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Sébastien Bottecchia, Jean-Marc Cieutat, Jean-Pierre Jessel

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BOTTECCHIA, Sébastien[1,2], CIEUTAT, Jean-Marc[1], JESSEL, Jean-Pierre[2]

[1]ESTIA Recherche, Bidart, France
[2] IRIT, Toulouse, France
{s.bottecchia}@estia.fr

Abstract—**T.A.C[1] system was built in order to propose a new mode of remote communication. When somebody needs to be assisted on a manual task, classical technical support methods such as phone or visioconference rapidly show their limits in terms of human interaction. By allowing a distant expert to see exactly what an operator is seeing, he could interact with him in interactive time thanks to augmented reality via an adequate interaction paradigm named "Picking Outlining Adding". By "simulating" co-presence of the expert close to the operator through visual guidance information, ambiguity of language and difficulty of communication are avoided, and operations are easily performed. Scientific experimentation we have conducted and we describe in this article shows the teaching interest and the efficiency of this new mode of communication. The operator learns and operates more rapidly, in complete serenity, increasing reliability of his tasks. Moreover, throughout this paper, we show that the developed principles are sufficiently general to be applied to other use cases of tele-assistance that go beyond the originally planned industrial maintenance.**

Keywords - Augmented Reality; Teleassistance; Collaboration; Cognitive psychology

I. INTRODUCTION

Information and communication technologies (ICTs) are increasingly present in the world of industry. Their uses are constantly expanding and becoming more and more important in the functioning of companies.

However, despite technological advances, the maintenance operator does not have appropriate tools when he wants to be assisted in his task by a physically distant expert. In the absence of ergonomically acceptable solutions, the phone remains the preferred communication tool. To try to remedy this lack, the introduction of augmented reality (AR) appears to be a ready means. In this paper, we propose the use of this technology through a new teleassistance system that we have called T.A.C.

In the first place, we will define the problems involved in the communication process between an operator and an expert. After a survey of existing modes of communication, we will present the system we have developed drawing on insights from cognitive psychology.

Finally, we will present the results of user tests that we conducted before analyzing the relevance of TAC as a teleassistance tool.

II. MOTIVATION-PROBLEMATIC

A. Background

When carrying out a task, an operator directs his activity in relation to the targets to be reached. In order to do this, he uses different means made available to him (machines, tools, interfaces, etc.). However, whether we are talking about an operator or a simple user, we are currently confronted with a variety of mechanical /electronic/computer systems that are increasingly complex and system renewal that is more and more frequent. Set within this highly dynamic context, it is becoming difficult for an operator or user to have the skills or knowledge required to accomplish the task.

To offset these shortcomings, we generally resort to two types of assistance. The first calls upon information aids (paper, electronic, etc.). The knowledge that can be found here appears in a tangible form and is therefore easily stored or transferred. This knowledge, known as explicit knowledge, corresponds to the information that can be formalized in operating mode, among others (see ISO 9001 standard).

However, access to this knowledge is not always sufficient in order to fully perform a task. Therefore it is necessary to have access to another type of knowledge. This is the second type of assistance, which is intangible and difficult to structure in a coded form, and which calls upon a certain experience or know-how. In this case the knowledge is referred to as being tacit or implicit. The latter assistance has the particularity of only being linked to human involvement. Whereas explicit assistance is of no help when an unforeseen situation arises, implicit assistance can only be applied by a person who has the required level of qualifications and who has already been confronted with this situation.

[1] French acronym for "Collaborative Tele Assistance" (i.e. Télé Assistance Collaborative)

Studies such as [15][24] demonstrate, on the one hand, that a task may be performed more rapidly and contain fewer errors with human help than when using a manual only. Indeed we now know that the human brain functions all the better for the emotions that are felt when learning [11], which is a situation that an apprentice can find himself in when benefiting from the know-how and advice of an expert.

However, the expert is not always on the spot to be able to lend a hand. Should an operator resort to the assistance from a distant person, the latter mainly uses the telephone in order to provide his help. An interview with an aeronautics trainer concerning a helicopter turbo-engine enabled us to confirm this reality. It also appears that the assistance provided by the expert is not always sufficient as he is not aware of the operator's environment and the reasons behind the latter's mistakes. Indeed, when the parties are physically in one another's presence, they share the same communication mechanisms (ostensive references, i.e. Deixis and designation) the same environmental context (common visual space that enables the situation to be grasped). In this case, reference is made to symmetrical collaboration [2].

It is not the same when the expert and the operator are physically separated by distance. Collaboration then becomes more difficult even if studies [13][24] tend to show that remote assistance provides better results than working alone.

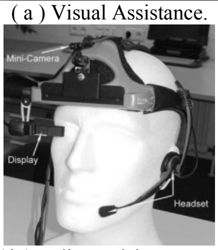
Our work is therefore based on the possibility of offering a remote collaboration system that enables the participants to interact in such a way that is as natural and efficient as if they were together at the same location and this is thanks to augmented reality.

B. State of the art

Over the last few years, the boom in augmented reality in industry has especially given rise to projects devoted to automatic task assistance. In particular, the prototype KARMA [7] can be cited as being at the origin of such a concept as early as 1993. Then it was a matter of letting oneself be guided by the system in order to carry out repair work to printers. Other, more ambitious, projects later followed such as ARVIKA [1] whose purpose was to introduce AR in the life cycle of industrial product, Starmate [23] to assist an operator during maintenance tasks on complex mechanical systems, and more recently ARMA [6] which aims to implement an AR mobile system in an industrial setting. More recently, Platonov [20] has offered a more developed system that belongs to a new generation of assembly-dismantling systems for maintenance based on the use of markerless RA. Using a Head Mounted Display (HMD) equipped with a camera, the operator is guided, step by step, through the assembly procedure thanks to the virtual information that is superimposed onto the image (Fig. 1). KUKA may also be quoted as an example of programming training of their robot by enhancing the view of people with different information systems and the simulation of trajectories of the tool [16].

The aim of introducing all these systems to the industrial environment is to reduce costs and lower time spent on maintenance as well as to improve quality [21]. However, the limits of automated systems are reached when an unforeseen situation arises, and this despite good results obtained by [10] in evaluating their automated AR prototype. These assistance systems no longer provide any help and human assistance is then indispensible, but the person having the level of qualification required to resolve the problem is not always close at hand.

(a) Visual Assistance.



(b) Indirect vision HMD.

Figure 1. Example of an AR-based maintenance system.

Today, thanks to the explosion seen in the output of communication and the World Wide Web, we are beginning to see the emergence of augmented reality systems for remote support. The aim being for the expert to be able to understand what is impeding the operator either in a given situation: wrong perception of a situation, correct perception but wrong decision, or perhaps a wrongly-performed task. In his work, Zhong [25] has created a prototype that enables an operator equipped with an indirect viewing device to share what he sees with an expert in another location. The operator can handle the virtual elements associated to the marker in order to train at accomplishing a task, all of which is supervised by an expert who guides him using voice-only instructions. In [22], Sakata suggests that the expert can interact remotely in the physical environment of the operator. This operator is equipped with a camera fitted with a laser pointing device (Fig. 2), all of which is motorized and guided by the expert using remote control. The latter can therefore view the operator's work space as he wishes and point to an object of interest using the laser. There are other systems such as [5] that enable the expert to give visual indications to the operator, who is equipped with an AR display device fitted with a camera. What the camera sees is sent to the expert who can "capture" a streamed video image, add annotations and then send this enhanced image back to the operator's display device. More recently, the European DiFac [19] project has been developed that integrates a component of augmented reality for collaborative environments. It is based on the same principle as the previous systems but this time provides the expert with the possibility of increasing the real-time video flow thanks to annotation functionalities. It therefore provides better interaction.

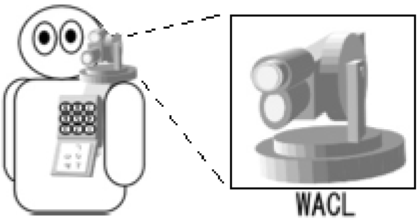


Figure 2. An example of collobarative system: the WACL. A laser Pointer is on top of a rotative camera to point out a location.

III. DESCRIPTION OF T.A.C.

All the previously mentioned projects have a point in common and that is the way that the operator will perceive, in indirect vision, the virtual information that is sent to him. For the human brain, making the link between the displayed image and the corresponding reality leads to mental overload that is a potential source of error and intellectual fatigue. A direct visual system would therefore be more appropriate.

As far as the expert is concerned, he does not see exactly what the operator sees (eye attention zone) and has difficulty in perceiving his immediate environment.

We have therefore developed the T.A.C. system (Collaborative Remote Assistance system) in order to take into account these parameters. Thanks to audio-video communication means and augmented reality, we suggest a simple way for the expert to transcribe his directions to the operator on the site via the principle of designation (that we have called Picking).

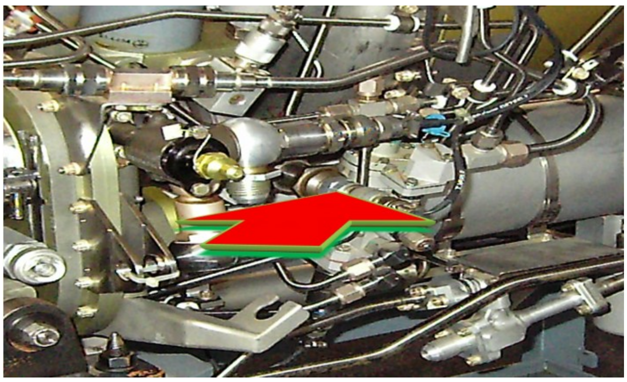


Figure 3. A simple way for the expert to point out a special location in the current scene; the "Picking". A virtual element enhanced the image.

A. *The Rationale*

Collaboration is an unpredictable and indeterminate process [17], and a distant expert must have possibilities of interaction available that are similar to those of the operator. We have, in particular, thought about the capacity of being able to rapidly point out an object by showing it (Fig.3) rather than by giving an oral description of it (possibilities of ambiguity).

The TAC system integrates these two concepts that are fundamental to any collaboration:

- The mechanism of communication linked to designation. They are ostensive references, i.e. the combination of Deixis (“that!”, “there!” etc.) associated with the designation gesture (“pointing”). A great deal of research as in [13][3] suggests the importance of designation in collaborative work.
- Shared visual space. In providing remote assistance, the expert has no spatial relationship with the objects that surround the operator. In order to be able to correctly coordinate the operator’s actions [8] and to understand the work status, he must be able to visual the operator’s environment.

B. *Principle of Use*

Figure 4 illustrates the underlying principle of the TAC system’s functioning. The operator is equipped with a particular AR display device (cf. III.C). By virtue of its design, this enables video stream to be captured that is exactly what is seen by the wearer (Flow A) and a wide angle video stream (Flow B). The expert, who receives these two flows, will be able to augment Flow A by simply clicking on it to designate the action to be accomplished. The augmentations are then sent in interactive time to the operator’s RA display. To compensate head movements of the operator, virtual enhanced element are tracked with the KLT algorithm [4].

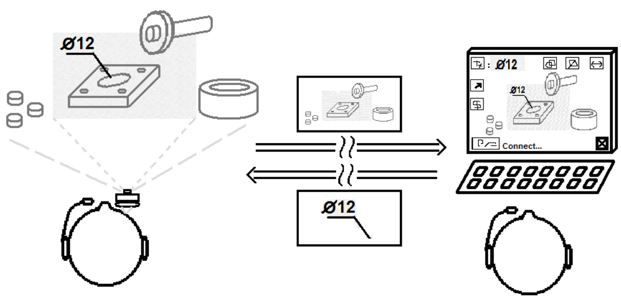


Figure 4. T.A.C operating principle : operator’s view is sent to the expert which can enhanced it by simply clicking on it in real time.

C. *Description of the system*

The operator wears an AR display device that we have designed. This is an AR type, Video-See-Through monocular glass with orthoscopic display. This particular HMD, called MOSVT (Fig. 5), meets the following criteria:

- The operator must be able to easily understand his environment, and therefore not be in immersion (Choice of monocular system).
- The operator must be able to maintain a field of vision that is as natural as possible (orthoscopic vision) in order to simulate direct vision.
- The operator must have his hands free.
- Transmit to the expert exactly what the operator sees (to increase his view thanks to virtual indications)
- Transmit to the expert the operator's global vision, as the lack of peripheral vision in remote collaboration leads to loss of efficiency in communication between the two parties. [9].

Figure 5. The MOVST Head Mounted Display for T.A.C.

The expert is equipped with a simple computer executing an application that receives video streaming from the operator (Fig. 6). The application interface superimposes the "augmentable" orthoscopic vision over the peripheral vision (principle of "Picture in Picture" or PiP).

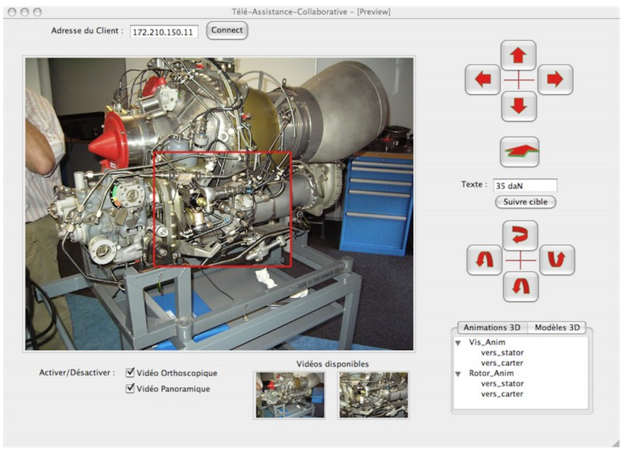


Figure 6. Interface for the expert. The orthoscopic view (inside red square) is inserted on the peripheral view.

IV. Description of User Tests

A. Purpose

We wanted to compare different means of communication within the context of remote assistance provided to an operator. To do so, we tested the operator who performs what are essentially simple tasks: maintenance operations on a printer and a computer.

The telephone is the most widely used means when carrying out maintenance tasks and we wanted to test the pertinence of audio communication alone in front of a system like T.A.C. (with direct or indirect vision). We were mainly interested in this study in order to respond to the following question:

"Do different methods of communication enable a task to be performed with the same rapidity?"

This aspect, although reductive, is an important viewpoint for an industrial application. Indeed, at worst the introduction of a new technological tool should not make waste time compared to conventional methods. If so, the tool must justify an additional contribution (e.g. improve quality control of the task…).

At the end of the test, we also questioned the users about their impressions (user friendliness, conversation with the expert…).

B. Descriptions of tasks and means of Tele-assistance

We used two types of industrial products that require maintenance. For each of these products, we determined three maintenance operations. All the operations, between them, are of equal difficulty in terms of manipulation (dexterity required) with relatively similar execution times, independent of the industrial product to be maintained.

The first industrial product to be maintained was a PC type computer and the three maintenance operations were as follows:

- Change an extension card for another with specific connection.
- Change a faulty memory module (RAM).
- Connect an internal DVD player (ribbon cable, sound jack and power plug)

The second industrial product was a black and white laser printer and the three maintenance operations were as follows:

- Take out the toner, ink recuperator and heat resistor.
- Change the toner, ink recuperator and heat resistor (the procedure is not exactly the same as the first one).
- Physically change the printer paper adjustment (take out the paper tray, position three cursors in three different places, put the paper tray back and position another cursor in the printer).

For each of these six tasks, strict linear procedures were established (with the help of the maintenance manuals for each of the systems).

As far as the means of Tele-assistance used for the tests are concerned, we wanted to compare the pertinence of the T.A.C. system with the most widely used means, i.e. the telephone. We tested three configurations:

- TEL: a hands-free headset in order for a conversation to be held in the classic way between the operator and the expert.
- VISIO: augmented reality with indirect vision, i.e. without the MOVST glasses. The operator was equipped with a wide angle tie camera and display device (20” screen) placed on the work surface. The expert still has the possibility of designating elements on the orthoscopic video stream.
- T.A.C.: the use of the T.A.C. system with direct vision such as has been described in paragraph III.C. It should not be forgotten that both parties can communicate by speaking to one another.

C. *Subject and procedures*

Eleven subjects participated in the study. All were male with an average age of 22 and they were all unrelated. They were not familiar with collaborative applications and had no experience of Tele-assistance. They had never carried out any manipulation tasks on the industrial products used during the experiment. We made all those choices to limit the influence of personal experience on the results.

Each participant tested the three means of communication (TEL, VISIO and T.A.C.) in a totally random order. For each of the three methods, a task to be accomplished was composed of two maintenance operations (Computer + printer) that were randomly drawn from the six suggested tasks. The different random draws were to neutralize (limit) variable parasites such as, for example, the phenomenon of apprenticeship (task familiarization).

The tests took place in a room containing a work table (180x80 cm) with all the necessary tools and equipment (computers, printers, screwdrivers, etc.). The participants were not familiarized with the new methods of communication prior to the experiment. By virtue of their very nature (talking on the telephone, putting on glasses, etc.), no method learning was required.

For a given means of communication, the two maintenance operations were carried out sequentially. We logged the time taken to carry out each of the maintenance operations and the total time. No time limits were imposed. The only instruction given to the participants was that they should let themselves be fully guided by the distant expert.

All the manipulations were recorded so that they could be subsequently viewed. In order not to introduce any influence due to the presence of a fixed camera, we used the “Trojan horse” technique recommended by [12]. This consisted in presenting the use of the camera as being part of the system. The real use of the camera was revealed at the end of the experiment. (We then obtained the participant’s agreement to our using the recordings). To finish, we asked them to fill out a questionnaire judging the different criteria with an eye to drawing up a rating table.

As far as the expert is concerned, the subject is a 26-year-old man who is an expert in computer maintenance and who has considerable experience working on a help hotline. He had been previously trained to use the T.A.C. software interface and had not had any contact whatsoever with the operators and did not know them. The expert’s room was equipped with a hands-free telephone headset and a computer containing the T.A.C. application with direct connection (local network, SIP/SDP/RTP protocols) to the operators’ room.

V. RESULTS

We shall present the results in two parts. First, we shall examine the time taken to carry out the tasks in relation to the systems used, and then we shall examine the results obtained from the assessment questionnaire.

A. *Completion time of the task*

We wanted to study the influence of 3 factors (TEL, VISIO, T.A.C) on the quantitative dependent variable that is time completion for a maintenance task. To do so, we submitted subjects at each level of the independent variable (i.e. the mode of communication) in accordance with the test plan described in IV. We are therefore in a repeated measures test plan.

Our statistical hypothesis H0 (null hypothesis) is: “completion time of the maintenance task is equal for all modes of communication ($t_{TEL} = t_{VISIO} = t_{TAC}$)”.

The bilateral hypothesis H1 corresponding to our research objective is:

”Is it true to say that the completion time of the task varies depending on the method used?”

TABLE I. WITHIN-SUBJECTS EFFECTS ON COMPLETION TIME

		Avg. time (s)	**STDEV**	**F**	**p**
Mode	TEL	441	83	0.699	0.509
	VISIO	444	123		
	T.A.C	404	91		

To infer the relationship between modes of communication and completion time, we used repeated measures analysis of variance (ANOVA) with a risk level α=0.05.

The Table 1 summarize descriptive statistics of the user testing. Data analysis indicates that the average time for TEL is 441s (σ = 83), for VISIO is of 444s (σ = 123) and for TAC is of 404s (σ = 91). The repeated measures ANOVA showed that the difference between the three systems is not significant ($F(2,20) = 0.699$, $p = 0.509$, $\eta_p^2 = 0.065$), the hypothesis H0 should be preserved. Statistically, we can therefore conclude that the type of collaborative mode does not affect the completion time of the maintenance task.

B. *Questionnaire data*

At the end of the tests, each operator was handed a 6-point questionnaire concerning their feelings about the experiment. For each question, we asked them to assess the three methods of collaboration on an ordinal scale of 0 (low) to 14 (strong).

We used Kendall's W, i.e. Kendall's coefficient of concordance [14] while following recommendations made by Legendre [18]. This coefficient enabled us to determine the degree of agreement between the different subjects on the rating given to the systems. Table 3 and 4 summarizes the data analyzed.

TABLE II. AVERAGE RATING FOR EACH MODE

	TEL		VISIO		T.A.C	
	Average	*STDEV*	*Average*	*STDEV*	*Average*	*STDEV*
Q1	8.4	1.33	9.5	2.55	11.3	1.41
Q2	7.7	2.77	7.4	2.06	9.6	2.29
Q3	6.7	2.27	10.3	1.5	11.3	1.58
Q4	10	3.57	7.4	3.53	10.7	2.22
Q5	4.3	1.8	10	2.64	11.2	1.98
Q6	9.8	2.02	9.2	2.22	11.5	1.5

Question 1 (Q1) concerned the facility of expression and being understood by the expert. For the question "Was the conversation with the expert easy or difficult (effort of conversation)?" (0= very difficult to 14= Very easy), we obtained the rating TEL<VISIO<TAC. However, the degree of agreement between the subjects was 49.8%. Concerning the average ranks, it was observed that disagreement was especially between TEL and VISIO. The averages, however, enabled it to be seen that communication did not present any major difficulty.

TABLE III. ASSESSING AGREEMENT AMONG RATERS

	Average Rank[a]			Kendall's W	
	TEL	*VISIO*	*T.A.C*	*W* [b]	*p*
Q1	1.33	1.94	2.72	0.498	0.011
Q2	1.67	1.72	2.61	0.374	0.034
Q3	1	2.33	2.67	0.824	0.001
Q4	2.28	1.39	2.33	0.297	0.069
Q5	1	2.33	2.67	0.875	0.000
Q6	1.83	1.67	2.5	0.259	0.097

a. From 1 to 3 (Higher is better)

b. Accordance (Higher is better)

The subjects were not given any information concerning the time taken and we were interested in knowing how they perceived their performance. Question 2 (Q2) asked "How quickly do you think you accomplished the task?" (0=Very slow to 14=Very quickly), we obtained the rating TEL<VSIO<TAC. Here again, the degree of agreement was only 37.4%. The average ranks showed us that disagreement again concerned TEL and VISIO. Examination of the averages however indicated that the subjects did not really have the impression of accomplishing the maintenance task more quickly even though they admitted gaining time with the TAC.

Question 3 (Q3) asked, "Is it easy to make the link between the expert's indications and the real world?" (0=Very difficult to 14=Very Easy), here again we obtained the rating TEL<VISIO<TAC this time with a degree of agreement of 82.4%. The averages clearly indicated the inferiority of TEL compared to VISIO and TAC. This result allowed us to reach a conclusion as to the efficiency of the expert's designation for the operator's direct or indirect vision. The difference between VISIO and TAC came mainly from the extra mental load that an indirect visualization method like VISIO can induce.

Question 4 (Q4) treated the degree of user comfort for the systems. The question asked was, "How comfortable did you feel using the system?" (0=Very uncomfortable to 14=Very comfortable), this time we obtained the rating VISIO<TEL<TAC. However the degree of agreement was only 29.7%. When examining the ranks and averages more closely, we saw that disagreement especially concerned TAC and TEL, which nevertheless seemed to be quite comfortable to use. This should certainly be put down to the extra mental load previously mentioned and the fact that the expert often asked the operator to change his position in order to better perceive the scene (via the tie camera).

Question 5 (Q5) concerned error management. When we asked "Is it easy or difficult to correct your mistakes while carrying out the task?" (0=Very difficult to 14=Very easy), we obtained the rating TEL<VISIO<TAC with an 87.5% degree of agreement. When looking deeper into the ranks and averages, VISIO and TAC were of greater superiority. With these two systems, the expert immediately realizes what mistakes have been made and immediately informs the operator who can correct them as easily. This result perfectly illustrates the usefulness of image-based methods of communication.

Finally, question 6 (Q6) asked: "How would you rate your stress level for each method of communication?" (0=Very stressed to 14=Very relaxed) and gave the rating VISIO<TEL<T.A.C with a degree of agreement of 25.9%. Here again we noted that according to the statistical data, disagreement concerned TEL and VISIO which were both equally judged as not giving rise to high levels of stress.

VI. DISCUSSION

Early results suggest that there is no significant difference in terms of completion time for task maintenance. However, after analyzing the video, it is interesting to note that subjects take advantage of their time to complete the task with VISIO and TAC. This finding is consistent with the results of Question 2 where the subjects did not appear to be faster with one or the other modes. Knowing that the expert sees what they see, they use their finger to point out an object in order to get a validation. At the end, Operators have less hesitation to perform an action.

By cons, regarding from TEL, we see a lot of misunderstandings that lead to the hesitation. Some individuals persist even in their mistakes while others do

not know what to do. The most efficient subjects are those that establish a protocol of communication with the expert. (Voice confirmation of the order to execute, current task description and end task acknowledgement).
Once we switch onto VISIO and T.A.C, the types of errors committed with TEL disappear or are quickly corrected. These observations are consistent with the results of questions 3 and 4. Subjects easily understand where they must act and are quickly arrested by the expert in case of errors.

Although we see that the attitude of subjects is positively affected by VISIO and by T.A.C, a difference between them persists in all ranking made by the subjects. Indeed in most cases, we've had remarks that it is easier to be guided by T.A.C than by VISIO. This is liaising closely with the different type of display modes (see the result of question 3). T.A.C, thanks to MOVST HMD, allows a direct vision unlike VISIO that is using indirect vision.

In the latter case, it must then make the effort to watch on-screen instructions and then make the connection with reality, what has sometimes been a source of errors. Some subjects have even taken away their camera tie in order to present a better vision at the expert. However in one case as in the other, subjects do not seem to be stressed by the task (question 6). However, the subjects' remarks show that they are more relaxed when they know that the expert can directly correct their mistakes.

By cons, we had lot of comments about T.A.C on the ergonomics of MOVST HMD. Despite weighing less than 100 grams, this seems to be too heavy. This physical load may cause problems on tasks of long duration. It is important to note that subjects, however, have appreciated to not be in immersion with MOSVT HMD, having in consequence a better perception of their environment.

For the expert, the fact of using VISIO and TAC is considered appreciable, especially to being able to view what the operator are doing, and the opportunity to quickly show where action is required.
In terms of perception, the expert considered more relevant T.A.C for two reasons:

- The first comes from being able to see exactly what the operator's eye sees. It also seems to be the biggest default, because of the head movements of the operator that greatly affect the image stability. When the operator moves too quickly, it becomes difficult to give instructions by clicking on the video stream.

- The second reason is the presence of the video stream representing the more global view of the immediate environment of the operator. The expert is then made more easily a mental representation of the workspace of the operator. Interestingly, this panoramic vision has been widely used to locate the subject when fast movement, a problem mentioned above.

Finally, the expert and the subjects have raised a problem on the interpretation of virtual arrows. Indeed, we only have implemented the same color for all arrows in T.A.C. When the expert tried to use the designation as a means to present an action, this has often been misunderstood. We believe that a color code for the arrows could be more relevant in terms of association of concept.

VII. CONCLUSION

In this paper, we wanted to explore the relevance of TAC as an interface for remote collaboration on a maintenance task.

We offer a simple way for an operator to be visually guided by an expert. The problem was twofold. On the one hand, we must transcribe the immediate environment of the operator to the expert in order that he may make a mental representation of the operator's environment and therefore guide the latter using virtual clues. On the other hand, we must not obscure the operator's awareness of his reality and directly enhance his view with virtual clues from the expert. In this, the MOVST HMD helps TAC to compensate one of social asymmetries implied by the distance between two people. The use of ostensive reference is now possible in both directions.

However, through user testing we found that the gain in time performing a task is not significant (Apart from saving time to prevent a site visit by the expert!). However, it is clear that even if the task is not performed more quickly, the result is guaranteed by the expert, which validates the quality of the maintenance operation.

In future work, we will study the effect of color association for the virtual clues and how the frame rate affects the expert guidance. In this paper, we have described of a qualitative way the expert's experience. The feedback on the introduction of an orthoscopic and peripheral vision seems positive. We will study of a quantitative way benefits from this vision for the expert.

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