Lingunia World of Learning

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Abstract

In this paper we present a soft toy named Lingufino for pre-school children that uses speech input and output for communication. It takes the child onto a journey to an adventure world: Lingunia. Based on a story that is shown in a picture book the toy explains different topics like animals, colours, numbers, seasons etc. and involves the child into the fictional situation with the help of question-and-answer games. By asking for words and facts which previously have been mentioned, the child becomes part of the adventure and – on the fly – improves it's active vocabulary.

Index Terms: human machine interface, children

1. Embedded Speech Dialogue System

Lingufino (project is based on previous studies [1, 2, 3] and funded by [4, 5]) implements a speech dialogue system (SDS) running on an embedded microcontroller platform mounted hidden insight of the soft toy. The human machine interface (HMI) communicates via speech only, no additional modes such as keys, touch functions or displays are applied. The system consists of three parts (Fig. 1):

- TTS – speech production, output is performed by the limited word/phrase based text-to-speech system using prompts that are prerecorded from a professional.
- ASR – speech input, an automatic speech recognition (ASR) system named *Picard ASR* is able to recognise words, phrases and sentences (64 in parallel). Its very low memory consumption (RAM: 15 KB, FLASH: 90 KB, CPU: 40 MHz) enables Picard ASR to run on very low price microcontrollers, which is necessary for the toy market but also for other consumer markets. It is a phoneme based Hidden Markov Model (HMM) recogniser using 64 shared GMMs, configurable tristate mono- or triphones. Feature extraction runs with 13 primary MFCCs and additional Δ and $\Delta\Delta$ features.
- DMS – the dialogue management system, runs dialogues that are given by dialogue description files. These include fixed dialogues but also dynamic structures driven by random processes to make the toy dialogue more alive.

2. Didactical Approach

The Lingunia World of Learning [6] is a fun interactive game for children aged four or older. It includes the soft toy Lingufino, which features modern speech technology and lovingly illustrated adventure books. Each book comes with a discovery module (a removable memory) which covers the speech dialogue configuration files (ASR model files, TTS model files, DMS description files) for the current adventure dialogue. Lingufino speaks to players, recognises what has been said and guides them through fantastic adventures. Over 1,500 voice responses encourage the player to interact through speech. The integrated language games are based on scientific findings on language development in early childhood. Intelligent dialogue and a variety of games make the Lingunia World of Learning a unique interactive voice gameplay experience.
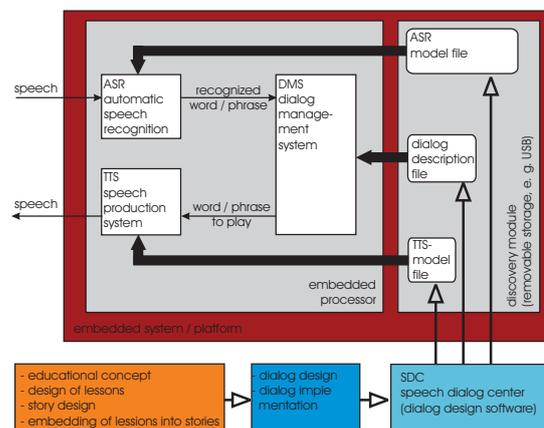

Figure 1: *Speech dialogue system and associated design process.*

3. Design Workflow

The speech dialogue design process includes three competencies (Fig. 1): (i) educational sciences, (ii) media sciences, (iii) speech technology sciences. First the educational is developed followed by adventure stories where the lessons are implemented. These stories are to be implemented as a dialogue structure using a dedicated dialogue design software tool SDC (Speech Dialogue Center). Later speech recognition and speech production are to be designed for the given dialogue. SDC automatically generates all necessary configuration files which are stored on the adventure module for the regarding adventure.

4. References

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[6] www.lingunia.de, access March 2015.