3D Rendering System using Data Glove

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Abstract—**In this paper, we introduce 3D motion rendering system based on a data glove. Our glove measures the movement of fingers by using flex sensors. Integrated FPGA gathers the data from sensors and performs pre-processing of the sensor data. The acquired data are forwarded to PC through Bluetooth communication and an application program displays the gesture.**

Keywords-Ueser Experience, Wearable Devices, 3D Rendering

I. INTRODUCTION

As user interacts more with devices such as game platforms, smart phones, smart TVs, entertainment equipment in automobile etc., enhancing personalized experience became challenging to enable more natural modes of input-output as compared to traditional devices. For instance, various devices that enable selecting or moving object on electronic devices adopting infra-red rays or eye tracking methods without touching devices were introduced. A glove like mouse is already in the market and a 3D air mouse for open space usage is also available, enhancing user experience. Accordingly, vendors have developed various wearable devices such as Google Glass, Galaxy Gear, Fitbit Charge, and so on. Various wearable devices are proposed and attracted attention in healthcare field and communication field. For example, wearable foot mouse successfully controlled a computer [1,2] and wearable shoes imformed the ambulatory pattern on smart phone [3].

Over the past twenty years, many researches about a data glove have been done in entertainment field such as Mattel Power Glove or VPL Data Glove [4]. The glove based controller controls a device through hand motion recognition. Control through motion recognition is intuitive and provides more user experience than a keyboard, mouse or touchscreen. Typically, motion recognition is classified into two groups. One is vision processing method and the other is the way to use mechanical equipment such as data glove. Data glove based motion recognition has the precise classification capability and fast response time compared to the vision processing method. Hence, it has been chosen for many systems [5]. We presented a data glove that recognizes user's hand motion and controls object in the racing game and shotting game [6]. In this paper, we introduce 3D rendering system based on the data glove targeting acceleleration of 3D animation production. Main contribution of this work is the recognition of hand motion and representation on a computer. It is well known that hand motion reflects the emotion and stauts of a character.

The rest of this is organized as follows. In section 2, we give an overview of our 3D rendering system, including implementation of our data glove and application. In Section 3, we show the experimental results and conclude the paper in section 4.

II. IMPLEMENTATION

A. *mrGlove*

The Figure 1 shows our system flow. The mrGlove captures user's hand motion and transmits data through Bluetooth communication channel. The mrGlove uses flex sensors and acceleration sensors to recognize user's hand motion. Flex sensors and switches are located in each finger, and signals from flex sensors are transmitted to FPGA for signal processing. The switches located on each fingertip enable a flex sensor to transmit a data to FPGA when they are turned on. When flex sensor is bended, resistance is changed. Acceleration sensor is used to detect user's hand motion. Signals from the flex sensors and acceleration sensor are aggregated and processed in FPGA. Terasic DE0-nano board [7] including cyclone IV FPGA, ADC and digital accelerometer is used for implementation of the mrGlove.

B. *Application Program*

OpenGL is used to represent the virtual 3D hand in the host PC. The virtual 3D hand program uses some functions in the OpenGL API. The OpenGL reproduces finger's movement and joint using the rotate function. The mrGlove perceives the

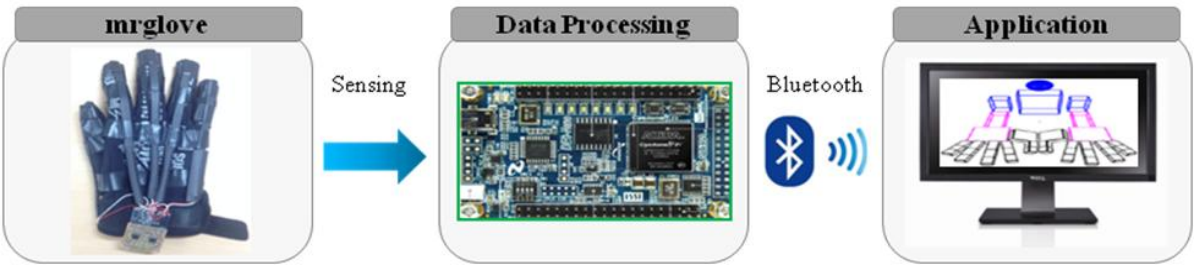

Figure 1. 3D Rendering System flow

movement of the fingers and sends the data to the host PC, including a fingers ID and movement data. The OpenGL compares the data with the index data in the virtual 3D hand to define the rotation values of each joint and finger. Finally, the virtual 3D hand is illustrated on the host PC according to the movement of mrGlove.

III. Experimental Results

Figure 2 shows the experimental results when user changes a motion wearing mrGlove. The first column shows the motion of fingers and the second column represents the realization of hand gesture of the 3D character in virtual world. Our system expressed the hands movement as 3D graphics through recognizing the user's hand gesture. We tested other motions in order to confirm the feasibility of our system. Experimental results demonstrated the feasibility of our proposal to accelerating the production of 3D animation through representing hand motion efficiently.

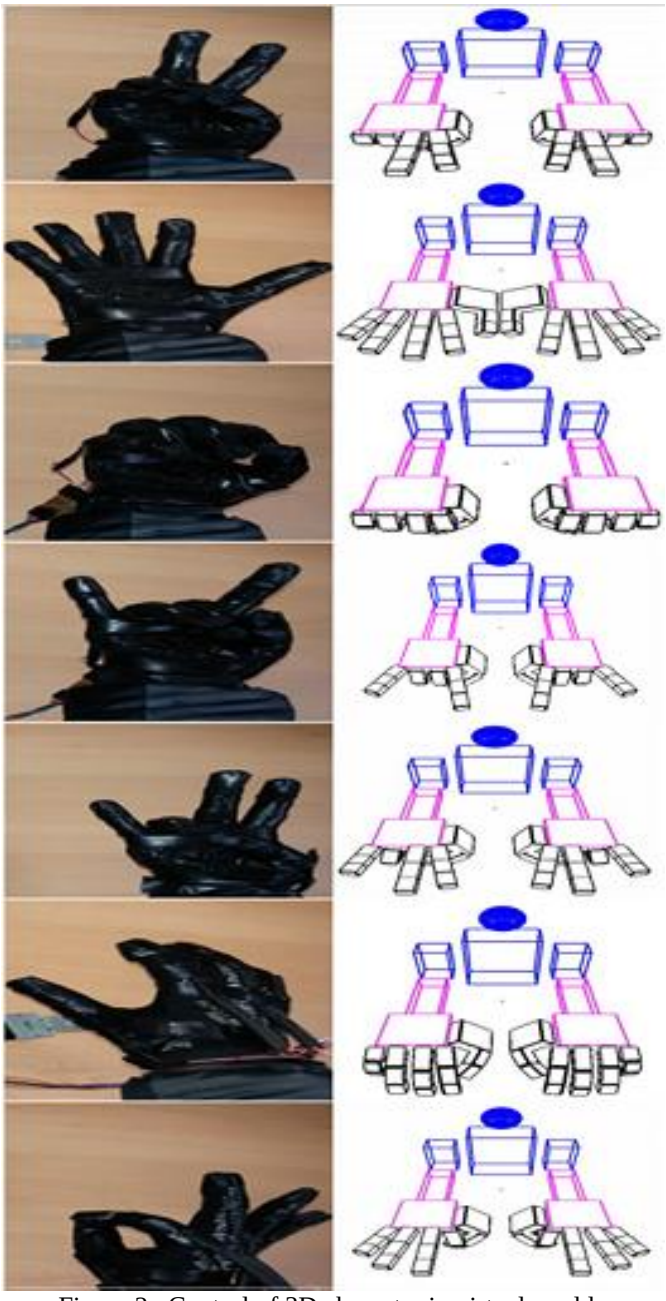

Figure 2. Control of 3D character in virtual world

IV. Conclusions

In this paper, we proposed a 3D rendering system that controls hand gesture in 3D virtual world. In experimental result, our data glove recognized the user's hand gesture, and controlled the 3D hand in virtual world successfully. We expect that our system brings a convenience and enhances user experience in augmented reality or the virtual reality systems such as 3D games, animations, and entertainment. We plan to improve the sensitivity of data glove by using the additional sensors such as accelerometer and gyro sensor, and control a robot hand in real world.

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