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Implementation of Robotic Hand Imitating the Real Time Motions

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ABSTRACT:

Today's technology has increased interest in robotic systems and the number of studies carried out in this area has increased.

These robotic studies have been developed as robot hands, robot legs and humanoid robots. The new developments in mechatronics and robotics have led to many new technologies and innovations, such as making human life easier. In existing systems and flex sensors used in wearable gloves for finger movements, robotic control system based on electromyography signals are used. Will produce errors when used for a long time due to change in the flexibility of the sensor. In the proposed system 3D printed hand is created to emulate the movement of the human hand to control the servo motors in the robotic hand.

I. INTRODUCTION

The new developments in mechatronics and robotics have brought many new technologies and innovations, such as making human life easier, increasing manufacturing autonomy, protecting people from working in risky places, and providing robotic limbs that can replace prosthesis. Because they are both cheap and functional, robot hands are useful for both adults and children and young people. Robot studies are very important developments in the medical sector for surgery. Waseda Legged (WL) robots developed during the 20th century by Professor Kato's robotic team at Waseda University in Japan. Research on the intelligent anthropomorphic robot began in the 1970s to develop a personal robot called WABOT. These physically anthropomorphic designs and considers are motivated by the fact that these human like arms can naturally form a basis for the resemblance or attainment of human movements and behaviors that help to understand the intention of robot movement, avoid disturbance or discomfort to nearby humans. When the hand is made anthropomorphic it can be programmed by using a human operator to map his own way of manipulating in the robotic hand. This avoids the complicated task to program grasping algorithms. Hands that are operated by human demonstration can be subdivided in telemanipulation hands and 'teaching by demonstration' type industrial applications, for exam. In the first the movements of a master hand are replicated, so only the low-level control tasks need to be programmed. In the second the algorithms of grabbing and manipulating are 'learned' by the machine. A human hand can grasp in many different ways. For heavy objects or for delivering a large force a robust grasp is needed. For lighter object a different and more dexterous grasp can be used. Furthermore, the grasp of a human hand is always adapted to the shape of the object. In situations where there is little force to be generated, position control can be used. This can produce good-looking movement demonstrations in the air for robotic hands. However, a controlled amount of force must be exercised on the object for manipulation tasks, so that force control is necessary. So some sort of force control is needed in most practical applications for manipulation with robotic hands.

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The robotic arm will be controlled via the designed controller, enabling objects to be captured, picked up and moved by their weights and shape. It is mostly expected that the manipulator design will pick up cubes and geometric shapes like a box. DoF differs depending on the number of joints, but robotic arms usually operate with 4 or 5 servo motors. The servo motors are popular because of their desirable robotic application characteristics. Most of tools, vehicles, electronic devices and cuisine are built and prepared with the help of industrial robots. For instance, there are industrial robot assembly lines which help in many cases that can operate more accurate and faster than humans. Recently, robots operate in almost all human labors mostly in the fields which are unhealthy or impractical for workers. This fact causes the workers to have more free time to spend on skilled professions including the programming, maintenance and operation of the robots. Using wireless hand gestures, a robotic arm is operated and controlled. This research uses an arduino, gyroscope, accelerometer, gloves and servomotors. The glove provided 3D printer robot hand movements that can be operated by the robot. In this study, a humanoid robotic arm is designed and implemented with using 3D printer, Arduino microcontroller, some sensors and android software. First, in the Solidworks program, the parts that formed the arm and hand were modelled. Secondly, parts were produced by using 3D printer technology. At the last, the parts were combined, servomotors were placed and connections were made. The microcontroller Arduino was programmed for the movements and placed to hand.

II. EXISTING SYSTEM

Robots are used in various fields, including industrial, military, space exploration, and medical applications. These robots could be classified as robots for manipulation and cooperate with other parts of automated or semi-automated equipment to accomplish tasks such as loading, unloading, spray painting, welding and assembly. A Robot is a reprogrammable, multifunction manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks. Robots can be classified according to their method of control pathway, structural design, or level of technology. The two major types of control are servo and non-servo. The pathway of the robot may be either point-to-point or continuous. Four Fingered Robotic Hand (FFRH) for a simple reflexive grasp which can be used for a wide range of objects. The FFRH is designed with four-pronged grippers (four fingers) based on servo, point-to-point, and cylindrical robot structure. This approach focuses primarily on the task of grasping objects of various shapes and not on the task of manipulating or assembling objects. This type of gripper has a variety of applications in object recovery systems. All complex human hand characteristics or many existing anthropomorphic robot hands are not needed. The methodology adopted is a simplified, three-fingered anthropomorphic design with an opposing thumb. Each finger has three connections, or phalanges, and three double revolt joints, nearly similar to the human finger in structure. The thumb has two connections and two double revolt joints. A single opposing pair of tendons acts on each finger.

DRAWBACKS

1. The complexity in both motion planning and force management due to the mechanical limitation in fingers
2. The use of two actuators in one finger will generate more heat and reduce the output speed relatively

III. THE PROPOSED STRATEGY

Due to certain disadvantages of the existing system, The propose system makes use of restoring force as driving power in grasping objects, which enables the hand to perform stable. The open source 3D printed project impresses with the implementation of the five fingered dexterous humanoid robotic hand. First, in the Solidworks program, the parts that formed the arm and hand were modelled. Secondly, the use of 3D printer technology produced parts. The parts have been combined at the last, servomotors have been placed and connections made. The Arduino microcontroller was programmed and placed to arm.

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IV. METHODOLOGY

The human hand and its structure of the skeleton were taken as reference individually. Second, using the solidworks program, the parts of the hand were drawn and modelled. The human hand with 5 fingers pre-designed 3D design is further modified to suit the need using 3D design software and locally printed 3D. Servo motors with pulleys were selected as the relevant actuator to control each finger's movement while mobile control was used to capture the actual human finger's finger movements. The hand's body is made from a 3D printer. This humanoid robotic hand contains three parts as mechanical system, software and electronics system.

ROBOT OPERATING SYSTEM

The Robot Operating System (ROS) for writing robot software is an open source framework. As stated in the Quigley paper, ROS is not, in the traditional sense of process management and scheduling, an operating system rather, it provides a structured communication layer above the host operating systems of a heterogeneous compute cluster. ROS relevance to the robotic hand project stems from the project's goals: modularity and control ease. The purpose of the robotic hand is to serve as a modular component: it can be used as a stand-alone system or as an attachment to a more complex robotic system. If the robotic hand is used as a ROS node, the hand can easily be integrated into a larger robotic system running ROS as well.

DESIGN OF HARDWARE

Five 6V Analog Servo Motors are used in this robot to move the hand parts. In addition to the motors, these motors are preferred to support sufficient voltage. Each finger has an servo motor. List of electronic materials used for robotic humanoid hands.



Figure 1.1 SG690 servo motors



Figure 1.2 zigbee transceiver

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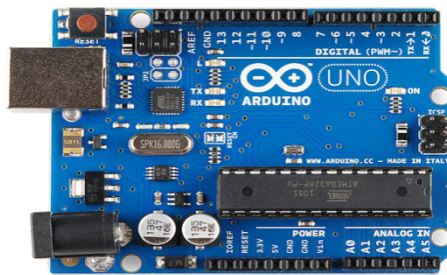
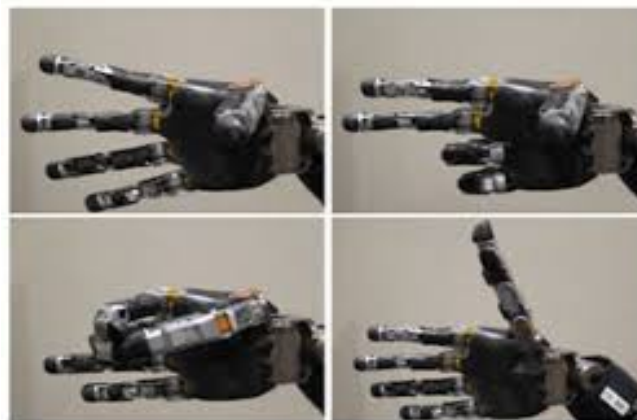


Figure 1.3 arduino uno

Next, we carried out grasping experiments to verify that the developed device satisfies the functions of robot hands. Our robot hand can be considered able to do grasping motion just like humans because it has the mechanism like a human hand. To categorize human grasping, power grasp and precision grasp are known for two main classification methods.



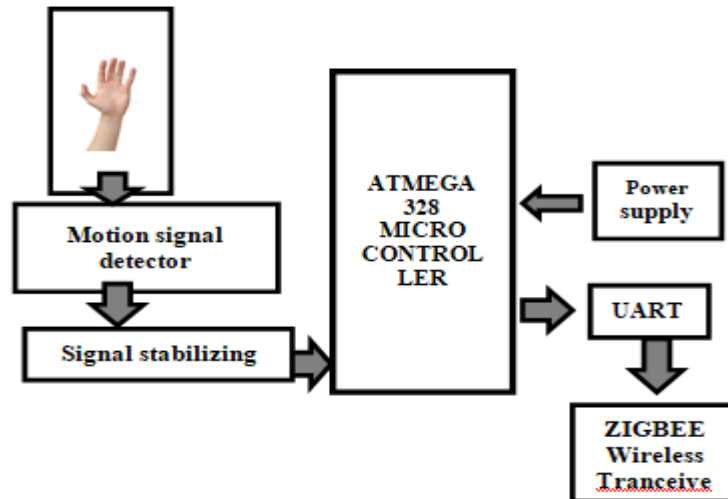
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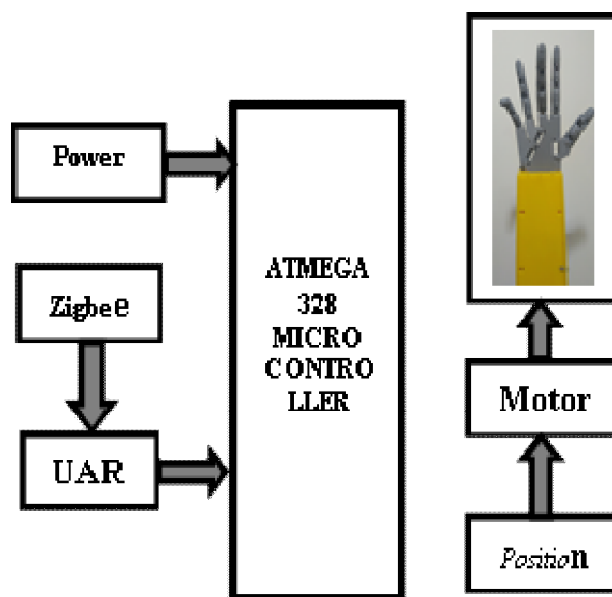
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TRANSMITTER



The receiver section receives the transmitted data through a zigbee receiver module placed at the receiver section and compares the analog values with the specified limits that are already programmed in the microcontroller. If temperature, voltage and current values violate the limits, then the microcontroller sends control signals to a relay driver. This relay driver further drives a set of relays that operate different loads. In this system, the loads can be feeders to switch the transformers when a voltage or current exceeds the limits. The servo motor has an attachable arm from the gearbox on an output shaft and this arm can be seen. This arm allows different attachments to be attached to a servo motor. The swing of the arm, however, has a large radius in this case and is not suitable for compact design. Not only that, but the arc is not long enough to close the prosthetic hand's fingers completely.

RECEIVER



DESIGN OF SOFTWARE

Design of Software An android program is prepared to move the fingers of humanoid robotic hand on desired directions. There are twelve buttons placed on interface of program. For connecting to the humanoid robotic hand with zigbee. After the synchronization,

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the robot can be moved using android software by clicking the buttons on the directions . In Fig.2, the flowchart of the program which developed to move the fingers with zigbee module module.

Arduino is an open-source electronics prototyping platform/environment.The Arduino Uno can be programmed with the Arduino software IDEThe Atmega328 on the Arduino Uno comes preburned with a Bootloader that allows you to upload new code to it without the use of an external hardware programmer

Programs written using Arduino Software (IDE) are called **sketches**. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors







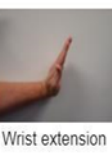





No.	The Real Hand Pose	Description	The Prosthetic Hand Pose	Description
1.	 Fist	All five fingers close	 Fist	All five fingers close
2	 Fist and wrist flexion	All five fingers close and wrist flexion	 Point	All four fingers close except index finger
3	 Wrist flexion	Wrist flexion	 Rock	All three fingers close except index and pinky fingers
4	 Wrist extension	Wrist extension	 Pinch	All three fingers close except ring and pinky fingers
5	 G1: REST Rest	All five fingers open	 Rest	All five fingers open
6	 Bicep	Bicep muscle tightens	 Wrist flexion	Wrist move up to 50 degree from rest position.

Figure 1 GRASPING MOTION OF ROBOTS

The console displays text output by the Arduino Software (IDE), including complete error messages and other

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information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. Zigbee is a protocol used to operate X-BEE modules. Zigbee protocols are commonly used in commercial buildings, industrial applications, health monitoring, telecommunication and retailing sectors. Zigbee technology is the most prominent radio network in home automation. Zigbee technologies are mesh networks possessing many ways to send messages bound to reach their destination The Nordic nRF24L01+ is a highly integrated, ultra low power (ULP) 2Mbps RF transceiver IC for the 2.4GHz ISM (Industrial, Scientific and Medical) band. With peak RX/TX currents lower than 14mA, a sub μ A power down mode, advanced power management, and a 1.9 to 3.6V supply range, the nRF24L01+ provides a true ULP solution enabling months to years of battery life from coin cell or AA/AAA batteries. The Enhanced ShockBurst hardware protocol accelerator offloads time critical protocol functions from the application microcontroller enabling the implementation of advanced and robust wireless connectivity with low cost 3rd-party microcontrollers.

V. CONCLUSION

In this paper, a robotic humanoid hand was developed and created, which could mimic a human user's finger motions. Several technologies, such as 3D printing, finger motion identification based on a motion sensor, motion control, serial communication and arduino programming, were integrated to create the robotic hand. There are many motions like the original human motions were performed by using this prototype. The response time is very high that the robotic hand can do quickly what the operator want. In future, authors highly believe this application can be further improving for healthcare, military applications and prosthetics fields. This application can be improved by other wireless technologies and can be used another fields easily

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