LOW COST DEXTEROUS TELEOPERATION HUMANOID ROBOTIC HAND WITH WEARABLE REMOTE CONTROLLER

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ABSTRACT

Humanoid robotic mechanisms are widely utilized to improve the efficiency and speed of industrial applications. The field is improving with the current tendency towards custom 3D printing and advancements in wearable technology. A method and an implementation to replicate the human finger movements in a vertical plane, using a robotic hand is presented in this paper. A wearable remote controller unit is designed to control the fingers of a 3D printed humanoid robotic hand which improves the dexterity. All five fingers of a human hand with natural bends are designed and implemented with the custom made 3D printed system. The wearable controller unit captures the moments of a real human hand and finger movements are communicated to the humanoid robotic hand. The implementation could be easily improved for applications in telepresence.

***Key words*:** Humanoid Robotic hand, 3D printing, Dexterity, Teleoperation

1. INTRODUCTION

Designing of humanoid robotics has influenced and helped many fields such as health care, military and general household chores [1, 2]. Having the ability to operate from a distant location, teleoperation, has been an added advantage in this context. Michaud and Francois [3] has discussed that teleoperation with assistive technologies constitute a promising avenue to decrease load on the health care system, reduce hospitalization period and improve quality of life. The ever increasing global trend of wearable electronics can be easily integrated in the teleoperation process. The introduction of 3D printing technology and the availability of the technology has further impressed researchers and practitioners in this field as it helps quick prototypes with lower costs. This research paper emphasizes the importance of the usage of 3D printing as a quick prototyping method in Sri Lankan context. Further the usage of assistive technology is elaborated with adoption of easy electronic prototyping platforms.

2. METHODOLOGY

The implementation of the five fingered dexterous humanoid robotic hand is impressed by the opensource 3D printed project InMoov [4]. The pre-designed 3D design of the human hand with 5 fingers is further modified to suit the need using 3D designing software and 3D printed locally. Servo motors [5] with pulleys were selected as the relevant actuator to control the movement of each finger while flex sensors [6] were used to capture the finger movements of the real human fingers. For quick prototyping, Arduino electronics prototyping board was selected. The overall process is elaborated in Figure 1.

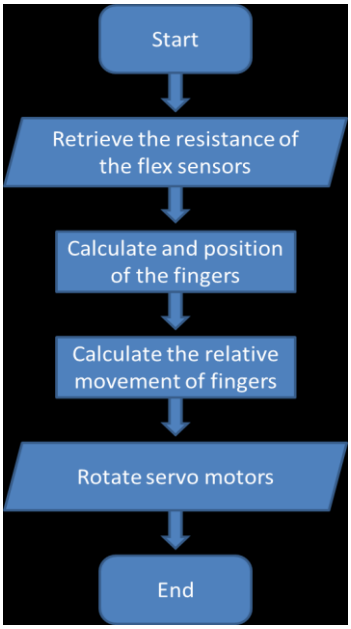

Figure 1: Flow chart

3. RESULTS

Figure 2 illustrates the finalized design of the humanoid robotic hand and Figure 3 illustrates the wearable glove with flex sensors embedded in. The wearable glove can be worn by a human and the humanoid robotic hand would mimic the movement of the fingers. Current implementation

is limited only to the right human hand while authors assert that the design is easily scalable to the left hand also. Further, this implementation connects the wearable glove and the humanoid robotic hand with wires, where authors believe that it could be easily upgraded to any other wireless communication methods and protocols such as Bluetooth or radio frequency.

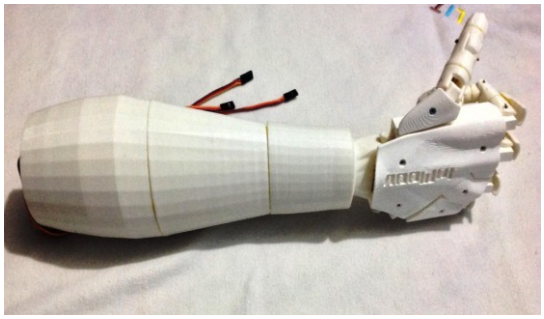

Figure 2: Complete 3D printed robotic hand

Figure 3: Wearable remote controller

4. CONCLUSION

This paper tries to conduce the fact that 3D printing technology is a credible candidate for quick prototyping with lower costs in Sri Lankan context. A five fingered dexterous humanoid robotic hand was designed, implemented and prototyped. Authors highly believe that the application can be further improved to various fields such as tele-operation in healthcare, bomb disposal in military applications, prosthetics and tele-operation in hazardous environments such as radioactive fields. The concept of wearable electronics is utilized to impress the tele-operativeness, which further can be improved by the introduction of wireless technologies.

5. REFERENCES

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