Wireless Animatronic Hand

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Abstract: As a result of employees utilizing their bare hands, there are more accidents in industries every year. Animatronic hands resemble human hands and are capable of carrying out a variety of tasks that humans are unable to do. Human hands cannot readily finish difficult tasks, but animatronic hands can mimic human movements and complete them. A number of actuators and sensors make up the robotic hand, which are managed by a person's hand. The pushers control how far the fingers can move. We employ flex sensors to detect the positions. The positions and motion of the hand are reported by sensors to Arduino. The microcontroller uses a 433MHz transmitter and receiver in both transmitter and receiver side to used for transmitting the data, so it will be access in remote area. We employ servo motors as actuators by getting the position and motion from another microcontroller also attached. Two microcontrollers are interconnected with 433MHz transmitter and receiver, Transmitter and receiver for 433 MHz When sending and receiving radio signals between any two devices, RF refers to a set of electronic RF transmitters and receiver modules. The transmitter module at the transmitter end transmits the data, which the receiver module at the receiver end receives.

Keywords: Arduino UNO,433 MHz RF Transmitter and Receiver, Flex Sensor, Servo Motor.

1. INTRODUCTION

In recent years, technological advancements have led to the development of remarkable innovations in various fields. One such breakthrough is the wireless animatronic hand, a marvel of engineering that is transforming industries such as medicine, defense, and chemical research. Combining the precision of robotics with the versatility of wireless communication, this revolutionary device is poised to redefine the way we interact with and manipulate our environment. This article delves into the multifaceted applications of the wireless animatronic hand in the medical, defense, and chemical sectors, highlighting its potential to enhance capabilities and improve safety across these domains. The medical realm stands to gain immensely from the incorporation of wireless animatronic hands into its arsenal of tools. With their intricate and precise movements, these hands have proven to be invaluable in surgical procedures, both invasive and non-invasive. Surgeons can remotely control these devices to perform delicate tasks with enhanced dexterity, minimizing tissue damage and reducing patient recovery times. For instance, in microsurgery, these animatronic hands can facilitate nerve reconnection and intricate tissue stitching, tasks that demand exceptional precision. Moreover, the wireless animatronic hand is paving the way for telesurgery, enabling experienced surgeons to operate on patients located in distant regions. This development holds the potential to bridge the gap in medical expertise between urban and rural areas, ensuring patients receive top-notch care regardless of their geographic location. In the realm of defense, the wireless animatronic hand emerges as a game-changer. Military personnel often encounter hazardous situations that require remote manipulation of objects, and this device can significantly mitigate risks. Bomb disposal units can employ these hands to handle potentially explosive materials from a safe distance, minimizing the danger to human lives. Furthermore, the integration of these animatronic hands with virtual reality and augmented reality systems allows soldiers to remotely interact with the environment, gather critical intelligence, and engage in intricate tasks such as disarming improvised explosive devices. This amalgamation of cutting-edge technologies is revolutionizing military operations by enabling troops to accomplish missions with heightened precision while maintaining a safer distance from potential threats. The chemical industry, known for its complex experiments and potentially hazardous substances, also stands to benefit from the wireless animatronic hand. Researchers can manipulate sensitive and reactive materials remotely, reducing the risk of exposure to harmful chemicals and ensuring the safety of personnel. These animatronic hands find their application in the handling of biohazardous substances, radioactive materials, and other compounds that pose health risks. They enable scientists to conduct experiments with greater accuracy and control, ultimately leading to more reliable results. Additionally, the integration of sensor technology within these hands allows for real-time data collection, enhancing the understanding of chemical reactions and enabling rapid responses to unexpected outcomes. The advent of the wireless animatronic hand marks a significant milestone in technology's role in reshaping industries. With its capabilities ranging from intricate medical procedures to hazardous defense operations and precise chemical research, this device underscores the potential for robotics and wireless communication to collaborate harmoniously. As the fields of medicine, defense, and chemistry continue to evolve, the wireless animatronic hand stands ready to play a pivotal role in enhancing capabilities, ensuring safety, and advancing human endeavor’s to new frontiers. In environments fraught with danger, such as explosive ordnance disposal (EOD), the wireless animatronic hand assumes a paramount role. Its delicate and precise movements allow remote manipulation of explosive devices, ensuring the safety of personnel while mitigating potential catastrophes. This innovation empowers bomb disposal experts to interact with hazardous materials from a safe distance, minimizing the risk of injury or loss of life. The dexterous nature of the animatronic hand enables the intricate disarming of intricate mechanisms, a task that was previously fraught with danger. As technology continues to advance, integration with virtual reality interfaces enables EOD specialists to immerse themselves in hazardous scenarios, controlling the animatronic hand with real-time precision. This amalgamation of cutting-edge technologies redefines explosive handling protocols, making the process more efficient and safeguarding human lives. The cleaning industry, often characterized by labor-intensive tasks, has undergone a paradigm shift with the introduction of the wireless animatronic hand. Cleaning large and complex surfaces, such as industrial machinery or high-rise windows, demands precision and efficiency. This innovation enables remote control of the animatronic hand, facilitating thorough and meticulous cleaning in hard-to-reach areas. The hand's adaptability to various cleaning tools and attachments further enhances its utility. In hazardous or contaminated environments, the wireless animatronic hand can be fitted with specialized sensors, enabling remote monitoring and cleaning of toxic substances. This not only ensures the safety of cleaning personnel but also leads to more effective and environmentally conscious cleaning practices. Beyond its specialized applications, the wireless animatronic hand raises the tantalizing prospect of replacing human hands in a multitude of tasks. From delicate surgical procedures to intricate manufacturing processes, this technology offers a glimpse into a future where human limitations are transcended. Individuals with physical disabilities could benefit from animatronic hand prosthetics that restore lost functionality and enhance quality of life. Furthermore, the seamless integration of sensory feedback systems allows for an unprecedented level of interaction and control, bridging the gap between human intuition and robotic precision. As we continue to unlock the potential of this technology, the wireless animatronic hand paves the way for a world where the boundaries between human and machine blur, leading to unforeseen advancements across various disciplines.

2. LITERATURE SURVEY

There has been a lot of research done around hand safety. There are numerous papers available, as shown in the reference list. [1] to [8]. Ibuki Hashira,et.al.,[1] invented by urological surgery mechanism. It has three fingers and folding mechanics to take and insert the organs, as well as servo motors. It has a total of eight degrees of freedom. The folding mechanism is less than 20 NM in size. In robotic urological surgery, laparoscopic forceps are routinely utilized to transfer organs away from the surgical operating room, however this tactic fails. We developed a three-fingered humanoid hand with a folding mechanism that enables it to be put through a tiny incision in order to increase the efficacy of organ donation. The target organs were decided to be the kidneys and bladder (including the prostate). To provide examples, we looked at three postures: "grasp," "open palm," and "pinch. Sen K Varghese,et.al.,[2] invented a robotic arm to reduce bore well falling incidents. It resembles a human hand and can pick up the victim without creating any problems. They included a high-resolution camera for video surveillance, as well as a PIR sensor, an ultrasonic sensor, a microcontroller, and a servo motor. The pangolin, often known as the anteater, is a species whose method of prey capture was employed in our paper. When a pangolin's prey becomes attached to its tongue, it stretches its tongue to dig a tunnel. Similarly, we have a mechanical extension system for the robot. We can assure the victim's safety by grasping them tightly and securely with an animatronic hand, akin to a pangolin's sticky tongue. To be certain that the Illya Starodubtsev, et.al.,[3] created an Animatronic hand. Inmoov 3D model hand and stand for servo drivers. It has Motion Capture MEMS, Node MCU, and Servo Drivers. It employs the Madgwick Algorithm. They have been partnered. In certain cases, the external device is a smartphone, whereas the device being used as a wearable electronic gadget. By connecting the electronic device to the external device, the devices may be able to communicate and share information. As a result of the rapid and cost-effective manufacture of both industrial designs and prototypes, new uses for 3D printing technology are emerging. Children's hand prostheses and communicative animatronic models, for example, are currently available. Each of these responsibilities raises the question of how to physically control a hand structure. Tahmina Aktar Mispa, et.al.,[4] created an animatronic arm called kiddie. It is beneficial for sketching and writing. It features cameras to collect data. A CNN Based ML model was used to train it. It analyzes the image, recognizes the form, and draws the shape. An huge dataset was used to train that model. In this attempt, they develop Kiddo, a new robot that can write on a whiteboard with a marker, sits on a desk, has an animatronic face, and provides a shared workplace where the robot and a kid may write simultaneously. Jianshu Zhou, et.al.,[5] designed a soft robotic hand and gave a prototype result of BCL -26 Pneumatic drive instead of hydraulics is how it operates. The benchmark items described in the grip classification with 33 grasp kinds were grabbed using the BCL-26. BCL-26 is used to practice handwriting and to manipulate a pen by hand to make a succession of strokes. New soft robot hands are said to surpass a surprising portion of human hand flexibility while having mechanical sophistication that is much lower than that of conventional firm or under-actuated mechanical hands. Soft robotics is a rapidly developing field in anthropomorphic robotic hand design. More intriguingly, as opposed to in-hand manipulation tasks, recreating item grip with soft robot hands was more successful. Jagruti P. Gour,et.al.,[6] The objective is to modify the perception of remote controls for a manually controlled robotic hand. A wireless electronic device called the animatronic hand is designed using the XBee S2, Arduino UNO board, servo motor, and flex sensor. The animatronic hand is particularly helpful for persons who are paralyzed and other people who are disabled. As building a robot's entire body would have been expensive, they will merely create a hand that will serve as a shadow hand. Akshay Sarkate,et.al.,[7] invented by The utilization combining open source development boards like the microcontroller such as Arduino and wireless technology to create a robotic hand is highlighted in this study. The major goal of this research is to demonstrate the applications of a robotic hand in diverse industries where human dexterity is still necessary but wireless applications are necessary. An Arduino board, a transceiver shield, and a control glove are used to implement the product. Virendra Sangtani,et.al.,[8] invented by Robotic hands that mimic human hands are known as animatronic hand, and they can play a specific role in tasks posing a risk to human life. It is utilized as a component of a humanoid robot to do a number of things. The human hand's movements are mimicked by the animatronic hand, which thus completes difficult tasks without endangering human lives. It is a mechanical hand that an Arduino is used to control. Flex sensors are attached to the human hand's fingers, and servo motors positioned on the robotic hand are used to move the robotic arm in accordance with the movements of the robotic hand at any given time. NRF24L01 transceiver module allows for wireless robotic hand control.

3. PROPOSED ARCHITECTURE

3.1 General architecture of the proposed system

The animatronic hand is typically composed of multiple mechanical fingers, each of which can move independently and grasp objects. The proposed system often utilizes sensors, actuators, and control algorithms to enable the robotic hand to sense and manipulate objects in its environment. This can include sensors that detect the size, shape, and texture of an object, as well as actuators that control the movement of the fingers and hand.

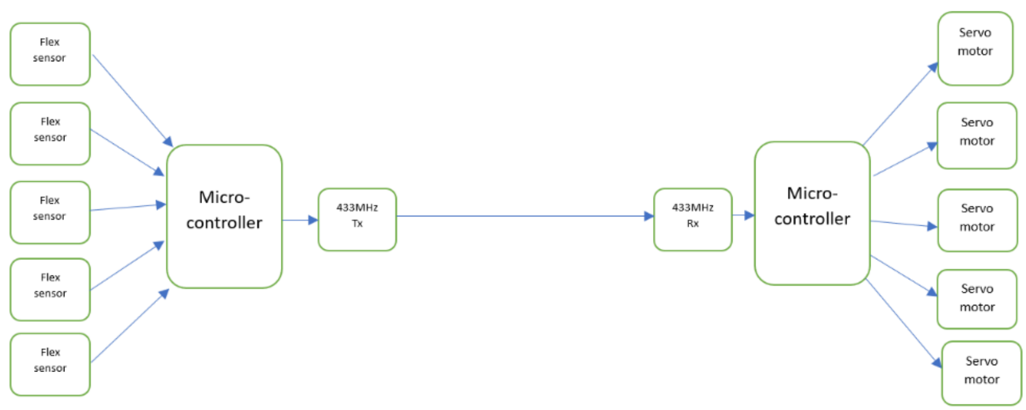
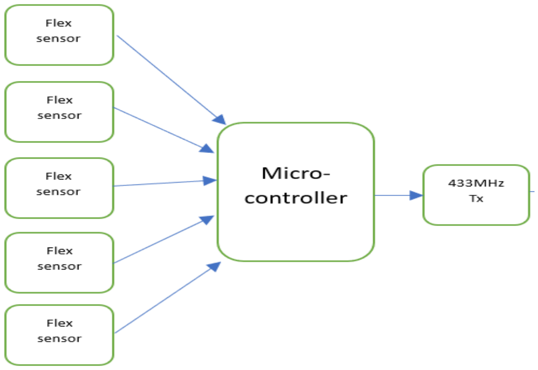


FIGURE 1. Architecture of Animatronic hand

As depicted in Fig. 1. The Figure of Animatronic hand, the sections of this proposed module are as follows:

- Transmitter and receiver side
- Components used

3.2 Transmitter and receiver side



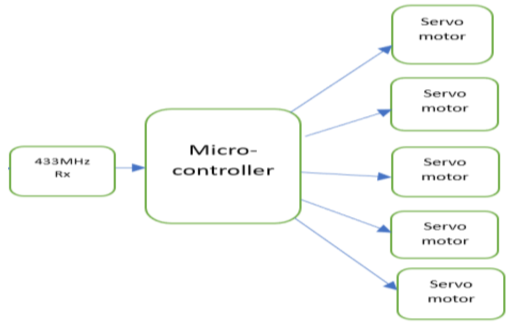


Fig.2.a). Transmitter Side

Fig.2.b) Receiver Side

3.3 Components used

The Animatronic hand system consists of the following components

- Microcontroller (Arduino UNO)
- 433 MHz RF transmitter and receiver
- Flex sensor
- Servo motor

3.3.1 MICROCONTROLLER (ARDUINO UNO)

For the Arduino it is a microcontroller board and it works with the ATmega328P high performance chip and it serves as the foundation it is a single chip. It is 16 MHz ceramic resonator, six analogue inputs, 14 digital input/output pins, which six can be utilized as Pulse Width Modulation outputs, The microcontroller has a power plug port, an ICSP header, a reset button, and a USB port that is used to send code from a computer to an Arduino. The Arduino runs on a 5V power supply by default. All necessary components are provided to support the microcontroller. The fundamental concept behind Arduino is that you create your code in an efficient programming environment, upload it to the board, and the microcontroller uses it to interact with other parts.

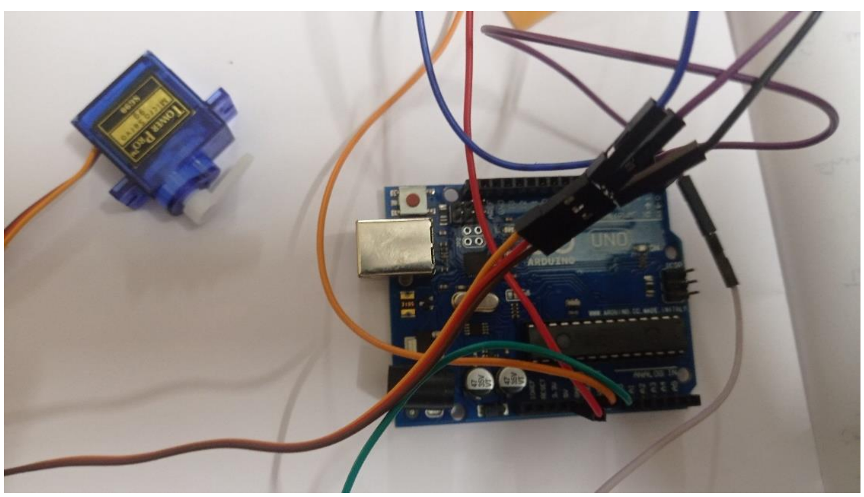


FIGURE 3. Interfacing of Severo motor with Arduino

3.3.2 433 MHz RF TRANSCEIVER

RF transceivers and receivers operating at 433 MHz are frequently employed in wireless communication applications. Here's some basic information about them, This is a device that sends radio frequency signals at a frequency of 433 megahertz (MHz). It is typically used to transmit data or control signals wirelessly over short to moderate distances. These transmitters are often used in remote control systems, wireless sensors, and various IoT (Internet of Things) applications. This component is designed to receive signals transmitted at 433 MHz. It's commonly used in conjunction with the transmitter to establish two-way wireless communication. The receiver demodulates the received RF signals and provides the output data for further processing. It's also used in applications like wireless remote control systems, weather monitoring, and home automation. Together, a 433 MHz RF transmitter and receiver can enable wireless communication between devices, making them useful in a wide range of applications where wired connections are impractical or inconvenient.

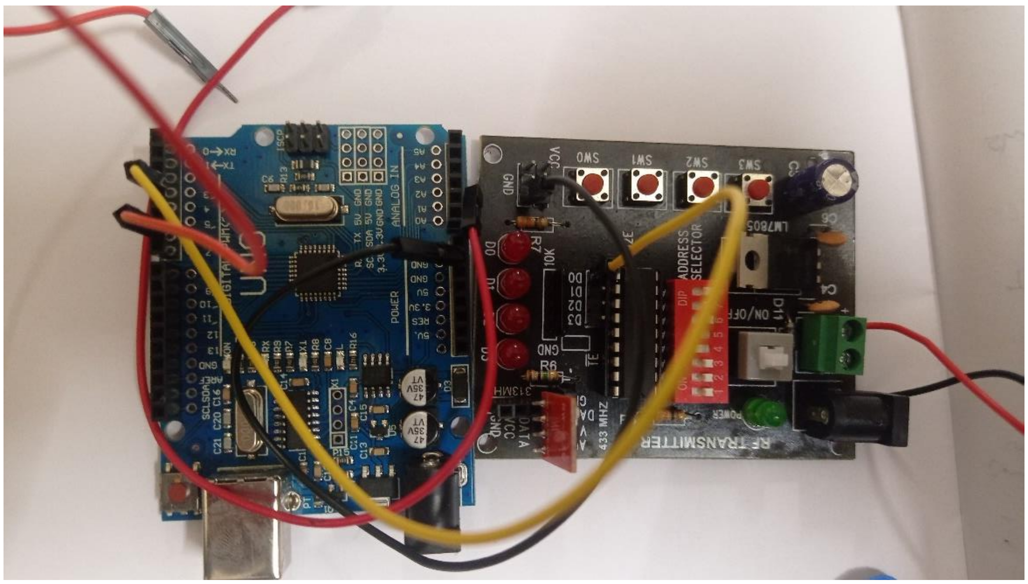


FIGURE 4. Interfacing of RF Transmitter with Arduino

3.3.3 Flex Sensor

A sensor that gauges how much a material is bending or flexing is referred to as a flex sensor, sometimes known as a bend sensor. It is frequently employed in robotics, medical equipment, electrical gadgets, and other fields where it is necessary to quantify physical movement or deformation. A typical flex sensor is made of a thin, flexible material such as plastic or rubber that is coated with a conductive material such as carbon or metal. When the sensor is bent or flexed, the material's resistance varies, and this change in resistance is used to calculate how far the material has bent or flexed. Some common applications of flex sensors include motion sensing in robotics and gaming controllers, bend sensing in medical devices, and position sensing in industrial machinery. They are also used in sports and fitness equipment to measure body movement and muscle activity.

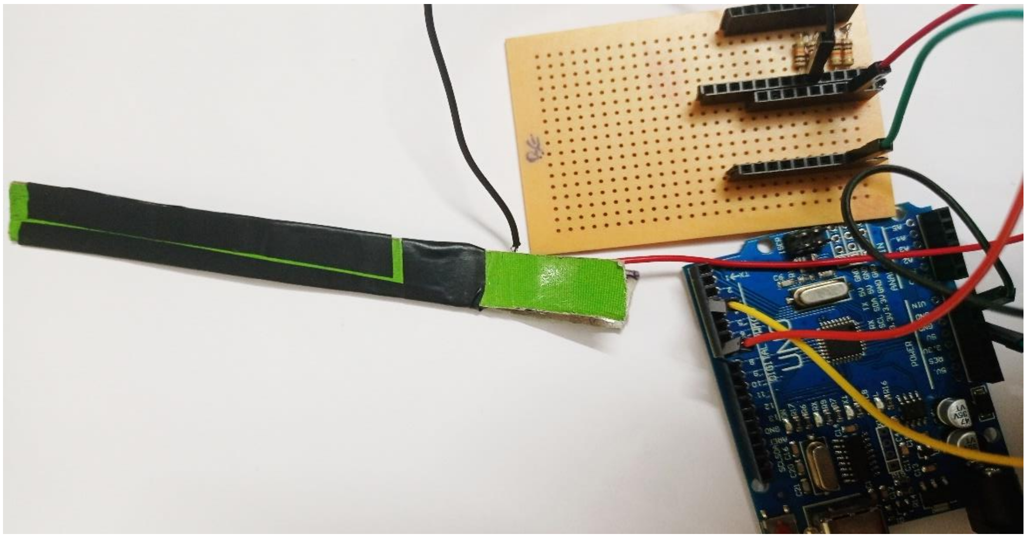


FIGURE 5. Interfacing of Flex Sensor with Arduino

3.3.4 Servo motor

In robotics, automation, and other fields where fine movement control is necessary, servo motors are a typical type of motor. It is a rotary actuator with fine control over rotational angle, speed, and direction. A gearbox, a control circuit, and a DC motor make up a conventional servo motor. The motor receives signals from the control circuit telling it how much to rotate and in which direction. The gearbox aids in boosting the motor's torque, enabling precise movement of big loads. Servo motors are frequently employed in equipment for automation, robotics, CNC machines, and 3D printers

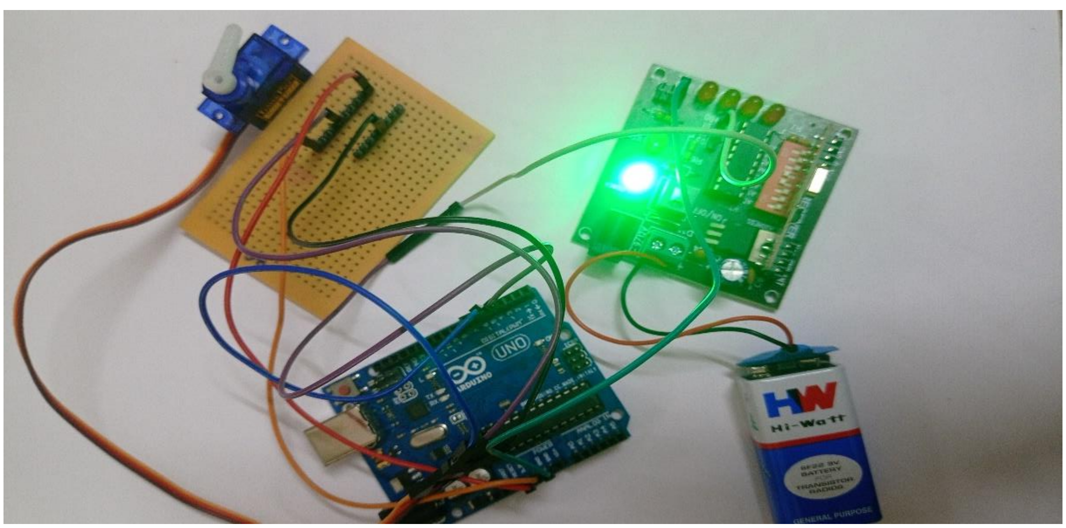


FIGURE 6. Interfacing of Servo Motor with Animatronics Actuator unit

4. RESULTS AND DISCUSSION

The working principle of this animatronic hand consists of having a thread wire going through each finger which is then connect to the horn of a servo motor; so we have an actuation system made up of five servo motors. When the flex sensor bends or the motor shaft tilts, the servo motor receives a control signal, often a pulse-width modulation signal, indicating the intended position. The duration of the pulse determines the position of the shaft, with shorter pulses indicating a lower position and longer pulses indicating a higher position. And it is connected to the Microcontroller (Arduino Uno). The code written in the Arduino IDE is executed by the micro controller, which sends signals to the input/output pins to control the electronic components. The USB interface allows the board to be for programming and connection with a computer, and power supply provides power to the board and the connected components. The Arduino microcontroller board provides flexible also user-friendly platform to creating a electronic initiatives. Our hand motion was tracked by Flex Sensors, it output is feed to the Micro controller. A flex sensor involves the use of a flexible substrate material and conductive material that changes its resistance when the sensor is bent or flexed. The resulting electrical signal can be measured and used for a variety of applications, such as robotic hand control, motion sensing, and wearable technology. According to our hand motion Micro controller sense the motion and actuate the actuation system to generate a signal also to connected the 433 MHz RF transmitter to send the signal in receiver side. The receiver side 433 MHz RF receiver receive the signal to sent the Microcontroller in this signal of the degree from the flex sensor bends the degrees are sent to the micro controller and based on it the servo motor actuates and robotic hand bends relatively how the human hand bends

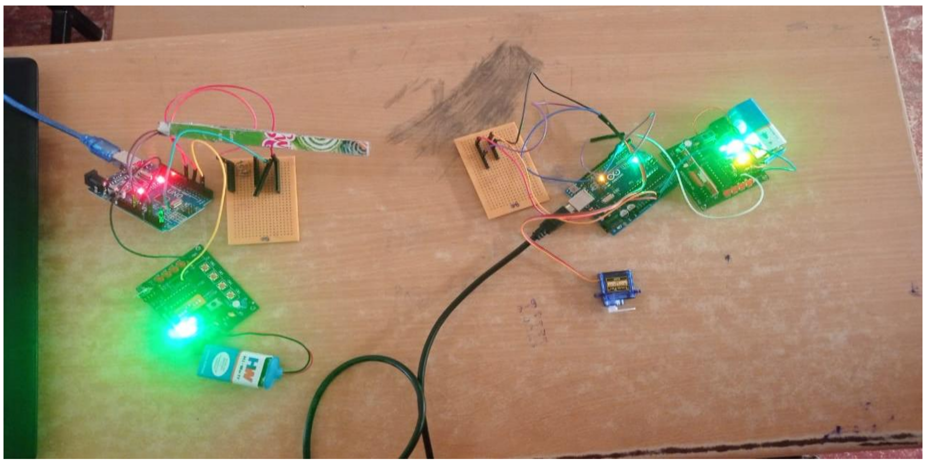


Fig 7. The Overall Connection of wireless Animatronic hand

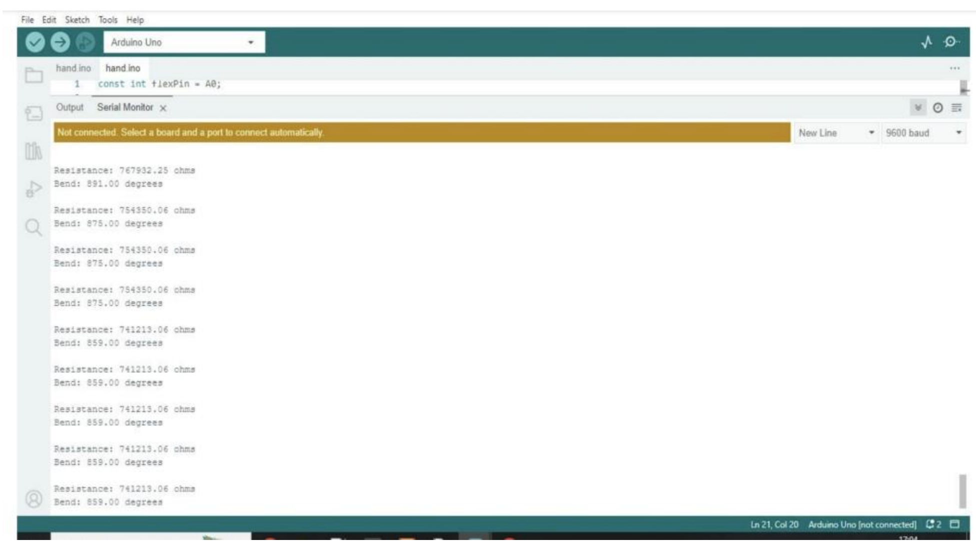


Fig 8. The output of wireless Animatronic hand the output result of the system.

5. CONCLUSION

This study could be used as a basis for developing robotic hand is a complex and challenging project It needs in-depth research, design, also testing. The purpose of this project to create an device it can accurately and precisely manipulate objects, adapt to changing conditions, and integrate with other components of a larger robotic system. To achieve this goal, the design of the robotic hand must take into account a range of factors, including the materials used, the type of sensors and actuators employed, and the programming and control systems utilized. Additionally, safety considerations must be paramount throughout the entire design and development process to ensure that the robotic hand operates safely in various environments. At some places of employment, such as nuclear reactors and thermal power plants, where serious potential danger to human hand is foreseeable, human presence and mobility are restricted. It is used to prevent our workers hand in machinery industries and chemical industries. The potential applications of a robotic hand are vast, ranging from manufacturing to healthcare to space exploration. A successful project can lead to increased productivity, safety, and efficiency in various industries, and open up new possibilities for innovation and advancement. The Future research can develop a advanced sensors, actuators and cameras as well as integration of Artificial Intelligence and Machine Learning algorithm to enhance the hand functionality.

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DOI: https://doi.org/10.15379/ijmst.v10i2.2931