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THE VOICE INTERFACE IMPLEMENTATION IN THE PROTOTYPE OF A MOBILE COMPUTER-AIDED AIRCRAFT TECHNICAL SUPPORT SYSTEM

ABSTRACT

The article concerns the use of computer support systems for technical support in the difficult conditions. The term difficult conditions should be understood as such conditions, in which an operation is carried out in a specific location, impeding or preventing the use of the computer. In such cases, computers integrated with operators' working clothes (wearable computers) should be used, with which the communication takes place using voice. This article shows the attempt to resolve the problem of voice communications in a portable system to handle aircraft M-28.

Key words:
aircraft maintenance, computer support system, expert systems, CLIPS, mobile systems, VUI interfaces.

INTRODUCTION

The use of computer-aided support has been used since the 80's of the last century. In these years the XCON system was created, which was the first system for computer-aided setup process of computers VAX at DEC company [1]. Since then, there has been a huge technological leap, which currently manifests, inter alia, in the progressive miniaturization of computer hardware, increasing its mobility. This opens up new possibilities when it comes to the use of the computer in assisting

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maintenance of technical objects, in which the use of the computer was until now impossible due to the lack of space.

An example of the use of new technologies in this field can be presented in the article [2] the prototype of a supporting system for an aircraft handling. This device, like the others belonging to the class of computer-aided support systems, is a typical expert system and consists of the two main hardware-software modules (fig. 1):

- CLIPS Server;
- AR Interface.

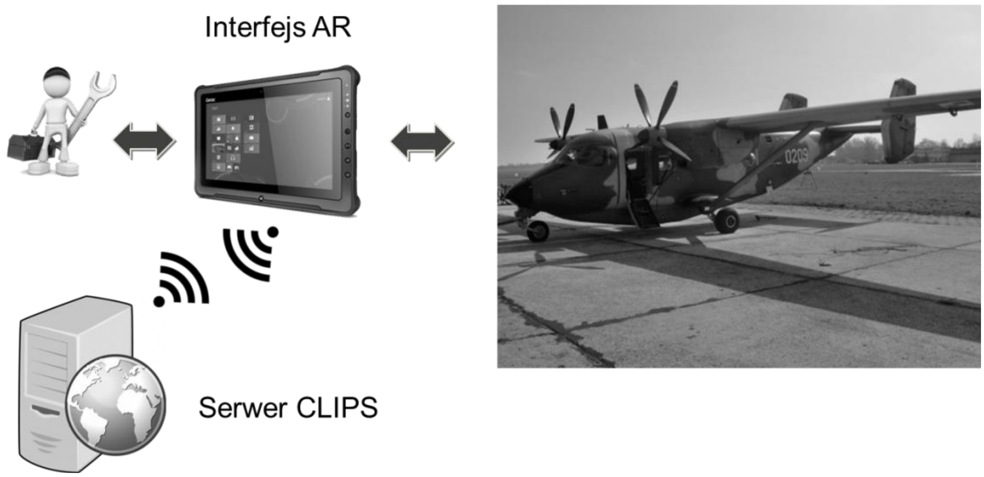

Fig. 1. How to use a mobile aircraft support system [own work]

The CLIPS server is a desktop computer on which the essential elements of the expert system with the exception of the interface are implemented. To implement this module the non-commercial version of the expert systems shell CLIPS (CLIPS — *C Language Integrated Production System*) was used-building tools developed in the NASA Space Center and used in the implementation of expert systems associated with diagnosis [3].

The AR Interface is part of a mobile system and is installed on a laptop-tablet. In terms of function it is a graphical user interface (GUI) extended with the possibility of implementation of functions related to augmented reality (AR). Therefore, its implementation uses the cross-platform game development system Unity 3D, containing the game engine and integrated runtime [5] along with a set of SDK libraries Vuforia [4] for this engine. The interface communicates with the CLIPS server using a wireless network.

The primary disadvantage of the above solution is the accepted way of operator-machine communication. The need for continuous device holding is very problematic in the case of attempts to performing a service activity, during which the two hands must be engaged, for example while perform a control or using the tools, and there is not enough room to put away the device.

In this case, as stated above, it is necessary to use hardware based on the concept of the so-called wearable computers, with which the communication takes place using the so-called the natural user interface (NUI). One of the methods of applying the concept of NUI interface is the man-machine voice communication.

This paper shows the construction of the aircraft handling system using a voice interface VUI (*Voice User Interface*). It also shows how to use it on the example of handling a diagnostic simulator of an M-28 aircraft.

THE VOICE INTERFACE IMPLEMENTATION

The introduction of voice communication to the AR interfaces is associated primarily with the development of the interface with functions of generation and speech recognition.

Generation of speech is real time processing text data on the voice. The speech generation uses ready speech generators:

- speech synthesizer Samsung;
- text to speech converter Google;
- IVONA text-to-speech HQ.

Speech generators to their actions require appropriate dictionaries TTS (*Text-to-Speech*) containing sets of words in a particular language. Due to the use of Unity 3D packet in this solution to communicate with speech generators, the software plug-in EasyTTS was used.

In the case of speech recognition, as in the case of its generation, software engines STT (*Speech-to-Text*) available on most platforms are used, but their diversity is no longer as big as in the case of modules intended for speech synthesis. STT modules are usually created by the manufacturers of the most widespread computer systems e.g. Android and Windows. In this project were used the factory-installed voice recognition mechanisms of two software companies:

- Samsung powered by Vlingo;
- Google’s speech-to-text conversion mechanism.

To communicate with them uses software plug of Unity 3D-SpeechRecognition. Figure 2 shows the structure of a software interface.

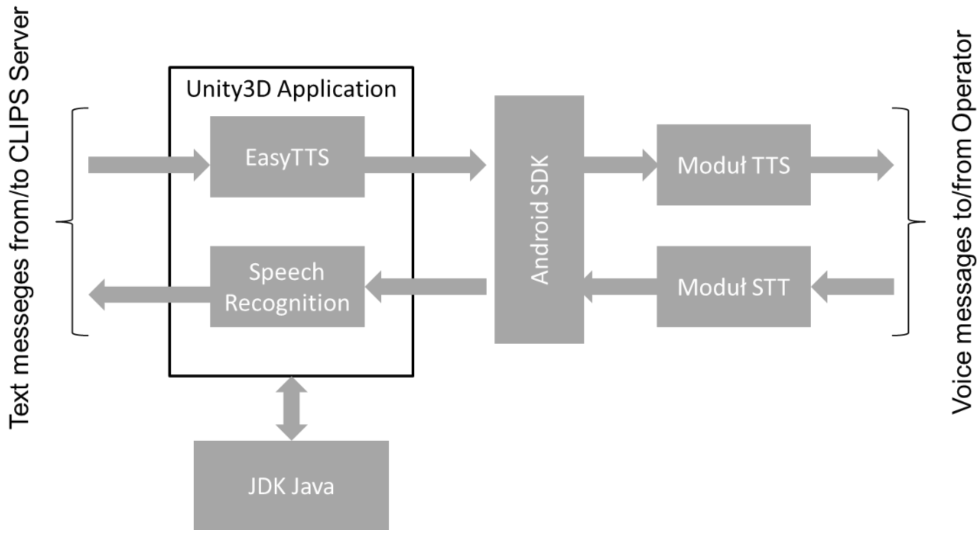

Fig. 2. The software structure of the VUI voice interface [own work]

The Interface communicates with the CLIPS Server using text messages. These messages are processed with the use of software EasyTTS plug-ins which using software libraries of the Android SDK, enables easy control over the TTS module. Because it contains the scripts written in Java, to correct its action, the presence of the Java JDK libraries is necessary. The TTS module generates voice messages for the operator on the basis of the received data and set options.

Voice messages of the operator are received through the STT module. The data from the STT module are processed by software plug-ins features, Speech Recognition, using Android SDK programming libraries and are send in the form of text messages to the CLIPS server.

DESCRIPTION OF THE VOICE INTERFACE

In figure 3 the view of the interface during voice communication operator--machine is shown. To lead to this condition firstly the Start button must be pressed, which takes the device in standby mode on the initialization process. From that moment the system is full ready and is awaiting for a beep, which volume exceeds the declared amplitude value.

The man-machine dialogue starts the CLIPS server by generating a text message containing either a question or command to carry out a control service. For example, in figure 3 it is a question about the implementation of control activities (the inscription at the top of the monitor tablet). This message is processed into the speech signal. The operator performs the specified action and answers to the machine's questions, using one of the three commands that are visible in the lower right corner of the screen (fig. 3): 'Yes', 'No', 'Finish'.

Fig. 3. An exemplary view of the interface during a voice communication [own work]

The registered speech signal in the case of detection of the expected command is processed to a text message form, and passed to the CLIPS server, and speech recognition service automatically goes into a wait state on the initialization of a listening process.

The CLIPS Server receives text message and adds it to its working memory as a new fact. Then, based on the modified collection of facts and the knowledge base, the server generates a response for the operator in the form of a text message.

CONCLUSIONS

In the article were presented the concepts of using a two-way voice communication in the prototype of portable computer system support aircraft — the equipment intended to perform simple maintenance and repair activities and assistance of military equipment operators training.

The solution focused only on the aspect of voice communication. The next step for the interface development will be using of so called 'wearable computers' such as e.g. a vision monocular M100 of the VUZIX [6] company. This device was tested, but due to the too small size of available RAM, there were serious problems during the application runtime. Dividing the application on the vision monocular and a Smartphone it cooperates with probably would eliminate the problem of RAM shortage needed for its proper operation.

In conclusion, the tests carried out in the laboratory confirmed the correct direction of works and the obtained results bring forth high interest in using up-to-date methods of training support and maintenance processes among technical personnel.

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IMPLEMENTACJA INTERFEJSU GŁOSOWEGO W PROTOTYPIE PRZENOŚNEGO KOMPUTEROWEGO SYSTEMU WSPOMAGANIA OBSŁUGI STATKU POWIETRZNEGO

STRESZCZENIE

Artykuł dotyczy problematyki wykorzystania komputerowych systemów wspomagania obsługi obiektów technicznych w warunkach trudnych. Pod pojęciem warunków trudnych należy rozumieć takie warunki, w których obsługa odbywa się w specyficznej lokalizacji, utrudniającej lub wręcz uniemożliwiającej wykorzystanie komputera. W takich przypadkach należy stosować komputery zintegrowane z odzieżą roboczą operatora, tzw. komputery do noszenia (*wearables computers*), z którymi komunikacja odbywa się za pomocą głosu. W artykule przedstawiono próbę rozwiązania problemu komunikacji głosowej w przenośnym systemie wspomagania obsługi samolotu M-28.

<u>Słowa kluczowe:</u>

obsługa statku powietrznego, komputerowe systemy wspomagania, systemy ekspertowe, CLIPS, systemy mobilne, interfejsy VUI.