A Step toward Telecommunication with a Machine Interpreter

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Abstract

An Eng1ish-Japanese bidirectional machine interpreter is presented. This system was tested via satellite link with users in Japan and Switzerland. The design philosophy is described and a communication model with a machine interpreter is reported.

1. Introduction

Means of telecommunication have been continuously and successfully developed and telecommunication is now a useful and stable technology. People do not feel distance even in overseas conversation through a telephone connection. Distance can be said to be overcome. We have, however, another barrier for making completely free communication with people in other countries, that is, a language barrier. An automatic telephone translation system is a solution to this problem. There are several difficulties in realizing this instrument, namely, speech recognition (speaker-independent, continuous speech recognition), and machine translation(real-time, non-sentential, simultaneous translation). We will and have to leave those problems until the 21st century.

On the other hand, we now have an operational machine translation system called AS-TRANSAC, which is nearly real-time and small-sized. This gives us an idea of a conversation system through a keyboard with bi-directional machine translation.

We built such a system and made an experiment between Kawasaki, Japan (the author's office) and Geneva, Switzerland (the demonstration site of Telecom'87 Exhibition). Participants of conversation were eight members from the author's office and about eighty people who visited Telecom'87 Exhibition from various countries such as Switzerland, Great Britain, France, Germany, United States, Saudi Arabia, Turkey and so on. This is the first telecommunication with a MACHINE INTERPRETER (machine interpreter, as opposed to a machine translation, is a real-time fully automated translation system: see [Iida 88]) in the world, to the author's knowledge. We have encountered various language phenomena through this experiment. The analysis of those phenomena was reported to ACL 88 at Buffalo and a paper for a high-speed parser used in this system was submitted to COLING 88 at Budapest. So in this paper, we mainly describe the philosophy of the system.

2. System configuration

A general idea of the system is illustrated in Figure 1. Workstation were situated in Japan and Switzerland, and linked by a conventional satellite telephone connection. The workstations at either end were AS3260C machines. Running UNIX*, they support the Toshiba machine translation system AS-TRANSAC. The workstation screens are divided into three windows, as shown in Figure 2. The top window shows the user's dialogue, the

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*: UNIX is a trademark of AT&T Bell Laboratories.

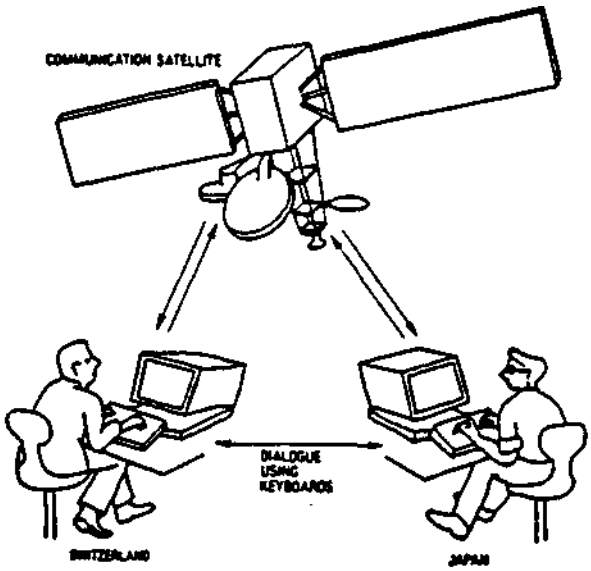
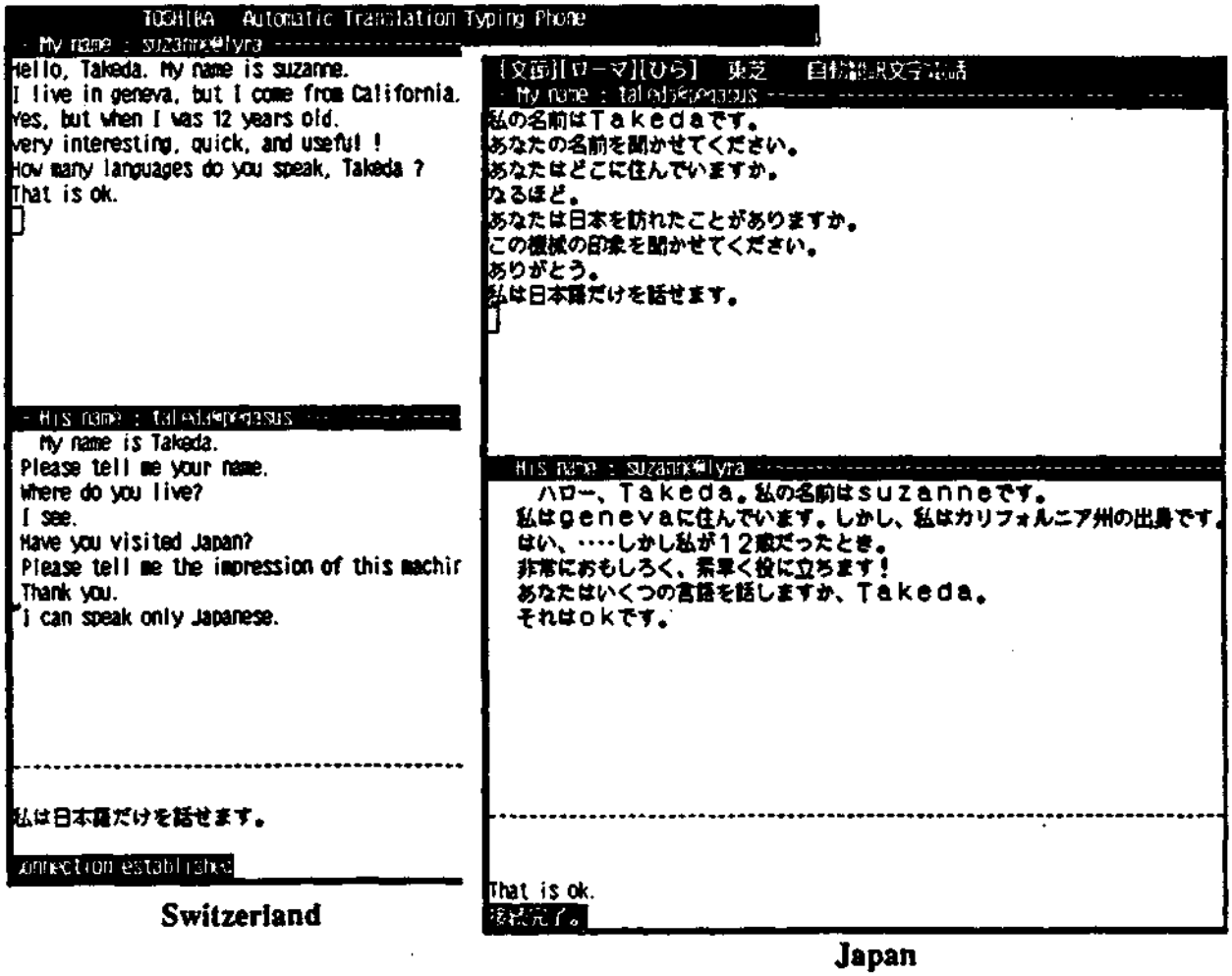


Figure 1. General Set-up



Switzerland **Japan**

Figure 2. Screen Display

middle window the correspondent's replies. Both sides of the dialogue are displayed in the language appropriate to the location of the terminal. A third small window serves the purpose of indicating to the conversers that their conversation partners were transmitting. Figure 3 shows the set-up in more detail. At the Japanese end, the converser inputs Japanese in Kanji at the keyboard by Kana-to-Kanji conversion method, which is displayed in the upper window of the workstation screen. The input is passed to the translation system and the English output, along with the original input is then transmitted via telecommunication links (KDD's Venus-P and the Swiss PTT's Telepac in this case) to Switzerland.

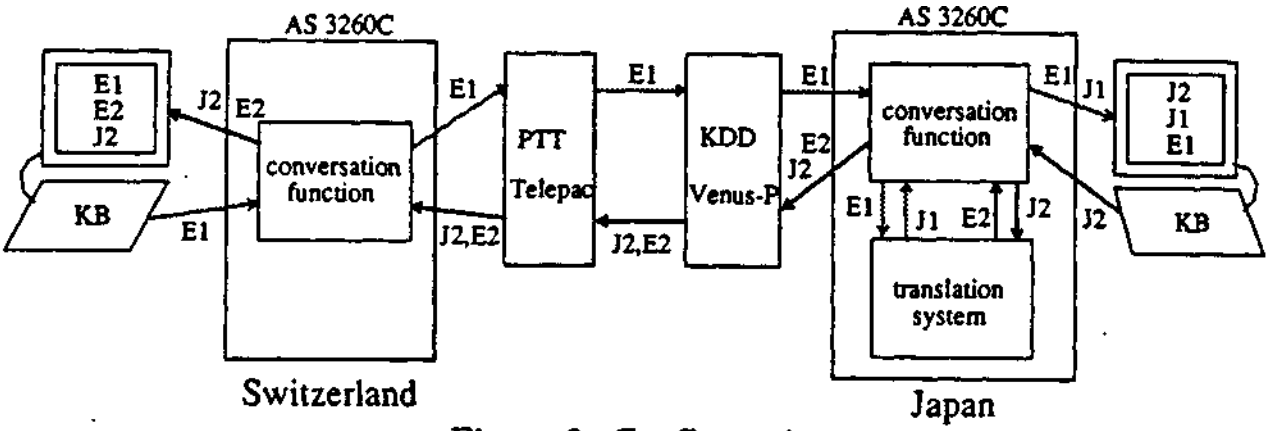


Figure 3. Configuration

3. Presuppositions for the machine interpreter

We make three presuppositions for designing the machine interpreter. These presuppositions have to prove true for the machine interpreter to function well.

3.1 Cooperation of conversers

The first presupposition is a cooperation of conversers. This cooperation consists of two kinds.

(1) Cooperation with the machine interpreter

The machine interpreter expects some rules to be kept when sentences are input: for example, proper nouns should begin with capital letters. Sentences should end with a proper punctuation signs such as period.

If these rules are violated, then the system does not work properly.

For example, "Japan" means a country. But "japan" has a different meaning, lacker ware. If a period key is not pressed at the end of sentences, the system waits for following input. These are, however, rather small problems. If conversers are trained for about five minutes, then they can input properly. So the presupposition can be expected plausible.

(2) Cooperation between conversers

This is the most different feature of the machine interpreter from machine translation systems. The machine interpreter is regarded as transparent to the conversers. The conversers may not be aware that their partner uses other language rather than their own. If the utterance is transmitted in a way the receiver can not understand, for instance, non-translated, semantically illegal, syntactically illegal, then the receiver will have to ask the sender what he/she means. The partner will have to be cooperative if he/she wants to make smooth conversation. In our system, the machine interpreter is transparent, that is, it never issues any messages to the receiver that were not input by the sender. Some one thought as follows: if the machine interpreter fails in translating the utterance, then it will return the message "I do not understand" to the sender. This is not the case. If it were the case, the sender would be troubled with double conversations both with the machine interpreter and the partner. Our system is transparent in the sense that the machine interpreter sends the utterance to the receiver even if the translation is word-for-word as a last resort. Even in that case, the receiver may be able to understand the utterance, and if not, he/she can request the paraphrase to the partner with the message "I do not understand."

3.2 Asking back/ Paraphrase

The second presupposition is deeply related with the first one. When the converser does not understand utterances of the partner because of jump of topics, difference of culture, mistranslation, and so on, he/she can ask back using such phrases as "I do not understand,""Paraphrase , please," and so on. This is the point by which the machine interpreter is typically discriminated from machine translation.
The partner may be expected to paraphrase or explain his/her last utterance:

For example.

E: I could have riz in dinner.
TJ: What is "riz."
E: Riz is rice.

Here, E means English, TJ means translation of Japanese.

This presupposition may be violated when the conversation is meta-conversation.

TJ: Can you understand Japanese?
E: iee. ("iie" means "no" in Japanese and this German converser tried to use Japanese and mistook "iee" for "iie.")
TJ: What is "iee."
E: I thought it is no in Japanese.
= TE: watashiwa sorega aruto omoimashita/nai/nihongode.
(This is a partial translation of the sentence in question with the following division: I thought it is/no/in Japanese)

J and TE are displayed in Kanji in Japanese site, but here we show them in the roman alphabet for the readers' convenience.

Japanese converser could not understand this translation of English(TE) . - Strictly speaking, the sentence "I thought it is no in Japanese" is grammatically illegal. Thus the machine tried partial translation with three division shown by slants above. The converser should have quoted the "no" for the machine.

3.3 Converser's Use of Context

This is the last presupposition and expected to be valid. It is very difficult for an operational machine translation system to use context. In a case of the human interpreter, because it is a human, not a machine that understands context, conversation will be smoothly done unless topics are suddenly and greatly changed.

4. The treatment of mistranslation by these presuppositions

The most interesting point in a machine translation system is translation accuracy. From another point of view, it is a problem of mistranslation. There are several reasons for mistranslation and the following four appeared most frequently during this experiment.

(1) syntactic ambiguity
(2) lexical ambiguity
(3) unknown word
(4) partial translation (in an extreme case of this, word-for-word translation)

In a case of machine translation, these cases are covered by

post-editing . On the other hand, in a case of the machine interpreter since conversers are expected not to understand their partner's language, post-editing is not available. However since presupposition 3.3 effectively functioned, mistranslations were not critical problems.

There were some mistranslations based on the above reason (1), but most of them are easily understood using presuppositions of use of context or the principle of cooperation.

For example:

TJ: Do you understand Shinkansen?
E: I think is a fast train, ("it" is omitted.)
TE: watashiwa omoimasu/hayai retsha dearu.
(= I think/ it is a fast train)

In the worst case, the partner can not understand the utterance at all. Then he/she is expected to demand his/her partner to paraphrase the utterance.

The cases (2) and (3) are often critical when sentences are short.

In case of (2), since the sentence becomes semantically illegal, the converser has to ask back.

In case of (3), the unknown word is displayed without translating, and so the converser must ask it back to his/her partner about its meaning.

See again the example of "riz". Here "riz" is a French word. So it was not translated and displayed as it was on a screen in Japanese site like "watashiwa yuushokuni rizwo taberu kotoga dekita." But the Japanese converser could not understand the word "riz." So he asked. The partner in Switzerland explained in English this time.

In case of (4), if the sentence is long enough, we can guess the meaning unless it includes problems (2) or (3). Sentences are redundant when they are enough long and partial translation has enough information to understand them using context.

5. Model of the machine interpreter

Now we can build a model of the telecommunication with the machine interpreter. It consists of the following five parts : two utterance sources and context understanders as conversers, a machine interpreter, a noise source, and means of cancelling noise,(figure 4). The means of cancelling noise listed in the

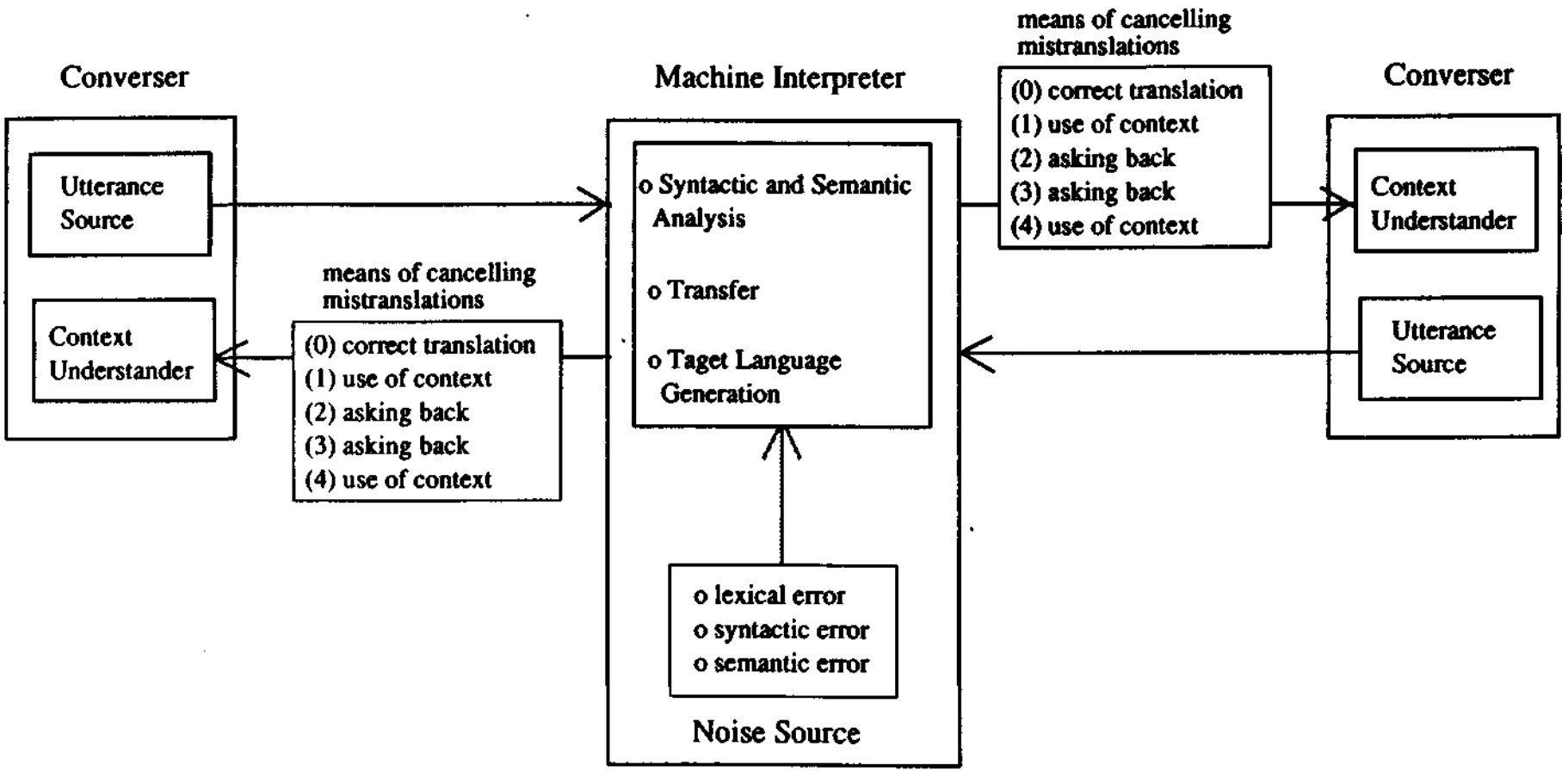


Figure 4. Model of Communication with the Machine Interpreter

figure correspond to Che noise sources described in section 4.

In this model, the point is that conversers play not only the role of an utterance source but also the role of context understanders. Context analysis consists of a lot of factors. One of them, for instance, is referent-identification. But context analysis is not only this kind of simple and well defined function. It includes a broad range of and ill-defined functions. Even conversers sometimes lost it, because of jump of topics. In this model, context analysis is left to conversers.

The machine interpreter mainly consists of a syntactic and semantic analyzer, a transfer unit, and a target sentence generator. It translates source languages into target languages. It is principally transparent, but is practically smoked by various noise such as lexical, syntactic, and semantic errors. Most of them can be cancelled by the conversers using the means mentioned in section 4.

6. Conclusion

We made the presuppositions mentioned above and built a communication system with a machine interpreter. Through eight day's experiments, we ascertained that the presuppositions are valid except for the case of meta-dialogue.

In the future, we need to build grammars for phrasal and fragmental expressions, because these expressions often occur in spoken language.

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