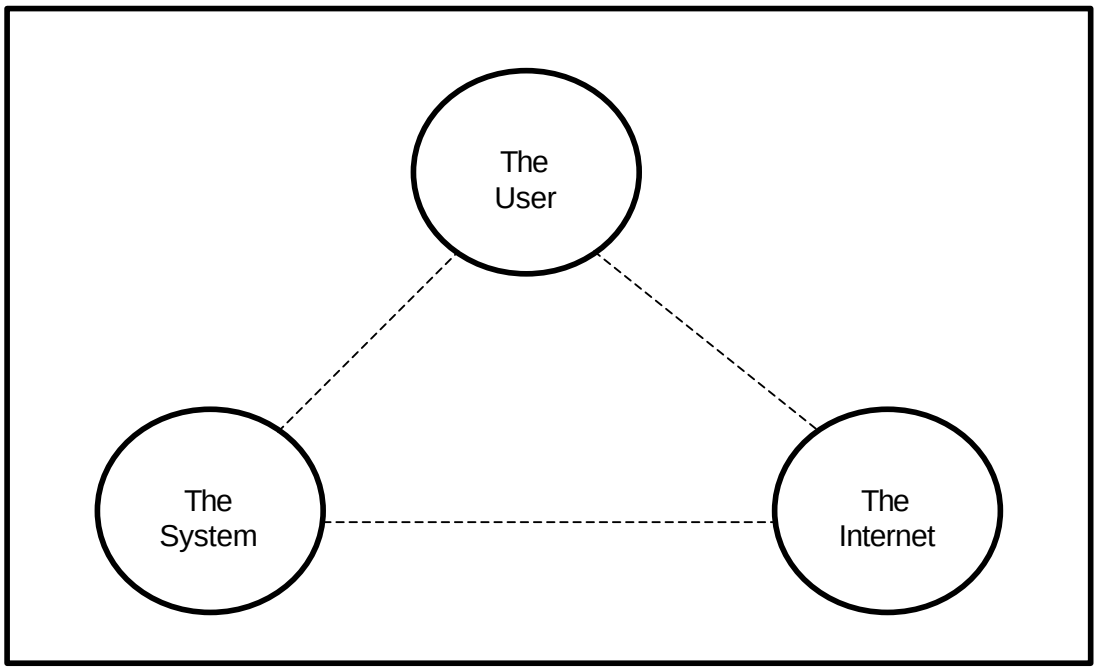
Privacy and information security

The user has to be well informed about the protection of his/her data. And that there will be no loss or misuse by a third. **[6]**

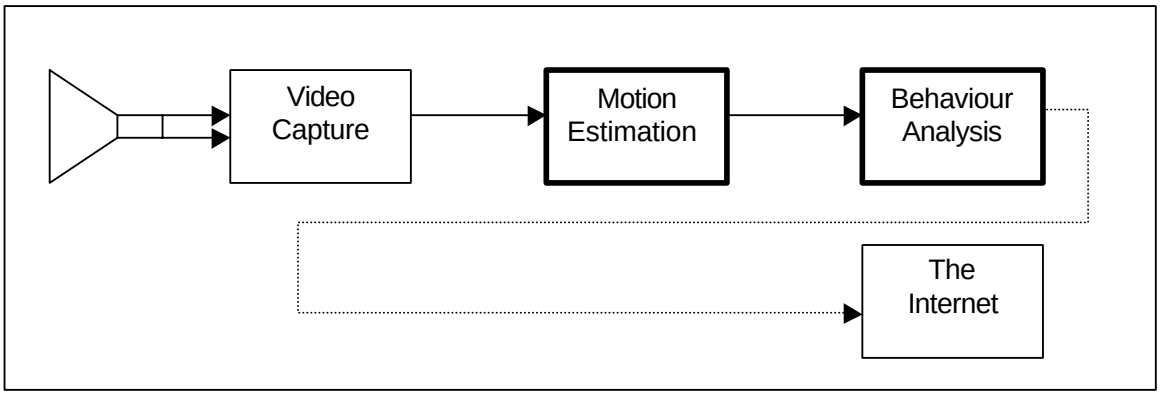
Start of the interaction
After the user has agreed to use the plug in, the interaction will start.



The following graph should give us a general picture of our three ***main*** project candidates:



4 The Technical Solution



From the task specification we can clearly see that the project is divided into two important parts. The first one is concentrating on the **image processing** in Real-Time, which has to deliver robust information about the user's head motion.

The second important part is to use the delivered results, as classification whether the user is interested, reading, looking around in favour of updating the homepage. Which means; the results have to be transferred through the **internet [3]**, to use them for further update decisions.

Now, let us take a deeper look at each module by its own.

Video Capture

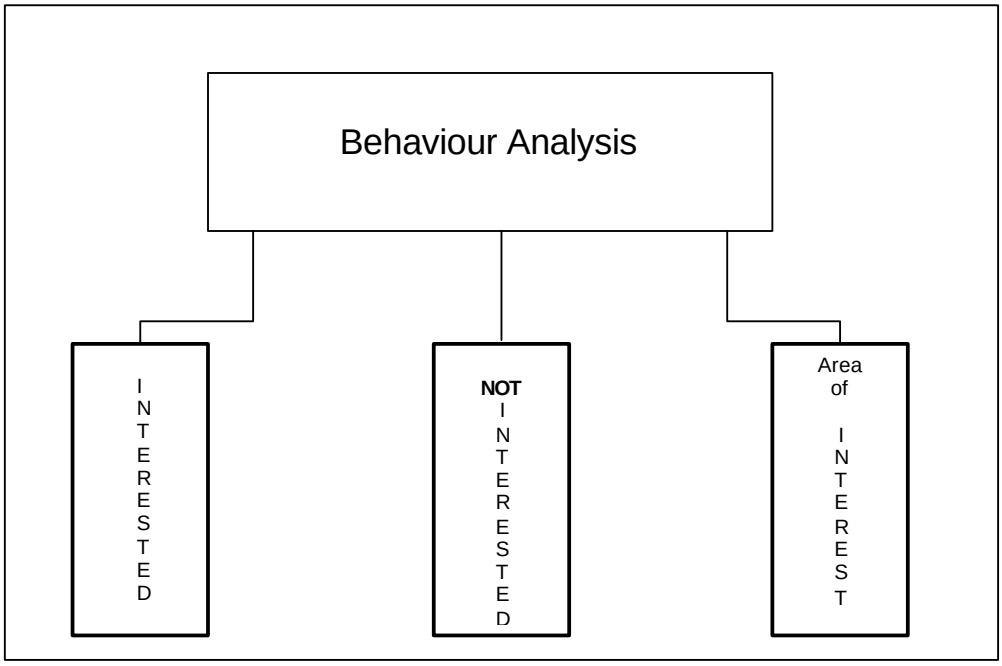
The video capture follows through a typical video Web Camera.

Motion Estimation

Head Motion Estimation needs special algorithms to solve following problems in Real-Time **[1]**;

- Find the Face in an Image
- Facial Feature Extraction
- Facial Motion Estimation

Behaviour Analysis



After that we have to consider that the estimated head motion should give us some important hints about the user's behaviour. At least whether he/she is interested or not. The Head-Gaze relationship gives us also a clue where roughly the use is looking at. One other hint for example is to capture the speed of the head motion.

The Internet

After all, the results of the user's behaviour have to be ready for the internet transmission. So the seller could update the homepage according to the needs of his customer **[3]**.

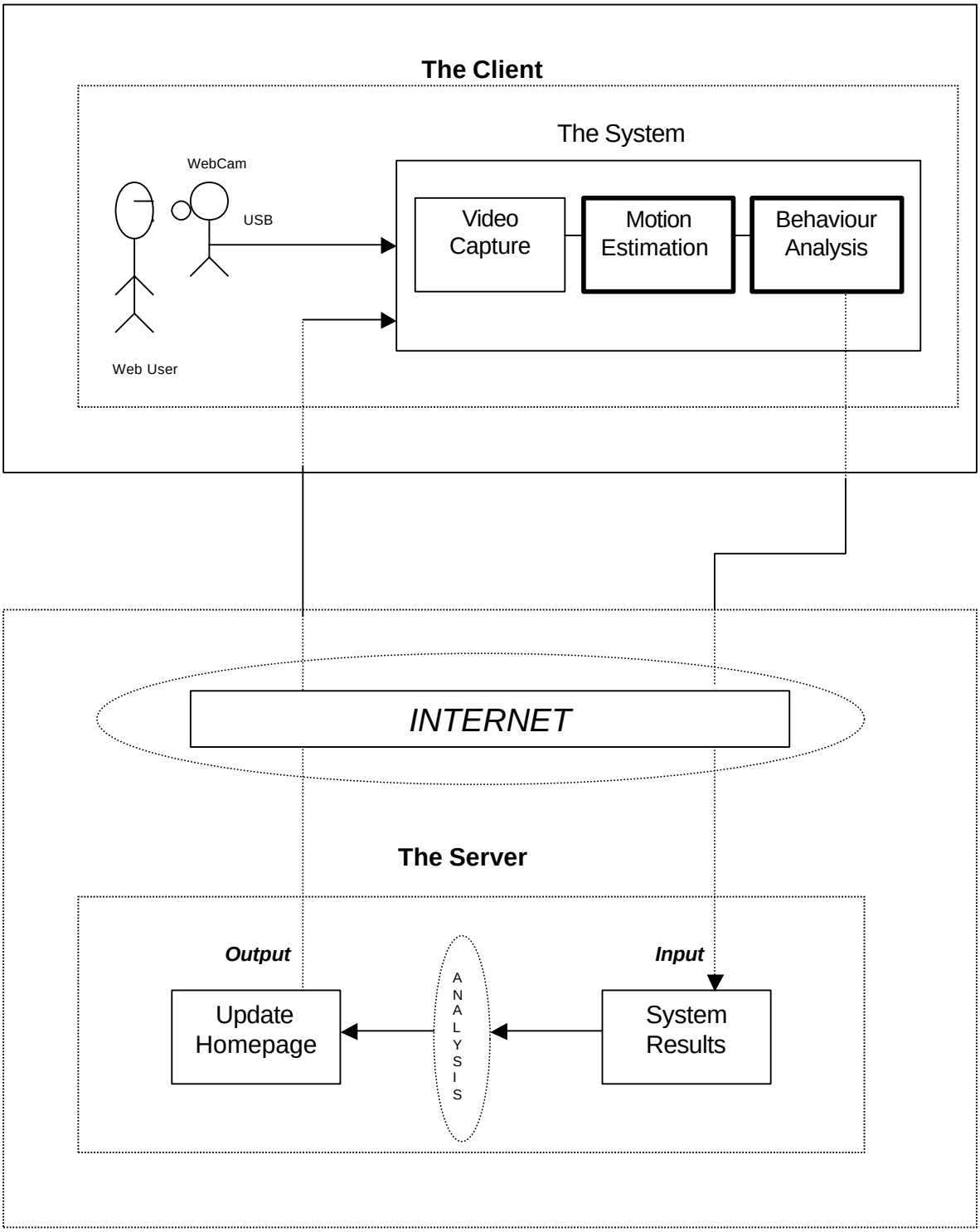
The way of usage:

Following steps have to be taken to run the application:

- Install the plug in/Software
- Allow the interaction with the system
- Place the Web Camera in front of the user "Right, Left, Centre, main thing in front of the user"

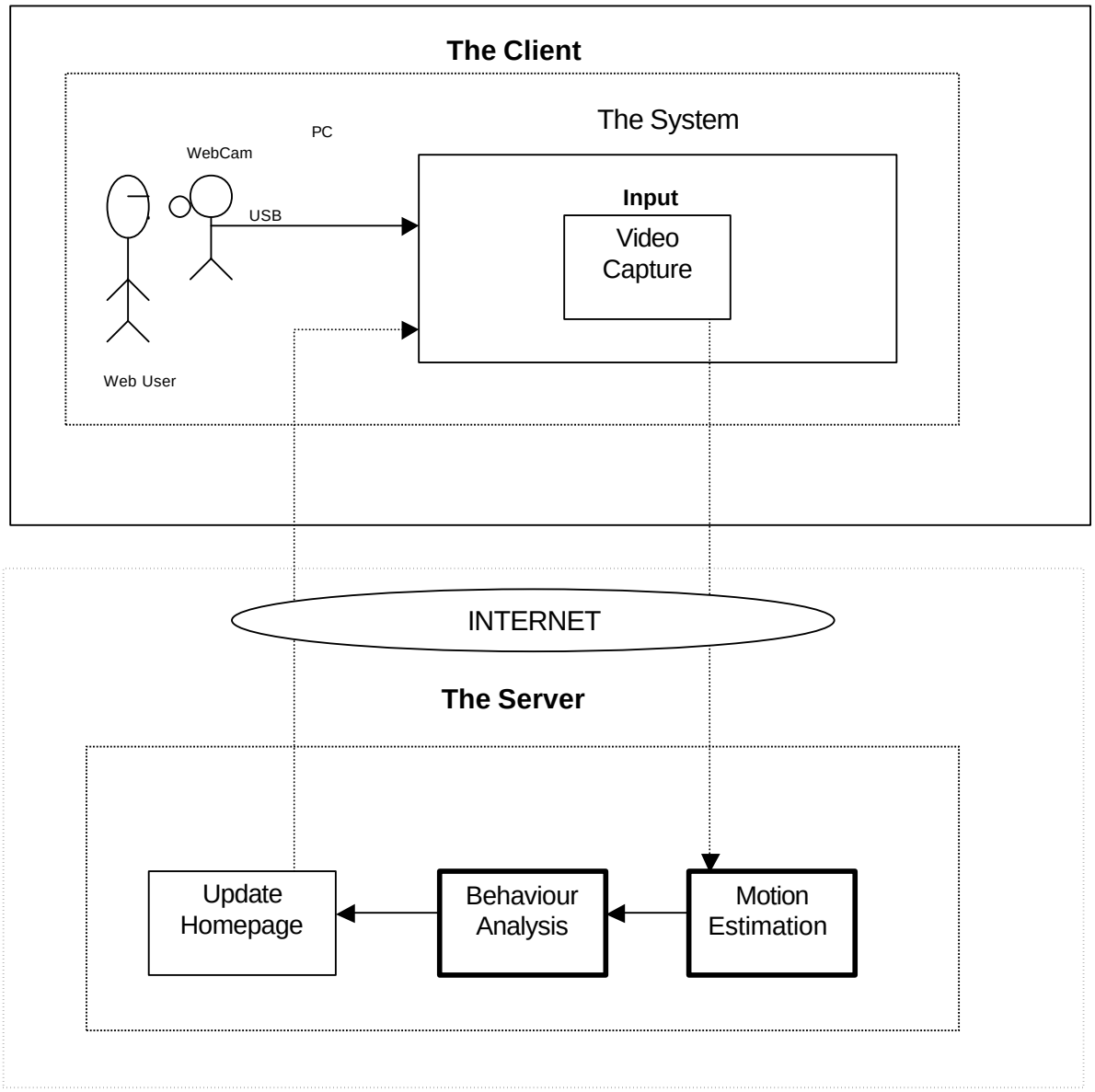
5 System Architecture

(I) First Option



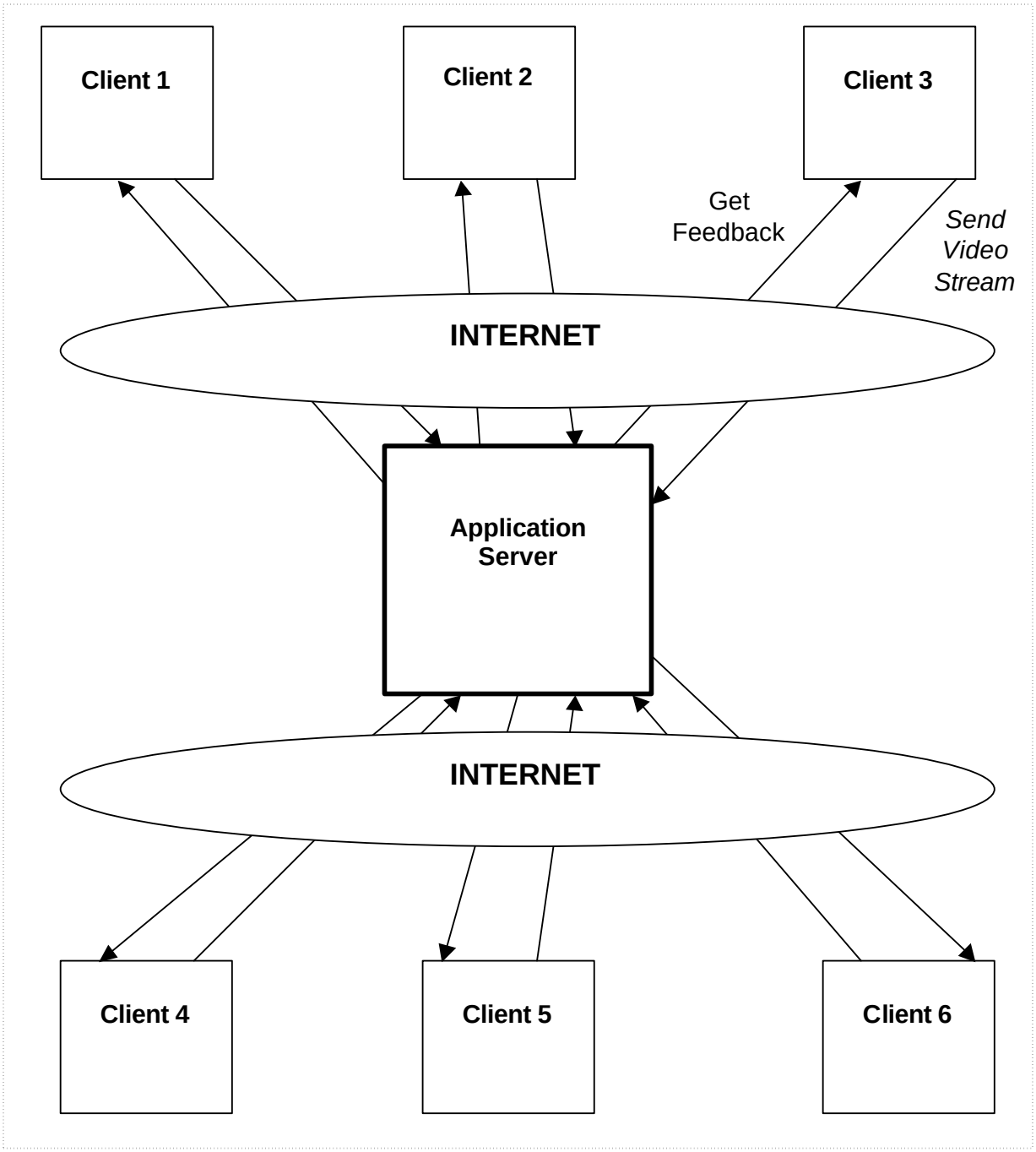
That first option showed us, that there is one way of many , to implement the system. For example we could have all the calculation procedure taken on the client's side. Which would be in Real-Time, due to the fact, that the video capturing and the complicated calculations would be run on the user's pc and would save the time of transmission through the internet. We will discuss the advantages and disadvantages with more details after explaining the second option.

(2) Second Option



The second option is as shown to capture the videos and send them through the internet and make the motion estimation, behaviour analysis on the server's side. This option is also a good one, but on the other hand we have to be aware of many things that might come ahead:

- The video stream has to be **transferred** through the internet, which needs time and safety of transmission
- The server has to be powerful enough to **serve several clients** in the same time and all the time
- Bandwidth is from one user to another different



Conclusion

From the two options above, the decision was taken to go for the first option. Due to many reasons that would lead to the goal. One main reason is to achieve Real-Time and reliable results.

The second options is possible, but needs us to concentrate on many factors to achieve a Real-Time-Application. We can imagine the second option as a chain with many elements, where each element is sensitive and its possibility to fail is high. **[7]**

6 System Implementation

Two main Solutions

a) Plug In [8]

This method is going to run the system on the client's pc after installing the Plug In. It has got the big advantage, that the whole procedure will be in Real-Time. And the privacy problem will be avoided.

Drop back:

- A Plug-In is "Browser dependent", not all users use the same browser!

- The Plug-In has to be downloaded and that would request patience from the user while visiting the homepage.

Plug Ins are mostly programmed in two languages

- **C++ [9]**

  Here we can also run the program on the user's system and then send the results through the internet (UDP: User Datagram Protocol)

  Advantages:

  - Very fast and promising for Real-Time-Applications

  Drop back

  - C++ is Operating System dependent

  - Each user's PC has to be powerful for complex calculations to reach Real-Time

- **Java [10]**

  Advantages:

  Independent, which means compared to C++, Java could be used on any Operation System.

  Problems:

  - If the Algorithm is complex, it would influence the processing time

b) Java Applets [11]

This method is also very close to Real-Time with the exception, that it has to be streamed every time the user visits the homepage, which is time consuming and requires user's patience. And the program should not be complex.

Advantage

- Easy to write and test (compared to Java)

Disadvantages

- Restricted to a few simple activities
- Not fully supported by all browsers (also because of competition - mainly with MicroSoft)
- Not powerful enough for complex applications

Implementation choice:

The first option is going to be implemented in form of "**wintel**": Intel technology and windows operating system. Due to the fact that most people have this combination we gain the advantages of this choice.

The programming language will be in a **visual C++** environment to achieve Real-Time and the ability to go for complex applications.

On the other hand an executable program would be browser- type independent. The results would be then sent through the internet.

7 Technical and general challenges

Let us start with questions, showing some of the problems that might/would face the realization of this project.

The User

Some internet users do not like to be watched through the internet. Especially if his/her pictures are transferred through the internet to the server. Therefore a security study has to be made how to make the user be sure of no misuse of his/her images. This problem will be avoided, if the user installs the plug in on his/her pc, so the images wont be transferred through the web.

The system has therefore to be able to inform the user of the personal security taken of the personal information. This information has to be protected from loss or misuse, and from unauthorized access, disclosure, alteration, or destruction.

Real Time Application

- The image processing has to be **Real-Time**!

  Due to some basic experience, one of the major problems the project will face, is the **processing time**; therefore a wise decision has to be made about special time saving implementation algorithms.

Where is the Web Camera?

- The **position** of the Web Camera is flexible!

  It is not easy to find head in an image and track it's motion with a flexible web camera. And to see where is the user looking with different camera positions.

The Algorithms

- Cropping the area of interest automatically! Which algorithm would solve that problem? Is it the head in the scene? The shoulders?

- Tracking or following the head motion in the scene has to be well studied. Through a template? Which other object-tracking algorithms are available? Capture the colour?….

- Classification of the motion results into different **behaviour Characteristics.** Based on the question; what is the user doing? Reading? Interested? Looking around?

No Prior knowledge about the users

The fact that we don't have any former information about the user; about his/her behaviour, the form of his/her head or face and so on, would make things more difficult. Therefore we have to find a general solution for that problem.

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