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Gesture Controlled Robotic Hand Using RF Unit and Accelerometer

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***Abstract*: In the race of man v/s machine, automation comes as a companion of man and machine. Taking the technology to the next level from the mobile driven world to an automation driven world, will increase manufacturers their production rates, productivity and efficiency with materials, product quality, and worker safety. From ancient times the ingenuity and the brain power human beings have astonished researchers with engineering and mechanical marvels like the wheel, bow and arrow, cross bows, etc. What started from the wheel did not end there but evolved into the complex mechatronics systems that we see around us today. The robotics is one such human marvel that will be one-day equal human beings themselves. The robots thus have far more use in the daily life than any other systems. The robotics and automation is a rising piece of technology which could lessen the loads of work and solve the problems exponentially. As robotics is finding its place on every sector in this globe, the aim this project is to introduce robotics in the field of industry. The title of the system is 'Gesture controlled robotic arm'. The aim of the system is to provide safety and to increase productivity in our industries. The research project should be designed in such a way that it should occupy minimum space, should possess high maneuverability and high agility. The project in discussion is types of robots which needs minimum space and are proved to be highly maneuverable and highly agile. The robot contains two main units, one is the robotic arm and second is the data glove with accelerometer using a RF controller. The robotic arm unit is responsible for the hand functions of the whole structure of the robot. The data glove is responsible for the input feedback to the robotic arm. The robotic unit will be controlled by an Arduino platform to improve its stability. The angle tilt will be measured using ADXL335 sensor. The ADXL335 uses angle, tilt and yaw values with Arduino for data transfer. Through advanced primary and secondary research techniques, system implementation hurdles and potential risks involved in developing such a system are identified. The project is fully planned using advanced project management techniques like PERT chart and Gantt chart in order to identify the critical activities and the timeline related with it.**

***Keywords*: Arduino based, Gesture controlled, Robotic-hand, Tele-operated.**

1. Introduction

The assimilation of the gestures of human hand is done by using a human-machine interface with the help of a data glove. The main aim of the gesture recognition research is to realize a distinct human gesture and input data into the robotic arm using wireless transmission. From the variation of gestures, particular gesture of use can be recognized and on the basis of that the specific input for execution can be given to robotic arm. The general aim is to make the computer and thus the robotic hand realize the human arm movement sequences thus extending the gap between both the robot and human. The hand gesture recognition can be used to increase the computer interaction with users without utilizing the general input devices like keyboard, joystick, mouse, light pen, camera, etc. The aim of this project is to make a gesture recognizing robotic arm using wireless data glove that can mimic the human hand to certain extend. This system is basically a robotic arm, which can be controlled according to the motion of user's hand. The degree of freedom in the robotic arm helps it to function very much like a human arm. This system provides the most sort out solution in the industrial need, which is the lack of safety people and productivity. This system consists of data glove that uses accelerometer which helps to sense the motion of user's arm, dc motors that enable the arm gesture, robotic skeletal arm frame and microcontroller for function as a human arm. The system also consists of wireless RF module that is built into the data glove for input transmission and in the robotic arm for input receiving. This gives the user a small range the ability to move without being constrained by anything.

The greatest advantage of this type of system is that the user can do the operations sung the arm from a safe distance depending upon the capability of the RF module. The other types of this robotic arm like the gesture controlled robotic arm using camera gesture input cannot give the efficiency, simplicity and the level of freedom that the sensor activated gesture controlled robotic arm gives. This is because it is wirelessly controlled using a data glove. The other direct benefit of this is the simplicity that the user feels when using the robotic arm. The user's action is enough to operate the robotic arm so that he/she doesn't experience work load. Another benefit of this system is the steady increase productivity of the work when it is in situations that humans cannot function. This helps the user to not feel fatigue or tiredness like in normal work conditions and can do more work thus increasing the working capability of the user. Now the user can work for longer hours without any physical or emotional

interruption that the work load can have. The main idea behind the sensor activated gesture controlled robotic arm is to ensure that the humans can work in conditions in which humans can't withstand or survive from a safe distance like, bio- hazard material probing, bomb diffusion, etc.

Another main benefit is the increased positive financial status, because as the productivity increases the profit also increases. Completely robotized equipment is another important benefit. By integrating the sensor activated gesture controlled robotic arm with precise finger control the development of living standards of humans can be assured along with financial benefits.

2. Idea

The basic idea behind the gesture controlled robotic hand is the concept of tele-operation. To surmise it in easy words it is the process by which the operator or the user can influence the working of a machine whether it be autonomous or assisted, from a far of distance with good results. The researcher here tries to recreate a RF based robotic hand to function under the concepts of tele-operation. The researcher has opted for trial and error method instead of proper calculated practice of creating a tele-operated machine sample. The researcher would like to express that the work that is put into this project was made possible by the contributions of many researchers and other academicians, who have also influenced the idea behind it. The project was done with theoretical concepts and direct application of available technologies in the market. There is no claim to the idea or the concepts of tele-operation and gesture controlled machines, except for the assimilated and processed research built upon the ideas with proper citations. The researcher would also like to stress on the fact that the hardware based on the research conducted is researchers own design that the research supervisors had approved and if it resembles that of another then it is rather coincidence.

3. Working

The design of the gesture controlled robotic hand is very simple and in fact the design is in such a way that it would make the user at ease. The major control feature of the project is the gesture control, which is done using the data glove or the gesture glove. The Arduino unit processes the input from the accelerometer to the RF module in the data glove. The radio signals from the data glove are intercepted by the robotic hand part as a part of the tele-operational concept. The robotic hand part decodes the intercepted data signals and then decodes them with a specific modulation algorithm that recognizes the actual data from the data glove. This processed signal is then converted to digital and then it is relayed to the Arduino unit aboard the robotic hand part. The Arduino unit distributes the command signals based on the Embedded-C programming hard burnt within the microcontroller of the Arduino unit to all the peripheral components that make the robotic hand function accordingly. So, basically the robotic hand along with the hand move with the data glove movement or motion input.

4. Design

The design of the project is kept minimal to the bare essentials and has not been extensively designed to make it complex in its working and aesthetic nature. The project consists of a data glove that has been made by incorporating a woolen glove with a circuit board connected by wires on top of it. The robotic part however had to build using the commonly available items like for example, wood or ply wood to be exact. The robotic arm was made using wood and the palm and the rest of the fingers were 3D printed.

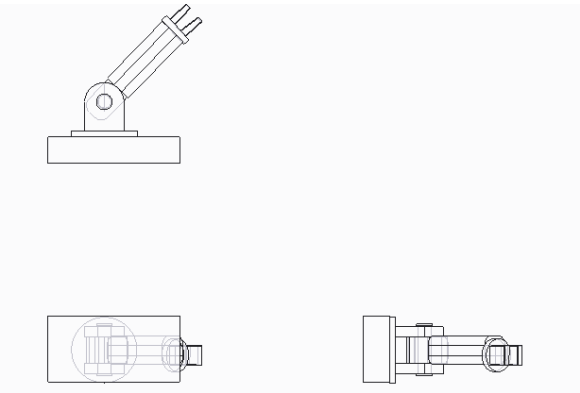

Fig. 1. Drawing and different views of gesture control robotic arm

The wood proved to be in excellent resonance with the design of the arm but the palm was not panning out the way it should have. The weight of the palm portion proved to be a hindrance in the working of the arm's dc motor. Please note that the components here were made using a combination of daily items with some acquired items. The DC motors are used here for joint control and it receives commands from the Arduino unit. The whole robotic hand was stationed on a wooden base with the main circuitry being integrated in to it.

5. Benefits

The greatest advantage of this type of system is that the user can do the operations by the arm from a safe distance depending upon the capability of the RF module. The sensor activated gesture controlled robotic arm you can perform functions like the human arm to a certain extend. The other types of this robotic arm like the gesture controlled robotic arm using camera gesture input cannot give the efficiency, simplicity and the level of freedom that the sensor activated gesture controlled robotic arm gives. This is because it is wirelessly controlled using a data glove. The other direct benefit of this is the simplicity that the user feels when using the robotic arm. The user's action is enough to operate the robotic arm so that he/she doesn't experience work load. Another benefit of this system is the steady increase productivity of the work when it is in situations that humans cannot function. This helps the user to not feel fatigue or tiredness like in normal work conditions and can do

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6. Conclusion

The research on the 'Gesture controlled robotic arm' is a twofold robotic with wireless communication and finger control. The aim of the system is to safeguard the workers in industry and increase the productivity of the industry. The user can control the robotic arm using the specially designed data glove controller which has got accelerometer with RF. Wireless communication module used to communicate between user and the robot is RF module which is selected because of its low cost.

The supporting data to implement the project are collected using secondary and primary research techniques. By reviewing the papers on already established technologies the researcher succeeds in building a base for the project. Using primary research techniques such questionnaire, interview and focus group study the researcher collected the data to support and to steer forward the implementation of the system. After the collection of these data the researcher was able to identify potential risk and ethical issues related to the project. As the researcher identified probable risks associated with the project, these risks are acknowledged in the risk assessment form which is approved by the committee which validate the researcher to continue with the project.

Implementing advanced project planning techniques like PERT chart and Gantt chart the entire project is divided into sub categories like objectives. With the help of PERT chart critical activities are identified and the number of days to finish the work is also identified. Gantt chart helped in properly planning the entire project with timeline for each objective. With the help of cross-referenced analysis potential components for the project is identified and using costing techniques the total cost for project is calculated. There are several hardware components involved in the project each one selected very carefully comparing it features and cost of the component.

By analyzing the entire collected data, it recommends that the application of gesture controlled robotic arm is the initiative of introducing wireless gesture controlled robotics in industry. The implementation of system can result in increase the productivity and safety. The robotics in industrial sectors could bring down the rate of accidents, lead time and many more advantages are associated with it. The gesture controlled robotic arm can replace a mass of people working inside hostile environments. Robotic systems are not biased as a human, which is why the instincts and judgment of a human being is a critical advantage for the proper functioning to which the robot is showing 90% throughout the time. Most labor architecture are already getting replaced by advanced machines such as drones, submarines, etc. so it is time for gesture controlled robotic systems to be a part of the industry and to drive the country to success and prosperity.

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