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Gesture Controlled Robotics arm using Image Processing

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***Abstract*— The combination of mechanical, electronic, informative, computer science and many other engineering that aims to replicate the behavior of humans, or to make tasks automated and easier is called Robotics. Robots can be used to perform many different types of tasks under various environments.**

Most of these environments are those that can be lethal to humans like those of radioactive radiations. Other environments include those that are beyond the reach of humans such as far into space or deep underground. There are tasks like carrying a moving a lever up and down twenty thousand times a day, which is not possible for a human. This is where a robot steps in. A robot can go to far off space like Mercury and send high resolution pictures back here to our planet earth. A robot can go deep inside our earth, study the soil and send back data. A robot can work on nuclear power plants with radiations have zero to negligible effect on it. A robot can be used to do automated tasks without getting tired. In this paper, our aim is to make a gesture-controlled arm robot that is better, and an improvement over the existing system.

Keywords—Mechanical, Electronics, Radiation, etc.

I. INTRODUCTION

Robotics is a growing field in research and in day-to-day life due to the wide range of applications in the military (defense and transport), industry, etc. Many predefined tasks, such as welding, painting, and other ones, are frequently carried out by robots at work [1]. This type of issue can be safely solved by UGVs equipped with robotic arms. Robots are also employed in a variety of other inappropriate or extremely risky contexts, such as the use of explosive bags that can detonate upon opening. A human-sized robot known as PUMA (3.2017) [3] can perform a variety of tasks including removing waste from industries, mixing or working with hazardous chemicals, and testing weapons without running the risk of endangering human lives.

Gesture robots are machines that react to your face, arms, or legs moving[2]. To operate the robot with hand gestures, you simply need to hold a small transmission device with an accelerometer and flexible sensors in your hand. The robot will receive the proper command from it and be able to carry out our instructions [4]. Robotic arms can be configured to move like a human hand, making them useful tools [1][2]. Such an arm can mechanically move both in a rotational and a reciprocating direction thanks to the numerous joints, motors, and gears that make up it. The Arduino algorithm interface is then used to manage it [5]. The manufacturing sector has made extensive use of robotic arms as part of automation systems. Robotic arms are frequently used in industry for tasks including welding, painting, assembly pick and place, packaging, product inspection, and testing.

The robotic arm in this project can be wirelessly controlled and has grab-and-release capabilities similar to a human arm. The user must use his own hand gestures to control the robotic arm's movement because it is entirely controlled by an Arduino-based microcontroller system. The transmitter circuit, which has an accelerometer and flex sensor connected to an Arduino microcontroller, is mounted on the hand glove[3]. The binary data from the microcontroller is encoded into serial data for transmission. To enable wireless signal transfer between the transmitter and receiver circuits in this case, we used a pair of RF Modules (XBEE). The Microcontroller (Arduino) at the reception circuit will take in and process the signal from the transmitter[4]. The driver IC processes the valid signal after which it controls the motor unit to move the arm in the desired direction. The received command indicates whether to move the robotic arm upward or downward, or whether to grip an object or release it because it has two degrees of freedom [5][6].

II. TERMINOLOGY

A. Flex Sensor

A sensor known as a flex sensor or bend sensor is used to measure the degree of deflection or bending. The surface to which the sensor is typically attached can be bent, changing the resistance of the sensor element. It is used as a flexible otentiometer and is frequently referred to as a goniometer because the resistance is directly correlated with the degree of bendMaintaining the Integrity of the Specifications

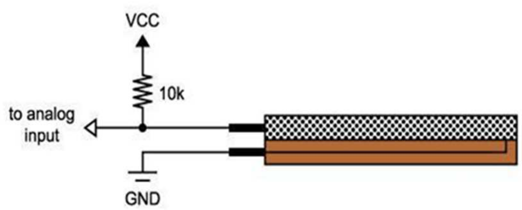

Figure 1. Flex Sensor

B. *Accelerometer Sensor*

An electromechanical device for measuring accelerating forces is called an accelerometer. These forces can be static, like the constant pull of gravity on your foot, or dynamic, like the movement or vibration of an accelerometer

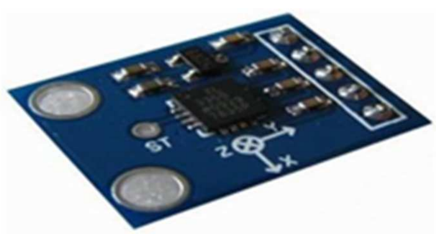

Figure 2. Accelerometer Sensor

C. *Arduino*

Makers, tinkerers, and hobbyists can create and construct objects that interact with the physical environment using an Arduino, an open hardware development board[6].

Different Types Of Arduino Boards

a. Arduino Uno (R3)(analogue I/O: 6 input,0 output)
b. Arduino due(analogue I/O: 12 input,0 output)
c. Arduino Mega (R3)(analogue I/O: 16 input, 0 output)
d. Arduino Leonardo(analogue I/O: 12 input,0 output)

Figure 3. Arduino

D. *Xbee*

A family of form factor compliant radio modules manufactured by Digi International go by the name Digi XBee. The first XBee radios were introduced in 2005 under the MaxStream brand and are based on the IEEE 802.15.4-2003 standard designed for point-to-point and star communications with a direct transmission rate of 250 kbit/s [8].

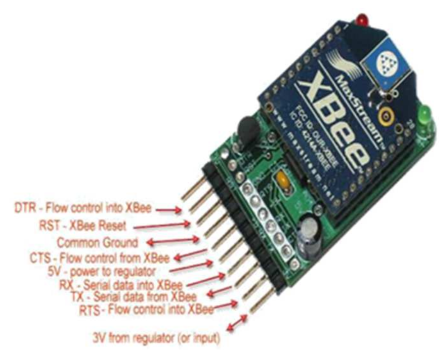

Figure 4. Xbee

III. PROPOSED SYSTEM

The proposed system is a robot with an arm controlled by hand gestures. The input in the form of gestures are made by the glove worn by the controller. The data is communicated by the two xbee(s) connected at the transmitter and receiver end[16-18].

The robot is designed to:

1. Move in all direction.
2. Hold, plus lift and object.
3. Move an object from one place to another.

Applications of the robot

1. Agriculture.
2. Medical science.
3. Diffuse bombs.
4. Production plants and factories.
5. Warehouses

6. National security.

IV. Comparison With Existing System

TABLE I. Comparison With Existing System

Batter Back up	Lower Batter Backup	Higher Battery Backup
Motor	Uses Servo motor in the arm	Uses gears and DC motor for greater strength to the arm.
Capacity	Can hold / life up to 100g.	Can hold / life upto 500g.
Movement	Not compatibile for movements in all directions	Can move in all directions.
Sensors	Can either house a flex sensor or an accelerometer sensor.	Can house both a flex sensor and accelerometer sensor.

The Robot can be classified into two parts:

1. The Transmitter
2. The Receiver

A. Transmitter

Circuit diagram of transmitter:

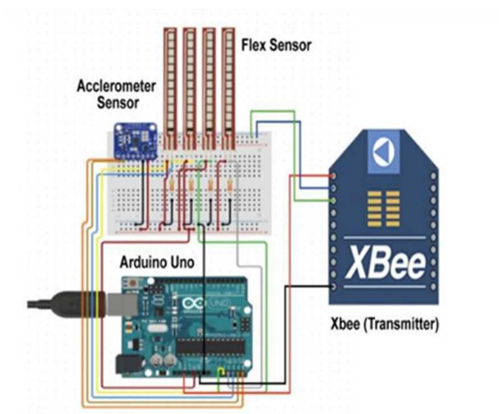

Figure 5. Transmitter

Components used in Transmitter.

1. Flex sensor
2. Acclerometer sensor
3. Arduino Uno
4. XBEE(Transmitter)
5. Power Source (Battery)

B. Receiver

Circuit diagram of receiver:

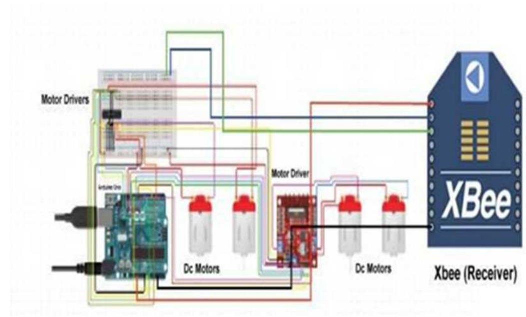

Figure 6. Receiver

Component

1. Arduino Uno
2. XBEE(Receiver)
3. DC-geared motor
4. Motor Driver
5. Power Source (Battery)
6. Robotic Arm (Clamp)

V. Working

The step wise working of the system is given below:

1. Power supply is given to the controller and as well as robot.
2. Input is given to the robot using the controller that is the glove.
3. Input by the movement of the glove is recorded by the Arduino on it.
4. Arduino processes the input are forwards the results to the transmitter (xbee[1]) connected to it.
5. The transmitter on the controller transmit the results wirelessly to the receiver (xbee[2]) on the robot.
6. The xbee[2] forwards the received data to the Arduino on the robot.
7. The Arduino understands the received data, processes it and send asks the motors to perform accordingly.
8. The motors perform the operation.

The list of possible inputs for the desired output is given below.

A. Movement of Robot

- FORWARD DIRECTION: Tilt hand downwards.
- BACKWARD DIRECTION: Tilt hand backwards.
- LEFT DIRECTION: Tilt hand towards left.
- RIGHT DIRECTION: Tilt hand towards right.

B. Movement of Arm and Clamp

- UPWARD DIRECTION OF ARM: Bend index finger.
- DOWNWARD DIRECTION OF ARM: Bend pinky finger.
- OPENING OF CLAMP: Bend middle finger.
- CLOSING OF CLAMP: Bend ring finger.

C. Robot Movement using Accelerometer sensor

This sensor is helpful for robot development. This development relies upon the palm movement of client since client holds this sensor on the palm[7]. Movement might be Forward , Backward, Left and Right course. Here we are utilizing accelerometer to send the hub incentive to the Aurdino. At whatever point client move palm, pivot is changed likewise and worth is sent to the Arduino more than once[8].

1) Forward Condition: When the accelerometer tilts in this direction, the x, y, and z axes are sent to the Arduino. If the x, y and z axes meet the requirements x>=190, y>=20 and z>=0, the robot will move forward[9].

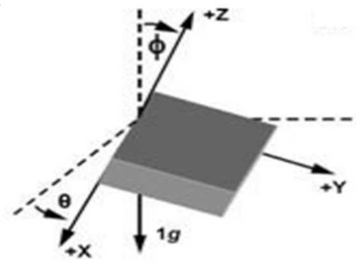

Figure 7. Forward Direction

2) Backward Condition: Despite the user tilting the accelerometer backwards, the x, y, and z hubs are sent to the Arduino in this instance. When the values of the tomahawks' x, y, and z meet the criteria x>=0 and x=20, y>=20, and z>=150[9], the robot retreats.

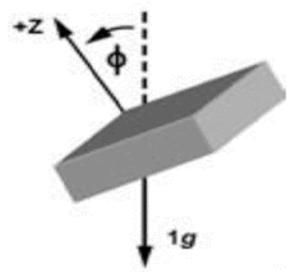

Figure 8. Backward Direction

3) Right Direction: In this instance, the user tilts the accelerometer in the x, y, and z directions, sending the pivots to the Arduino. The robot moves to the right if the x, y, and z tomahawks meet the criteria x >= 0, x = 20, y >= 250, y >= 60, and z >= 1.

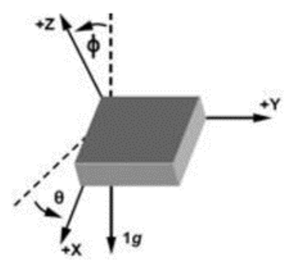

Figure 9. Right Direction

4) Left Direction: In this case, the user's left-tilting of the accelerometer caused the x, y, and z hub to be sent to the Arduino [19-21]. The robot moves to the left in the unlikely event that the tomahawks x, y, and z satisfy the conditions x>=0, x=20, y>=-3, y>=-250, and z>=1.

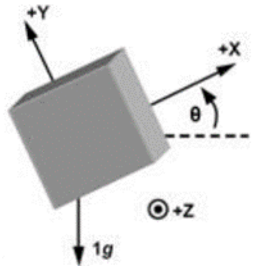

Figure 10. Left Direction

D. Arm and Clamp movement using Flexi Sensor

Flexi sensor contain conductive ink that go about as a resistor. At the point when sensor stay straight opposition, the estimation of obstruction is going to 25k ohm.when it proceed onward 45 degee its worth becomes 62.5Kohm.when it proceed onward 90 degree its worth becomes 100 kohm. Here we have checked opposition on various developments utilizing this equation[10].

$$V_O = V_{CC}\frac{R}{R+R_{Flex}} \quad (1)$$

The way the sensor-equipped globe is worn is seen here. Resistance esteems fluctuate in a similar way to how we move as a body[11].

As degree (movement) increase resistance value also increase.

Resistance(ohms)	Bend(degrees)
37605.7	0
39273.65	3
50865.32	23
71024.95	57
80134.69	73
82346.17	77
93899.54	90

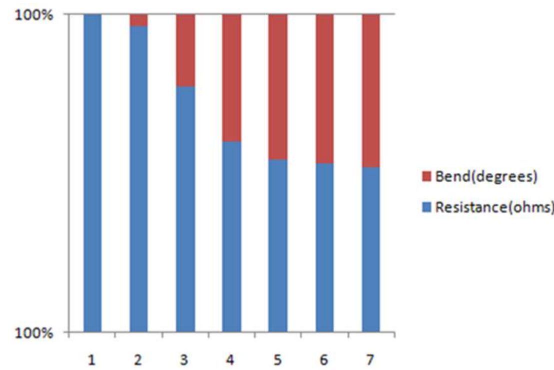

Figure 11. Resistance v/s Blend

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