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DESIGN AND IMPLEMENTATION OF ROBOTIC ARM USING PROTEUS DESIGN TOOL AND ARDUINO-UNO

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Abstract- This paper explores the robotic arm where the ability of a human to do a task is limited but not by his mental power but by his physical strength. In an environment where human interaction cannot be possible to do a particular job where the robots can do. Here we design a robotic arm where it is controlled by the interaction with the human hand using flex sensor, Arduino Uno, RF module (Wi-Fi Module), & servo motor. The system works on the values sent by the flex sensor to the controller, the same is analyzed and calculated how much the arm and the fingers has to move to grab an object which is also controlled by the five servo motors by the controller. The signals are transmitted and received via the Wi-Fi module.

Keywords–Robotic arm ,flex sensor, Arduino Uno, RF module (Wi-Fi Module), servo motor, proteus software.

I. Introduction

Robotic arms are mechanical products that are manufactured and marketed the world at a very high rate. There are thousands of types of arms are available on the market developed by different companies. Industrial use robot arm cannot be used at this time even more than the domestic robot can do the job. It is always use specific objectives and some conditions in the industry where humans cannot work at high temperature, polluted air region, weightlifting and so on. Robot arms are also used for high accurate places where local error are allowed. Robot arm set one tasks, and accurate implementation in a variety of environments. A robotic arm means a group of rigidly connected bodies that can be taken different configurations, and move between these configurations with speed and speed restrictions. Industrial robot arms vary in size and some are fixed body, type of joint, joint sequence. The range of motion to be connected and acceptable at each joint and individual fixtures are called links. Robot arm is made using different parameters such as quantity axis, degrees of freedom, working area and working space that arm cover, kinematics, payload, speed and acceleration, accuracy and repeatability, motion control and arm drive this survey summarizes a developing issue robot arm. People like to shop online rather than buy things and getting them online manually is now everywhere, comparing the last few decades into the Internet only wired, as well as people need to be in front of the computer to access the Internet. Now, the internet is just at your fingertips.We can bring the advantages of robotics into the homeworks. The mechanical and electrical construction are the components used to build the robot arm. Internet controlled robots will connect these wired robotsandhas some space limitations. So in order to avoid this restriction robot control is wirelessly controlled through online. Wireless also means using Bluetooth, however the advancements used here are the most extensive so the WI-FI comes in to picture.

II. Modeling

Programming and control an industrial robot through the use of the robot teach pendant continues to be atedious and long task that needs technicalexpertise. Therefore, new and a lot of intuitive ways that for mechanismprogramming and management are needed. The goal is todevelop methodologies that facilitate users to manage andprogram a robot, with a high-level of abstraction from therobot specific language. creating a robotic demonstration interms of high-level behaviors (using gestures, speech,manual/human steering, from visual observation of humanperformance, etc.), the user will demonstrate to the mechanismwhat it ought to do [1]-[5]. Here many analysis efforts aredirected towards recognizing human gestures, revenant tofinger gesture recognition and hand gesture recognition systems [9]. Accelerometer-based gesture recognition has become progressively standard over the last decade. The low-moderate price and relative tiny size of the accelerometers create it a good tool to notice and recognize human body gestures. many studies are conducted on the recognition of

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gestures from acceleration data exploitation Artificial Neural Networks (ANNs) [9], [10], [11]. However, the particular characteristics of associate industrial environment (colors, non-controlled sources of light, infrared radiation, etc.), the security and dependableness requirements, and therefore the high worth of some instrumentation has hampered the preparation of such systems in trade.

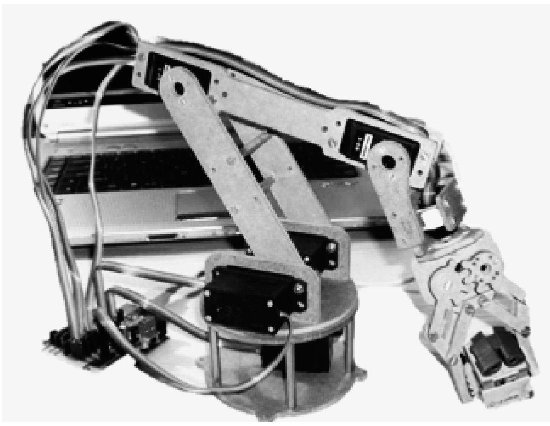

Fig. 1 Robotic Arm Construction with controller.

Given the on top of, the teach pendant continues to be the common robot data input device that provides access to all or any functionalities provided by the robot (jog the manipulator, produce and edit programs, etc.). within the previous few years the robot manufacturers have created nice efforts to form user friendly teach pendants, implementing intuitive user interfaces like icon-based programming [12], color bit screens, a 3D joystick, a 6D mouse [13], or developing a wireless teach pendant [15]. Nevertheless, it remains tough and tedious to work with a mechanism teach pendant, particularly for non-expert users [7]. In this paper is projected associate accelerometer-based gesture recognition system to regulate associate industrial robot in an exceedingly natural way. 2 3-axis wireless accelerometers are connected to the human arms, capturing its behavior (gestures and postures). An ANN system trained with a back-propagation rule was accustomed acknowledge gestures and postures. Finally, several tests area unit done to gauge the projected system.

III. System Overview

The entire system will be thought to start out with the management rig, otherwise called the master unit. This is a glove-like device that the user wears, increased by flex and tilt sensors or potentiometers to live the desired degrees of freedom. These sensors (and associated circuitry) pass analogue voltage values on to an Analogue-to-Digital converter (ADC), connected to a pc through the UniversalSerial Bus (USB). The pc runs a visible Basic vi (VB6) program that reads these analogue values and converts them into digital positional and speed values that it then sends to the server computer via Windows' wireless networking. The server pc, running a VB6 program, receives thedata and forwards it to the Serial Servo Controller (SSC) by way of an RS232 connection. The SSC takes an index, position, and speed value, and controls the corresponding servo motor on the Robotic Arm (the slave unit). The current through every servo motor is measured as a voltage level, and so well-versed a USB ADC connected to the server pc, that successively passes it back to the consumer computer for process. With the present activity from every servo motor [5], the client calculates the suitable force being exerted on every servo motor. It then sends this data through the USB ADC (which incidentally has digital I/O as well) to the feedback circuitry that successively controls the arm parts of the master unit.

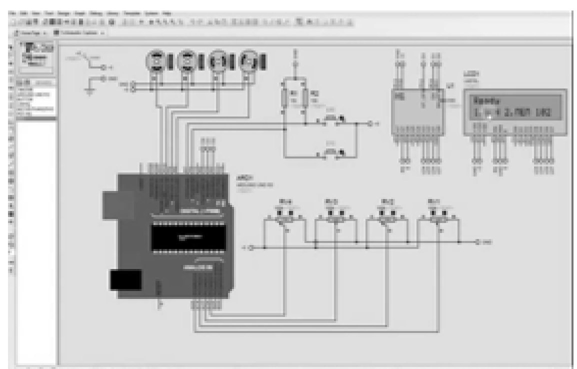

Fig. 2 Usingproteus design too for a Robotic Arm Construction.

Master-slave management is often divided into two categories - Unilateral and bilateral systems [11]. Unilateral the only type of feedback system is through visual media, andthat makes it easier to implement, which makes it smart more difficult to manipulate. Just as a bilateral system under investigation. Here is the opposite, but requires a higher quality lead to greater dexterity.Management equipment can be a glove-like device that covers the hand and arm to the user's shoulder. It measures six-degree freedom between four joints: thumb and finger, wrist, elbow, and shoulder. The entire system is placed on a surface where the arm and the remaining parts are made of hard card board sheets has a coplanar movement, such as elbow movement, or wrist and forearm vertical movement between measurement using a flexible sensor, a lightweight element once bent and increases the resistance. Rotation mensuration is employed to attain optical versatile detector that measures bending and twisting [14]. However, owing to its comparatively high value, tilt sensors and accelerometers looks better than the other one. The human arm and potential joint positions are relative to every different value of the rotary encoder.

IV. Methodology

The 3-axis measuring instrument connected to the correct arm is employed to recognize gestures (dynamic arm positions) and postures (static arm positions), whereas the measuring instrument connected to the left arm acknowledges the postures accustomed activate and deactivate the system (only 2 postures).

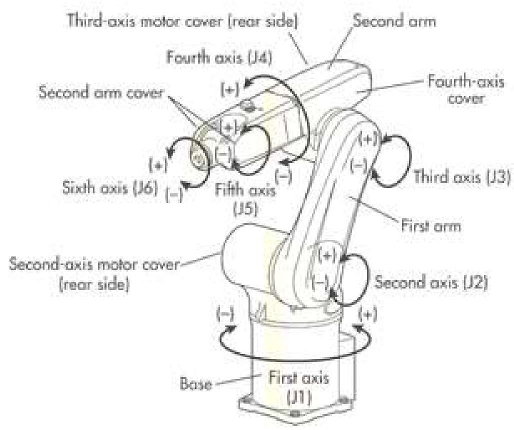

Fig. 3Shows the generalized way of axis present.

In apply, the user ought to create a gesture with the correct arm and at the same time use the left arm to activate or deactivate the system. once activated, the system acquires information from the accelerometer connected to the correct arm, acknowledges the gesture or posture and starts the golem movement. Performing a specific posture with the left arm, the robot stops. If the user ne'er stops the robot, the robot continues the movement up to the limit of its field of operation [12]. An ANN system trained with a back-propagation algorithm was accustomed acknowledge gestures and postures. The ANN system has as input the motion information (extracted from the accelerometer connected to the correct arm) and as output the recognized gestures and postures. The application that manages the cell receives information from the accelerometers, interprets the received information and acts in the robot. So even a Bluetooth can be a vital to require into consideration the dependability of this kind of communication and use it with care. The system here given is incessantly receiving information from the measuring instrument connected to the left arm and if the communication fails, the robot at once stops. According to the user right arm behavior, the automaton is moved from the current cause to the limit of its field of operation, or additional specifically, for a cause near the limit of the robot field of operation. the sphere of operation of a 6- DOF automaton manipulator is more or less a volume region bounded by 2 spherical surfaces. This way, it can be considered that the sphere of operation of the automaton is delimited by 2 spherical surfaces (1), each with the center coincident with the zero point of reference of the robot, and where R_{ext} and $R_{int}$are the radius of the external and internal spherical surface.

$$(x,y,z)=(x_r, y_r, z_r)+k.(d1,d2,d3),k=R \text{----------} (1)$$

$$x^2+y^2+z^2 \leq R_{ext} \& x^2+y^2+z^2 \geq R_{int} \text{-----------------}(2)$$

From (1) and (2)

$$(x_r+d_1*k)^2+(y_r+d_2*k)^2+(z_r+d_3*k)^2=R^2_{ext} \text{--------}(3)$$

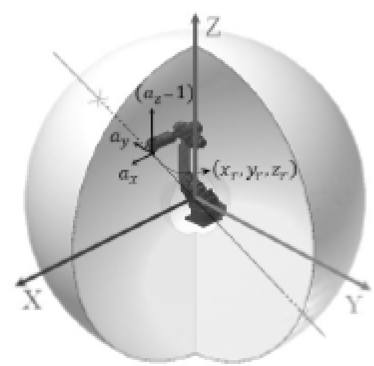

Fig. 4 The two sphere surface that defines the robot field of operation.

When the arm is stirred within the positive X direction (X+) (Fig. 4), ab initio the worth of acceleration x a will increase because the arm begins to maneuver so, once the arm begins to slow the positive price of x a isborn-again to a negative price. this time (a zero x =) marks the purpose of maximum speed. The acceleration a y remains almost zero and z a remains almost one as a result of the measuring system is held horizontally (acceleration attributable to gravity) [13]. A similar reasoning may be done to the opposite gestures (X-, Y+, Y-, Z+ and Z-) To interpret the acceleration values and acknowledge the right arm movements (X+, X-, Y+, Y-, Z+ and Z-), an ANN trained with a back-propagation algorithmic program was enforced into the system. in an exceedingly initial approach, the acceleration values (from the start of the movement to the primary purpose of zero acceleration (maximum speed)) were used as input pattern for the ANN. However, below this approach, the robot begins to maneuver once the user finishes the gesture, showing a major delay from the start of the gesture to the instant once the robot starts to maneuver. The aim is that the automaton starts the movement nearly at an equivalent time because the user activates the automaton movement (left arm) and makes a gesture with the correct arm [11]. To do this, straightaway once the user activates the robot movement, the system extracts the acceleration values from the measuring system hooked up to the right arm (only 3 measurements), identifies the gesture and sends a command to maneuver the robot.

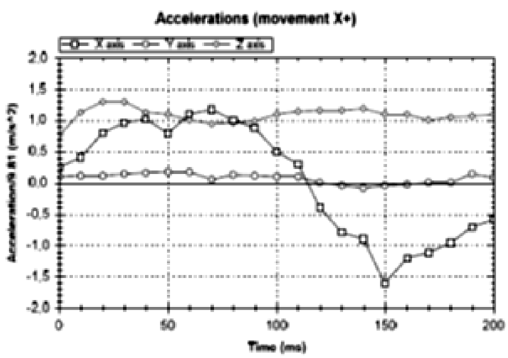

Fig 4: Measuring the acceleration of X axis, Y axis and Z axis in the positive direction.

These 3 measurements of acceleration are wont to acknowledge gestures, permitting a quick recognition. However, if the amount of measured accelerations is reduced, it's harder to recognize a gesture and also the recognition rate becomes low. Thus, these 3 measurements represent a compromise between the time delay and also the achieved recognition rate.

In addition to the automaton translations, the robot management architecture wants conjointly to possess as input six totally different robot rotations (Rx+, Rx-, Ry+, Ry-, Rz+ and Rz-). If the accelerometer is in free fall, it'll report zero acceleration. But if the measuring system is command horizontally, it'll report associate degree acceleration on the Z axis, the acceleration attributable to gravity "g". Thus, even once the user isn't fast the arm, a static mensuration will verify the rotation [12] of the arm (posture recognition). Analyzing figure 3, when the accelerometer is command horizontally, it'll report associate degree acceleration g on the Z axis. When the measuring system is revolved round the Y axis.On the contrary, when the accelerometer is revolved round the Y axis within the reverse direction. A similar approach detects rotations round the X axis. In terms of rotation round the Z axis nothing may be over as in each cases the gravity is along the Z axis. to resolve this drawback, associate degree ANN was wont to detect rotation movements round the Z axis.

The ANNs were conjointly used for recognition of postures (Rx+, Rx-, Ry+ and Ry-). The value of the x, y and z axis in the figure 4 shows the changes in the values of all the 3 axis in the positive direction.The recognition rate of postures is far over that of gestures. This discrepancy is owing to the acceleration readings that give data wherever the gravity components seem mixed with the mechanical phenomenon parts of acceleration, creating it tougher to acknowledge gestures. Another problem that hinders the popularity of gestures is that the necessary coordination between the arms that some users may be troublesome to assimilate. all the same, the expertise shows that in a fifteen minutes any user is ready to control the system [16]. The recognition rate depends on the samples provided during the coaching part. The results given were obtained exploitation thirty patterns instructed to the network. If the number of learning patterns is inflated, the popularity rate is improved however not considerably [10]. These thirty patterns represent a compromise between the specified coaching time and therefore the recognition rate. this can be achieved with the ANN parameters and pc characteristics given in Table II, where the user takes nine minutes to coach the system and half-hour of computational time. the popularity rate obtained by this system is in accordance with alternative approaches that use ANNs to acknowledge gestures.

Table I: The Arduino and ANN parameters

Sl. No.	Parameters	Specifications
1.	Training cycles	100000
2.	The hidden neurons	20
3.	Learning rate	0.28
4.	Controller used	Arduino UNO
5.	Sensors	Accelerometer sensor

The outcome of the entire project was designed using proteus design tool and the same is experimented in real time as shown in the figure 5. The movement of the arm axis of the robot is controlled by the pot for the experimental basis then the same is controlled by the flex sensor. The results are considered and the same is tabulated in the table II. Then the sensor and the accelerometer are connected together for the arm movement as well as for the pick and place. In most of the cases there was a little bit error which was overcome by using the ANN strategy. The same is noted down and reconfigured.

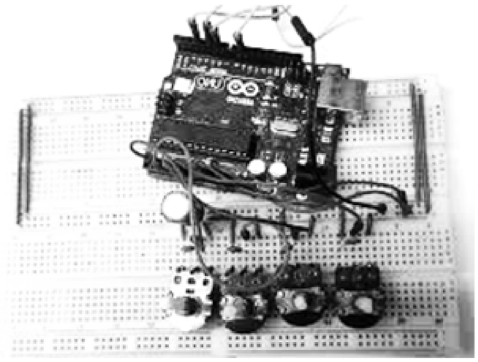

Fig: 5: configuration of the Axis using Pots for the flex sensor.

Table II: Accelerometer sensor vs the users

Sl. No.	Gesture	User 1	User 2
1.	X+	92	93
2.	X-	91	90
3.	Y+	92	85
4.	Y-	85	90
5.	Z+	93	88
6.	Z-	92	89
7.	RX+	98	98
8.	RX-	95	97
9.	RY+	96	97
10.	RY-	97	102
11.	RZ+	86	80
12.	RZ-	87	81

V. Conclusion

Due to the growing demand for natural Human Machine Interfaces and automaton intuitive programming platforms, a robotic system that permits users to manage AN industrial automation using arm gestures and postures was planned. Two 3-axis accelerometers were selected to be the input devices of this system, capturing the human arms behaviors. When compared with alternative common input devices, particularly the teach pendant, this approach mistreatment accelerometer is additional intuitive and straightforward to figure, besides giving the likelihood to control a automaton by wireless suggests that. mistreatment this technique, a no expert robot applied scientist will management an automaton quickly and during a natural method. The low worth and short set-up time area unit alternative advantages of the system. still, the irresponsibleness of the system is a vital limitation to think about. The ANN's shown to be an honest option to acknowledge gestures and postures, presenting a mean of ninety-two of correctly recognized gestures and postures. The system has a very good response time is another necessary issue. Future work can devolve on the development of the average of properly recognized gestures. One approach might be the implementation of a gyro into the system, in order to separate the acceleration because of gravity from the inertial acceleration. the employment of additional accelerometers attached to the arms is another chance. The Arduino has a very good response time and later the same system can be upgraded to raspberry pi in future and the same is implemented on proteus design tool. Finally, the system was first build on a bread board and the values area calculated the same values were used in the code to see the difference in the operation of the robotic arm.

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