Proceedings of the 17th World Congress
The International Federation of Automatic Control
Seoul, Korea, July 6-11, 2008

Development of an Android for Emotional Expression and Human Interaction

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Abstract: This paper presents the second version of an Android, EveR-2 developed in KITECH (Korea Institute of Industrial Technology). EveR-2 is a female robot which name derives from Biblical 'Eve' plus the letter 'R' for Robot. EveR-2 is a robot platform to implement and test emotional expressions and human interactions. She can express facial emotion and synchronize lip with voice. Also it can make gestures like human. She can sense visual and speech information from CCD cameras in her eyes and microphone. The head, upper body, and lower body which compose of total 59 DOFs(Degree Of Freedom) make behaviors, facial expressions, and lip sync. Software structure has the robot-oriented conversation using a dialogue database, and hardware structure is designed for embedding all motors and sensors into the human-scale space. EveR-2 can be applied to guidance service of an exhibition, oral narration of fairy tale, and singing, and conversation with humans.

1. INTRODUCTION

As the robot technology advances, the area of robot application is wider. In recent year, robots enter into home or our life from factory. So the importance of emotional robots increases gradually. Breazeal developed Kismet that is a face robot for researching sociable robot [Breazeal 2002]. Kismet can express nine facial emotions based on emotion space model. Takanashi group developed WE-4RII for expression of human emotions both using face and gesture [Itoh *et al.* 2004]. As an android type robot, there are Actroid by Kokoro Inc. and the face robot by Hanson robotics Inc [Matsui 2005, Hanson 2002].

In this paper, we describe EveR-2 developed in KITECH for emotional communication between human and robot. EveR-1, which is the first version of android, is capable of motion from her torso up, because her leg is not implemented to robotic body[Lee *et al.* 2006]. However Ever-2 has robotic legs and foots, so she can stand and move using her leg. Section 2 shows the overview of EveR-2. Section 3 and 4 presents the hardware and software structure of EveR-2.

2. OVERVIEW OF THE ANDROID: EVER-2

EveR-2 is bipedal type. So she can sing a song in standing. Although EveR-1 only has the upper body, EveR-2 adds the lower body with 12 DOFs. She has the function of EveR-1 and is added the function of whole body coordination and dialogue engine. Her gesture, facial expression, lip synchronization, and vision recognition are abundant. Fig. 1 indicates the major functions of EveR-2, and Table 1 explains the specifications.

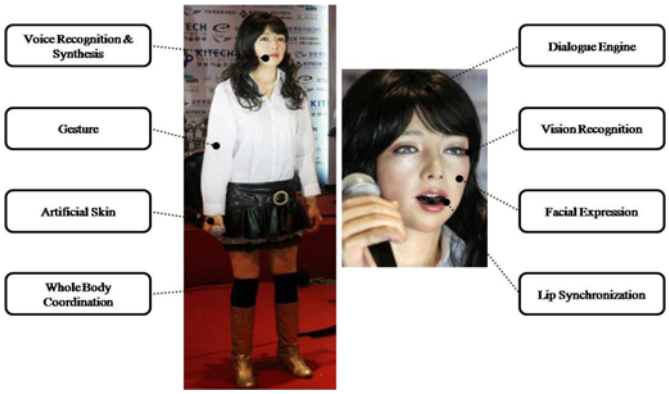

Fig. 1. Major functions of EveR-2

Table 1. Specification of EveR-2

Appearance		Korean female
Height		165 cm
Weight		60 Kg
DoFs	Face	22 DoFs (eyeball: 4 DoFs)
	Neck	3 DoFs
	Arm	6 DoFs * 2
	Hand	4 Dofs * 2
	Torso	2 DoFs
	Hip	3 Dofs * 2
	Knee	1 Dofs * 2
	Ankle	2 Dofs * 2
	Total	59 DoFs
Eyes		2 Small CCD Cameras

3. HARDWARE

EveR-2 uses a brake for increasing safety of mechanism in neck, waist, pelvis, knee with 1 DOF, and ankle with 2 DOFs. For defining a homing position of motors, an approaching sensor and potentiometer are applied. 3-Dimensional data of 3D Tool is used for designing each part. The neck uses belts due to reduce non-linear control and complement safety about the load of head. Backlashes made from shoulders and elbows are decreased by using reduction gears and belts. In structure of head, each axis is independently controlled for multifarious facial expression and shapes of lips. An increment of motor expands controlled points in muscle model of a face. The hand mixes the structures of linkage and tendon. It gives 4 DOFs; the middle and ring fingers move concurrently.

The inside skin uses FRP (Fiberglass Reinforced Plastics). It is bolted with frames. FRP in joints has to cut out for reducing interference of upper and lower links. The empty space is filled with flexible material. . Fig. 2 and Fig. 3 show the head and the body of EveR-2 which covered by FRP.

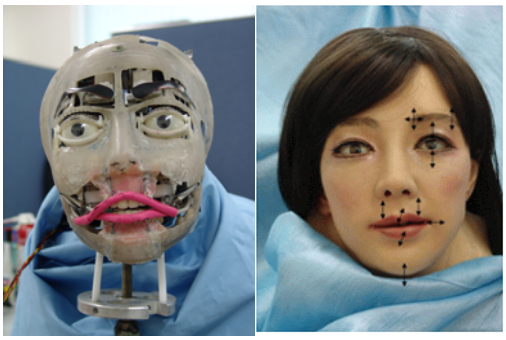

Fig. 2. EveR-2 head : inner structure and face

EveR-2 can express six emotions into face: happiness, sadness, fear, surprise, anger, and disgust in Fig. 3. In addition to basic expressions, simile and wink give people a sense of affinity in conversation. EveR-2 is designed for speaking and singing with the structure of lips: a, e, i, o, u, eo, consonant, and firm-set mouth. She has 100 gesture data to communicate with human. EveR-2 can interact with humans using speech, gesture and vision information.

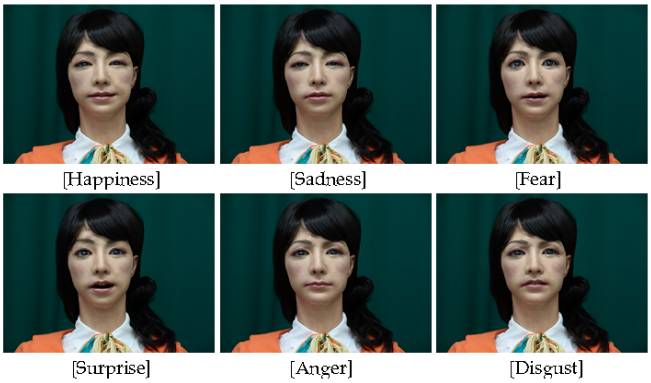

Fig. 3. Facial expressions of EveR-2

4. SOFTWARE STRUCTURE

Fig. 4 shows the software structure of EveR-2. EveR-2 is controlled by four computing units which are vision, brain, motion, and dialogue. Motion builder provides motion data by offline. Motion computer and robot are connected by CAN communication. The other is connected by LAN of TCP/IP.

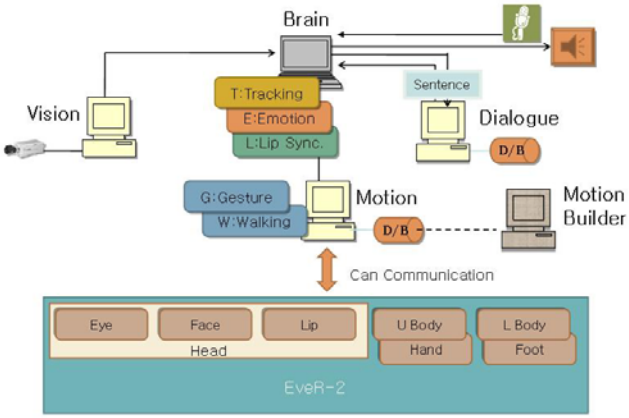

Fig. 4. Software structure of EveR-2

5. CONCULSIONS

EveR-2 is a robot platform to test and implement emotional communication between human and robots. In this paper, we present the hardware and software structure of EveR-2.

In future work, we will add 1 DOF in shoulder and pelvis for naturally movements in hardware. For reducing a load on motor, materials of skin will be continuously researching, and try to use flexible inner skin without interference of links. Also various sensor such as tentacle and auditory will be equipped in a next platform.

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