ON VR EVOLUTION

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ABSTRACT

Progresses in matter of computer techniques bring out the necessity to focus our attention on the man-machines relations in order to create systems well-adapted to man and not systems to which man has to suffer to be adapted to the machines.Among the possible ways,Virtual Reality technology can propose an interesting track.The paper deals with the basic questions to be examined before doing the main technological choices to access to good interactive systems relying on or using Virtual Reality Techniques.

1.Why Today Interest Is Focused On Human-Centred Systems?

Nowadays,technology invades the world and any people has to face the using of products including a lot of items unknown fifty years ago.

This invasion obliges us to put some questions such as:Up to where shall we go in term of technological development?Must we let the natural evolution of markets drive us to unforeseen situations?Or,are we able to identify a target that can be suitable for humankind?Some people think that technology transforms man and the planet into a system with slaves and pollution.Other people think that technological development is a positive thing and will help to reduce misery or to improve the mean way of life of every man,mainly in poor countries.The discussion is relevant to philosophical,sociological and economical data.A clear sight is uneasy to get and should demand a lot of studies and books.As a scientific researcher,I want here to present only one aspect from which we could draw a possible track to work on future technological systems.

In fact,we can divide all endeavours dealing with science and technology into only two huge classes.One is devoted to understand the nature and the functionning of the universe(including living beings).The other one is dedicated to automation of tasks whatever the task goal.A task can be defined as a software process (for instance reasoning) or as a hardware or material or physical process which results in a modification of the world.(In this last case,there is always a software part (sometimes hidden) mixed with the physical process).But we can also divide the tasks into two other different classes depending on their **human goal** and this point of view seems today more important than the previous classification to make general technological choices.

In fact,either man wants **to get rid of the task** to be performed because its execution generates a stress or a tiredness feeling or another type of dissatisfaction,or **the task is** considered by man with interest as a hobby or **an enrichment**.These two new classes will drive us toward two different approaches to automate tasks.

The true problem arises from the differences between the various judgments of man facing the task.A task considered as boring by some people can be considered as very attractive by other people.And the process leading to the feeling is not the same for every people.The reason to like or to reject the task are not identical.(A good instance takes place in the revolt of the Canuts in Lyon (France) with the arrival of mechanical looms...The work was boring but it provided salary.The task was accepted by economical reason,and,with the looms,the job disappeared,therefore the salary.No job replacement was foreseen...)

It should be very long to comment the historical evolution of automation [Coriat,1991].Let us throw a look at the today situation.We can notice two main approaches to design automation.None of them is totally mastered and that fact induces a fuzzy situation while we want to foresee the future.

Summarizing,the first one relies on the theory we could name **"push button"**.The interface of the machine (or the set of machines) performing the task with the human operator is reduced to almost nothing: to order with a switch (or with voice) the starting of

the task.After that,man becomes unuseful (if we assume all things as perfect).

The second one is based upon **a permanent intervention of man** into the task which passes through a **permanent man-machine interaction.**

So, if we accept this first coarse analysis,we could make the following correspondance considered as an ideal solution:

task leading to a man dissatisfaction ------- push button automation
task leading to a man enrichment ------- interactive automation

Of course,a long comment should be necessary to explain:1) what type of dissatisfaction we have to accept?2) what kind of enrichment has to pass through interactive automation?3) why the push-button techniques cannot be mastered for any task?4)why,nowadays,we are generally in favor of interactive task automation?

Shortly,let us give some elements to answer the two last questions.

The main technological challenge to generalize the push-button automation relies on the fact that the working machine must,by itself,understand its environment and deduce immediately what kind of action is now suitable.This problem is studied for more than thirty years by roboticians.They believed to overcome the difficulty thanks to Artificial Intelligence.This way failed for a lot of reasons,but the main one is the following:we can solve the problem only if we are able to make a "true" artificial man.Today,this way is generally abandonned to the benefit of other approaches that are inspired by the behavior of some very efficient animals that have no intelligence at all but are able to make a lot of complex physical tasks.[Ferber,1992]

When researchers began to understand that the former way was not efficient, a new interest was applied to teleoperation (which demands the presence of man during the performing of the task)[Vertut,1984][Tachi,1989].The intelligence problem shifted to the problem of man-machine interface (involving ergonomics and pertinent information feedbacks).Progressing on this track a new technique appeared around 1990 that opened new horizons.It is called **Virtual Reality** and it promises a huge impact exactly as,before it,computers and robots have had.

Anticipating the future,we can progress toward a technological revolution if we are able to correctly master computers to automate software tasks,robots to automate physical tasks,and V.R. systems to get immediate access to any source of stored information,to be immerged into any world,to create any world,and to control any remote system.So,human centred sytems are at the heart of our research concerns.[MITI,1995].

2. VR Background

To make a VR system consists in creating with computers an immaterial stage which exhibits,relative to the human operator the same properties as a real world exhibits.That means we can **immerge** man inside the virtual world,and this last one sends to man the **same sensory signals** as a real world sends to man.The main subsets we can meet in a VR system are the following:1) the **VR Engine** which relies on two functions:a) before the system works it is necessary to build the world using **data-bases** and **adequate softwares** (including all useful models);b)while the system works,VR Engine has in charge to modify the virtual world in function of the input signals coming from the operator and in function of other constraints such as the **image refreshment rate.** 2) the **Human Operator** who acts on the virtual stage thanks to suitable 3)**Input Tools**,and receive sensory feedbacks from the stage thanks to 4)**Output Tools.**With these four first subsets we get a first class of VR systems we can name **"closed VR systems".**

A closed system can become an **"open VR system"** if it has connection with the external world through the participation of **several human operators** (multiuser system) or through the link with **other information or computational resources** or through a link with **the real world** (remote control of machines or systems).

We easily understand that the variety of possible VR systems is huge,and the design of a practical system is oriented by the specific desired application.So,we cannot today purchase a VR system as we purchase a computer and,off the shelf,only some products facilitating the making of a small part of a specific system are available.

Basically, a VR system is a kind of (not yet available) universal tool (as robot or computer is) allowing to ensure three main functions:1) **simulation**,2)**communication**,3)**remote**

control, using a specific feature concerning the human operator position who is teletransported on the best spot to watch the working of the selected functionnality.These general functions are useful in any process;therefore,it is not surprising to find potential applications in all sectors of scientific or industrial or personal activities. Today,probably several thousands experiments are developed over the world [Helsel,1993].

Building a VR system is a long and relatively difficult work.If we except these kind of difficulties,the two main basic problems to be solved to reach an ideal system are the following:1)computers are generally too slow to ensure a correct refreshment rate of images,consequently limiting the complexity (therefore the realism) of virtual worlds;2)a satisfying immersion of man into the virtual stage assumes we are able to correctly synthetize all sensory signals adressing the human sensory system.It assumes we perfectly know this human system.In fact it is not the case and we stay very far from our needs (mainly in matter of cooperation or substitution of different senses. [Burdea,1994]

3. VR Technology Future:

3.1. General Technical Improvements:

Whatever the using,VR systems need a lot of practical improvements.A basic point deals with the immersion feeling which must be accompagnied by the feeling of freedom for the operator.Almost all tools devoted to that are of poor quality:discomfortable helmets giving a limited field of vision,complex data-gloves without tactile feedbacks,images not reproducing the complexity of the real world,strong limitations in sensory feedbacks,heavy or discomfortable harnesses to interact with the virtual world bringing out a feeling of jail and not this one of freedom... The technical input/output tools are very far from what we wait, and a lot of new products as well as improving in knowing and modeling the reality must be studied before reaching suitable and appreciated systems.

3.2. Human-Computer Interaction:

A general complain today is concerned with the difficulty to pleasantly and smartly interact with computers [Krueger,1992].In fact, every one,all along the day,interact with other men,animals,machines,objects,and in his interaction takes under consideration the nature and the constraints of his partner.Some partners cannot be modified and we have to adapt our behavior relative to them.With some machines and mainly with computers we are in a lucky situation because we build the computers and they can get some characteristics belonging to somes of our daily partners.So, before speaking of interaction modes we have to work on the following questions:what kind of partner do we wish?: a man?,an animal?,a not living object?...After that,the second question is :what kind of role do we wish our computer partner is playing?:a slave?, a cooperator?, an opponent?.At last,the third preliminary question is the position of our partner when we work with him: sequential or alternate work?,parallel work?,serial work?.Therefore, the vocation of our computer relative to the previous questions will orientate us toward technological choices in matter of computer hardware, computer "brain",computer communication tools,computer-man interaction modes.

Trends today are to consider computer as a man and to exchange with it through voice and gestures. VR principle,mainly with total immersion,can be a good way to get suitable interactions.Nevertheless, we have seen that the practical implementation exhibits numerous difficulties.We know also that it is impossible to simulate the behavior and the brain of a real man.At last,the role and the position of computer, such as evocated previously, are not taken into account, depend on the task goal of man, and have a direct link with the efficiency and the material implementation of the interaction tools.

3.3. Human-Robot Interaction:

This subject puts only subproblems of the general problem about human-computer interaction because the goal of robot is clear: to make a desired modification of its environment, a physical task.As we abandonned the idea to make a kind of artificial

man,robot remains a machine and must not be an opponent to man.It is a kind of slave with a very limited possibility of freedom(only some choices inside the constraints that oblige it to progress toward the task performance).So, when we know in advance all things about robot, environment and task (as generally in industrial applications),a **push-button** technique is convenient,and the robot-man interaction problem disappears.It is not the case for applications of mobile robots in the domains of intervention and services.A remote man control remains compulsory, and,with it, the robot-man interaction problem.

Robot is then considered as a kind of "manual" tool for man and exhibits two main difficulties in its remote control:1) robot is **"mechanically" ill adapted** to man gestures;its structure is ill compatible with this one of a man moving his own hand or walking;and generally robot is not **dextrous** (instead of a hand, it has, for instance, a two or three fingered gripper etc...);2) man can hardly get a good appreciation of the real situation where robot is working because the feedbacks are not convenient.

VR technique offers a new and potentially very fructuous opportunity when using a VR system as an interface between man and robot.Indeed,we can build a virtual stage which: a) represents not the real stage but only the **functionnality of the real stage**.And the representation of this functionnality is made for a **manual** or natural **execution of the task** by the immerged operator; b) is connected with the real stage in such a way that,when the human operator acts inside the virtual world,the robot does not execute the same gestures but executes the same action.That is to say that we build a robot well adapted to an automatic performance of tasks, and a virtual world well adapted to a manual performance of the same tasks by man. Of course, the links between virtual and real world are a little complex (the real world must update the functionnal representation of the virtual world).But VR allows to conveniently solve the robot-man interaction problem displacing it into a VR world-man interaction problem for which potentialities of solutions are high.[Coiffet,1995]

3.4. Advanced Multimedia Technology:

Due to the possibility to have a trip in the cyberspace,a lot of people are more interested in the **communication** potentialities of VR than in its simulation and remote control opportunities.

In matter of multimedia technology,the basic question is the following:Are we able to replace (or to complete) the classical means of communication and information (telephone,radio,newspapers,TV,Minitel,...) with **computers networks** and personal **VR workstations** filling all the classical functions with improvements and offering new possibilities?

The answer is complex:At a methodological level,the answer is yes.At a scientific level,the answer is: not yet,because,as we have explained,the general quality is unsatisfactory and demands to solve first the problems of computer slowness and of identification of the human sensory system.At an engineering level, the answer is no,because the input/output products are not ready with correct performances but also ill designed to be accepted by people.At an economical level,the investments are probably gigantic.

However, these elements of answer must be nuanced.The factor "time" is very important and it is interesting to start on time, that is to say before the acceleration of the general motion toward VR.Then,the previous answer is proposed about products of high quality.In fact we know well that a new product with limited and even frankly bad performances can be accepted by some people as a preliminary step toward better products.(And technologically speaking we are ready to deliver such performances-limited products.)

Indeed,the battle to date deals with the implementation of large computers networks and storage zones of resources able to receive the data transmissions concerning the future VR systems.

4.About The Research-Industry Links Concerning VR:

If we except the thousands companies involved in classical products development,there are probably several hundreds companies in the world specifically interested in VR products.(In 1993,we numbered 134 such companies in the world,mainly in USA)

Of course,basic research is expensive,but VR needs yet serious basic works.And these last ones are often performed in academic or public institutions (which suffer (almost whatever the country) a lack of financial support).

Every country has its own traditions in matter of basic research-industry relations.In none country these relations are ideal because the deep motivations of researchers do not match with these ones of the industrial side.In France we have tried a lot of systems to bridge the two sides.Today the fashion is directed toward the notion of "Resources Center" closely linked to one or several public research labs (but legally independant from these labs) and serving as an intermediate system between these labs and the industrial side.Any action with an industrial company adopts the form of a contract with delays,penalties and money.Every "Resources Center" is officially aknowledged by authorities and draws a basic financial support from them every year (up to it does not work and is cancelled).

With this system two important things are correctly solved: a)the confidence or rather confidentiality (industrial secret is preserved exactly as the industrial side demands it),and b)researchers working on contracts may have a financial personal resource that is added to their current salary.

I think there is no general solution to bridge basic research with industry.The most important items are confidence,clear agreement and money...

5.About European Intention In Matter Of Multimedia Technology And Infrastructure :

Although few valuable products exist,USA,Japan and Europe are on the starting blocks concerning the race about the new multimedia possibilities.

The infrastructure equipment deals more with an investment problem than with a technological problem.A lot of large industrial groups compete relying on well known technologies and the choices will be political and financial.

But the situation is different in Europe concerning the products dedicated to be connected to this infrastructure.The European Commission at Brussels has launched several "calls to participation" to programs directly connected with VR using and VR products development.A lot of industries (mainly small and medium) involved in computers begin to work on VR techniques and applications.Basic research knows also an expansion.

Generally speaking,we can think that Europe has the ambition to play a very active role in matter of multimedia technology and infrastructure,and that we feel the first real actions preparing the next century.

6.Conclusion:

VR technology is very promising but also very complex and expensive.We are not yet gone out from the step of basic research although some individual-using products in the field of games can already touch a large number of customers.A generalized development passes through the implementation of a correct and safe networks infrastructure.The time devoted to that step should be used to better understand the human and technological phenomena underlying any approach of VR, in order to get,not only technologically adapted products but also,products that take into account all the sociological consequences of the foreseen development.

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