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# Human Arm Controlled Wireless Robotic Arm

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**Abstract -**

*This paper discusses the design of robotic arm, which has controlled by the human arm using flex sensors for sensing the finger movements and accelerometer sensor for wrist and arm movements. ATmega328 controller has used at the sender and receiver sections. Further, the servomotors have used to drive the robotic arm. With the help of Xbee-s2 transceivers wireless communication has implemented. It enables the user to communicate with robotic arm from 300ft or 100m distance. Finally, this prototype of the arm has expected to overcome the problem such as placing or picking hazardous objects or non-hazardous objects that are away from the user in Industries and Military.*

**Keywords- Flex sensors; Accelerometer sensors; ATmega328 controller; Xbee-S2 transceiver.**

## 1. INTRODUCTION

In present technology, most of the robots work according to the program and performs as per the programming instructions stored in its processor. These type of robots have wide range of applications but they are lacking interaction with human. In certain applications like bomb diffusing in military and handling with hazardous chemicals in industries there is risk for human life. If robots perform these tasks then continuous monitoring and controlling is required because human intelligence is a need for decision-making. Hence, there is a need to have great direct interaction between Human and Robot so that it can perform the assigned work as required by the user at that instant of time.

The direct interaction is possible with animatronics. Animatronics refers to the use of robotic devices to emulate a human or an animal as per the human requirement. This allows us to take on this advantage into inaccessible areas for humans. Today the robots can move freely, and are capable of doing dangerous work in difficult areas. This not only provides us a way to access inaccessible hazardous environments, but also opens ways to make various tasks easier and more efficient in day to-day life.

This paper discusses the capability of a robotic arm in performing the actions in resemblance to the human arm like grabbing, releasing and lifting the objects. In order to control a robot we need a human operator, in this project the human operator is the human arm. As per the movements in fingers and wrist of the human, the robotic arm emulates corresponding actions.

This project contain mainly two parts transmitter and receiver section The transmitter section has flex sensors and accelerometer sensors and Arduino Nano for processing and Xbee for transmitting the data The receiver section is followed by the Xbee receiver, Arduino Nano for receiving servo motors are connected to Arduino which in turn operates the mechanical robotic hand.

## 2. LITERATURE SURVEY

Rodriguez, N. E. et. al (2006) has adapted a remote operation system for a robotic arm by using infrared sensors to control the movements. Graphic interface has achieved through Visual Basic in this project. This project has a limitation where the infrared can only communicate in a short range. [1]

Mastura binti Muhammed et. al (2008) has made a robotic arm that has five separate movements to grab, rotate wrist and pivot sideways controlled by five servomotors. This project described a new approach from wired to wireless technology added with Graphical user Interface (GUI). The drawback of this system is that, the arm cannot rotate to the desired destination flawlessly. Noise in wireless communication is another disadvantage. [2]

Joaquin Ortiz et. al. (2005) worked on a robotic arm that can distinguish a colour for a golf ball using LabVIEW as a program to control the robot. However, LabVIEW becomes
inefficient when designing complex control algorithm.[3]

This paper discusses the robotic hand, which records the gesture using the MATLAB. Hand implementation had

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done in three steps. First step was hand segmentation the next step was to track the position and finally the orientation of the hand. [4]

Jagruthi P. Gour et.al (2017) has made animatronic hand using Arduino UNO in order to grab and release objects. The drawback of this project is it cannot lift the objects, which was required for industrial needs. [5]

The 'Human arm controlled wireless robotic arm' aims for lifting, grabbing and releasing the objects according to the movements of human arm. This project is compact in size while compared to previous models and wireless communication has achieved up to 100m.

## 3. METHODOLOGY

Figure 1 completely describes the implementation of the project. It consists of three sections:

1. Human arm section
2. Communication section
3. Robotic arm section

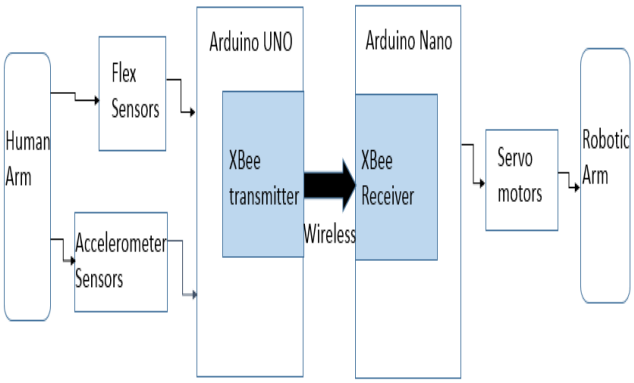


Figure 1:Block diagram

1. The Human arm section comprises of flex sensors, accelerometer sensors , Arduino UNO.

   i) Flex sensors[6]: A mechanical device which provides a variable resistance values after bending it is known as a flex sensor. A flex sensor is also known as a potentiometer or a variable resistor. Flex sensors are basically made up of resistive carbon elements. A flex sensor has a flexible thin substrate, as a variable printed resistor. When the substrate is bent, potentiometer or a flex sensor produces the output resistance as per the bent angle. Here there are two bent angles the straight resistance is 33 kilo ohms and 90 kilo ohms bent resistance when the finger is bent.

   ii) Acceleromter sensors:. An accelerometer is a transducer that is used to measure the physical or measurable acceleration that is made by an object. It is an electronic device that is used to measure the specific force of an object i.e., a force obtained due to the phenomenon of weight exerted by an object that is kept in the frame of reference of the accelerometer.In the case of static acceleration, the device is mainly used to find the degrees at which an object is tilted with respect to the ground. Accelerometer sensors are used to sense the arm movement in human hand.

   iii) Arduino Uno: The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

2. The robotic arm section comprises of Arduino nano, and Servo motors.

   i) Arduino Nano: The Arduino Nano is a small, complete, and breadboard-friendly board based on ATmega168 (Arduino Nano 2.x). This has used in the receiver section in order to make the receiver unit more compact.

   ii) Servo motors: A servo motor is a rotary actuator or motor that allows for a precise control in terms of angular position, acceleration and velocity.The receiver section arduino data is given to the servo motor it further drives the mechanical arm.

3. The communication section consists of Xbee Transceiver.

   i) Xbee Transceiver: Xbee transceiver uses Zigbee protocol. Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small. This is used to communicate wirelessly with robotic hand.

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## 4. WORKING

The complete working of 'Human arm controlled wireless Robotic Arm' has explained in the algorithm shown in Figure 2.

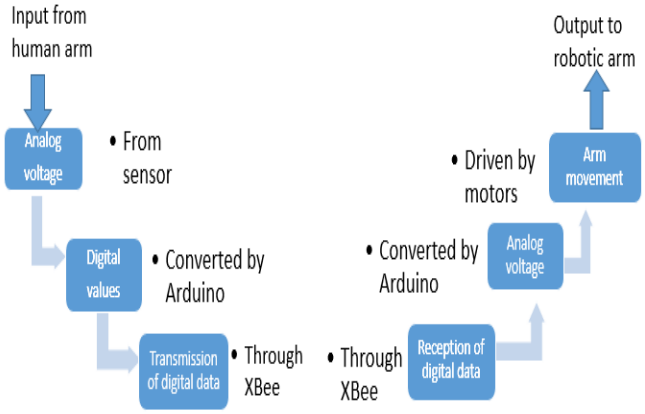


Figure 2: Algorithm

### A. *Hardware*

The input has taken from the human arm through the flex sensors. The finger movements are taken from the flex sensor. The flex sensors produce analog voltage corresponding to the finger movements of the user. The analog voltage is given to the analog pins (A0-A4) of Arduino Uno. The Arduino converts the analog voltage into digital values. These digital values are send to Xbee transmitter by connecting to the RXD and TXD pins of Arduino. Xbee transmitter transmits this data.

The Xbee receiver receives this digital data and gives to the Arduino Nano, which process the data. The output has taken from the five digital PWM pins of Arduino. Further, given to the respective servomotors. The servomotors rotates 180 degrees maximum. As per the user movements the servomotors rotates and the robotic hand moves and performs the task it may be picking or releasing.

Similarly, for the arm movements the accelerometer sensors are used. Accelerometer sensors are electronic device, which finds the degrees at which an object is tilted with respect to the ground. This sensor senses the arm movement and the respective voltage or value has transmitted through Arduino (A5 pin) and Xbee transmitter. Xbee transceiver uses ZigBee protocol for wireless communication. The receiver receives this and a DC motor rotates the elbow of the robotic arm. Elbow movement is needed in order to lift the objects that are placed on ground. Finally, for any action to be performed by a robot the basic operations are lifting, grabbing and releasing the object. Our project aims to perform these actions by using the components listed in the methodology.

### B. *Software*

The Arduino software is a freeware and simple to download that is available in the Arduino's website. Arduino is programmed as follows:

1. The program is written in the editor of the Arduino.exe software. The corresponding library files must be preloaded.
2. After the completion of the program, it must be debugged for errors. If there are no errors it can be simply uploaded in the Arduino Uno or Nano easily with the help of USB cables.
3. Then the program can be uploaded from option in the menu section

Figure 3 and Figure 4 shows the programming code written for transmitter and receiver Arduinos.

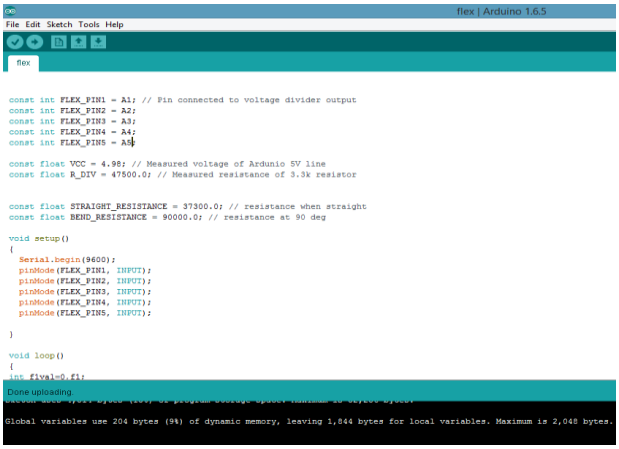


Figure 3: program for Arduino Uno in the transmitter side

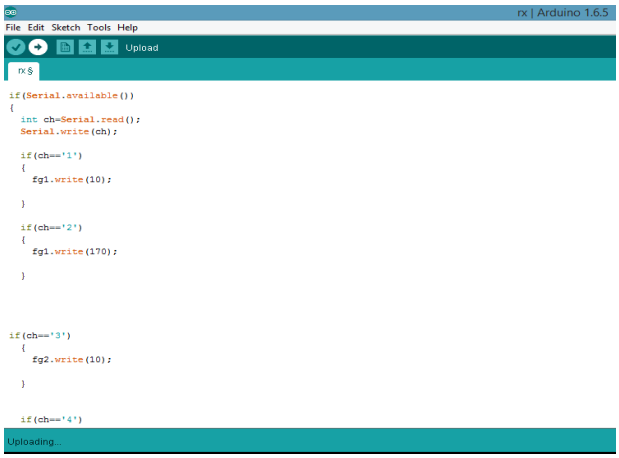


Figure 4: program for Arduino Nano in the receiver side

## 4. RESULTS

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The object grabbing and releasing can be observed in the below figures. Figure 5 shows the object grabbing. Figure 6 shows the object releasing. Figure 7 shows the object lifting.

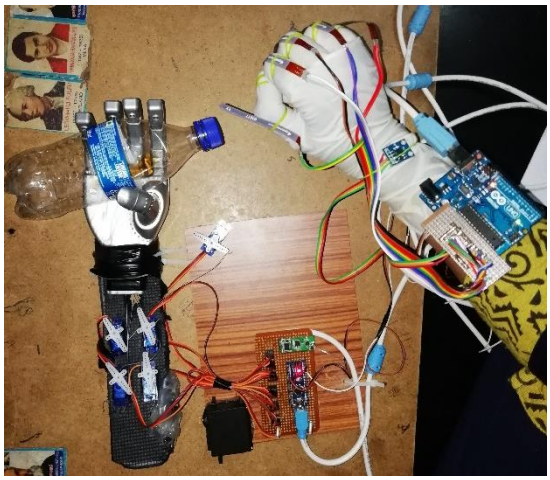

Figure 5: Object grabbing

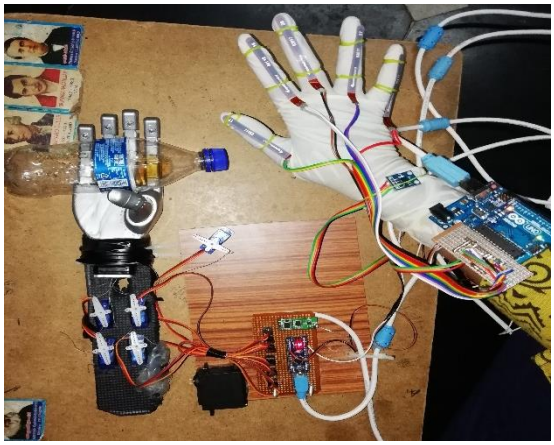

Figure 6: Object releasing

Figure 7: Lifting (arm movement)

## 5. Conclusion

This project Human arm controlled wireless Robotic arm is a successful implementation. The objectives of this project has been achieved and the robotic arm is able to lift, grab and release the objects accurately as per the user instructions from a distance wirelessly. This can be used in military and other industries to perform dangerous tasks under the guidance of human by viewing the robotic arm actions through a prefixed camera from a distant location. For further advanced applications, the range of wireless communications have to be extended by using better transceivers. If the application insists, a moving arm can also be developed. Finally, the realistic appearance of robotic arm is possible with 3D technology, which helps to give more precise and accurate results.

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