Wireless Vehicle With Animatronic Hand

Akshay Shenoy[1], Darshan Sawant[2], Prathamesh Vengurlekar[3], Vedant Vartak[4],Nilesh Gode[5]

Electronics & Telecommunication Engineering Department, Atharva College of Engineering, Malad West, Mumbai

Abstract: *Use of mechatronics to create machines which seem animate rather than Robotic is called Animatronic. Animatronic models are normally powered by pneumatics (compressed air), and in special instances, hydraulics (pressurized oil), or by electrical means. The figures are precisely designed with the exact dimensions and proportions of living creatures. "Muscle" movements, such as limbs to create realistic motions are imitated using motion actuators. Thus in this project a Animatronic hand is developed using NRF-24L01 module and Arduino UNO. The main aim of this paper is to show the use of wireless communication and its application by developing Animatronic Hand which can be used in many fields like medical, bomb diffusion, chemical industries.*

Keywords: *Animatronic, NRF, Ardiuno Uno, Flex, Servo Motor*

I.   Introduction

Wireless animatronic hand is basically a robotic hand which is implemented by using a latest wireless technology. Intension of this product is to help/get involved in many of the industries where human hand is must to complete the required task; but it may harm human skin or bones. Here, instead of using actual human hand, we can replace it by this wireless robotic hand. We may allow this robotic hand to complete the same task so that the risk will be avoided and obviously, required task can be achieved. For example, during bomb diffusing operation in defense field, this Animatronic hand can be mounted on a moving platform along with a camera to diffuse the bomb from a safer distance without any harm to human life . Also this hand can help dumb and deaf people to interact with sign languages. The project idea came to us after watching the movie named "Real Steel". We wanted to make a shadow robot from our curiosity. As the whole body of the robot would have been of much cost, We decided to make a shadow hand instead. Approximating the kinematics of the human hand was our top priority when developing this animatronic hand. Each joint of this hand has a movement range again the same as or very close to that of a human hand, including the thumb and even the flex of the palm for the little finger. Future efforts would be made to make this hand more flexible, more precise and moveable from one place to another.

II.   Block Diagram

The ATmega 328p microcontroller is used as a main controlling unit. GRBL shield helps as a interface between stepper motors and controlling unit. According to instructions provided by the software the rotary tools performs required motion in 3 axes simultaneously.
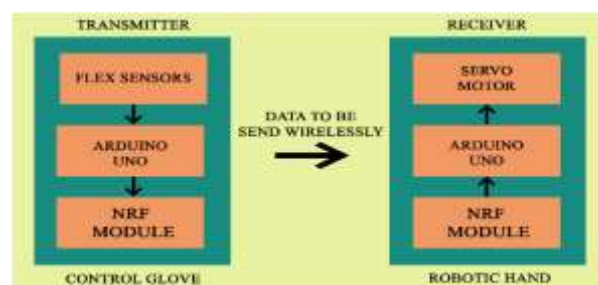

Fig 1: Animatronic Hand Block Diagram

III. Hardware Components

Arduino UNO: Arduino UNO is Atmega-328 based microcontroller board. It is very simple and powerfull board with ISP mode. . It has total 14 pins including digital and analog pins. There are 6 PWM(Pulse Width Modulation) output pins on this board. Also, it has 6 analog inputs, a USB connection, a power jack, a 16 MHz ceramic capacitor, an ICSP header and a reset button. The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.The power of the Arduino is not its ability to crunch code, but rather its ability to interact with the outside world through its input-output (I/O) pins.

Flex Sensors: These devices are used to measure the bending in the finger by change in the resistance. As the bending angle increases , the resistance increases and this variable resistance is converted into voltage by a voltage divider network and given to ADC for digital conversion. Varying the value of the resistor will results different readings. With 22k Ohm resistor I will get values between 300-700. This works fine for us. In our code we assumed that all values under 400 mean that the sensor is bend. All values above 600 mean that sensor is nor bend. Note that Flex sensor give reliable readings ONLY if you bend it on the specific direction (usually towards on the text side of the sensor).

nRF Module: The nRF24L01 is used on a wide variety of applications that require wireless control. They are transceivers which this means that each module can transmit and receive data. These modules are very cheap and you can use them with any microcontroller (MCU). Specifications nRF24L01 – 2.4GHz RF Transceiver.

Servo Motor: A rotary actuator that allows for a precise control of velocity, acceleration as well as an angular position is known as a servomotor. Servomotor is a motor suitable for use in a closed loop control system. It includes suitable motor coupled to a sensor to get a position feedback. To handle the finger movements and rotations, micro servo motors are being used in this project.

IV. Proposed System

Our project is basically divided into three sections. The Animatronic Hand is placed on wireless vehicle which is controlled by RF module.
The following three sections are:

The Glove:

Let us consider the first section of the animatronic hand in which the flex sensors are used,the flex sensors are use for capturing the moment of the fingers which work on the principle of resistance.Then we use Arduino Uno which is capable of reading the inputs like capturing flex moments and produces an output like rotating a motor.Then we have nRF module series which is used for transferring wireless messages through air.

The Hand:

Now let us consider the second section which is the hand in which we use 5 servo motors which drive the hand moment using a fishing line which runs from servo till the fingers.In this we also use nRF module and Arduino which receives the wireless messages which are transmitted from the golve.It can move its fingers individually from the instructions.

RF Vehicle:

The Animatronic Hand comprises of glove and hand section which is mounted on RF vehicle. We are using vertical shaft gear and pinion gear for Up-Down movement of Animatronic Hand. Both gears work in coordination with servo motor. The vehicle is visually controlled by wi-fi camera.

V. Applications
1. For use in chemical industry for safety point of view to human hand.
2. As a part of humanoid robot to perform various task.
3. In medical field for physically challenged patients.
4. For military use in bomb defusing.
5. Can be used in Space for repairs of Space Station.
6. Can also be used for household applications.

VI. Conclusion

One thing we learned from this project is that servos and flex sensors in positioning, timing and environmental texture can lead to all sorts of undesirable readings. We were a bit disappointed with the performance of the SG90 servos in this particular use case, It required a lot of the fine-tuning to get readings accurate as the servo rotated. Although the Animatronic hand did not operate with no errors, it is a great success overall. The Animatronic hand met all safety restrictions, easy to operate and energy efficient. This types of animatronic hand can be used for various puposes. The Animatronic Hand can be implemented in all the sectors where human interaction is needed, like-Handling of the explosive objects, performing various sophisticated operational jobs in the medical sectors, Industrial manufacturing etc. With more time and resources put for things like motors and base design we can carry a much larger payload and have a sturdier platform to carry things in.

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