PC-ROBOARM WITH EFFICIENT SPEED CONTROL AND PLANNING BASED ON WIRELESS TECHNOLOGY

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***Abstract*— Over the past decades, design and control a robotic arm is not an easy job. Many consideration need to be taken care while designing and controlling robotic arm. In addition, different robotic arm design may lead to different control solution. Furthermore, it is difficult for the robotic arm to follow the assigned geometry path in high precision and accuracy manner. This paper introduces the design and development of 6-DOF (degree of freedom) PC Based Robotic Arm (PC-ROBOARM). The main context of the study is concerning a DOF robotic arm, which is modelled as three-link, with each joint connected with a suitable DC motor. The robotic arm design and control solution is implemented by computer software. It allows user to model or design virtual robotic arm before building the real one. Therefore, the user can estimate the optimum size of actual robotic arm at the beginning so as to minimize the building cost and suite the practical environment.**

This project uses the wireless technology (RF Technology), thus RF transmitter and receiver are used to which it can travel certain distance by having the control of robotic arm in the PC. Furthermore, once the actual robotic arm has been built, the user can reuse the software to control the actual robotic arm in an effortless way without wasting time in constructing new control solution. The software also provides simulation feature. The PC-ROBOARM is actual robotic arm developed to prove the simulation results.

***Keywords*— 6-DOF PC-Based Robotic Arm, design, control, wireless technology, simulation.**

I. INTRODUCTION

A. OVERVIEW

Nowadays, robots are getting popular in a wide range of application ranging from manufacturing to medical surgery in order to handle tasks that might be difficult, hazardous or boring to human beings. A wide range of research in robotic arm designing has been done over the past decades. In fact, robotic arm design and development process is rather more complicated than applying the robotic arm in practical assembly line or surgical theater. PC-Based Robotic Arm (PC-ROBOARM) and software are developed to ease the process of designing a Degree of freedom (DOF) robotic arm. In many practical robotic arm design cases, after designers have obtained the required parameters, the trajectory planning of the robotic arm might also become a great challenge in order to create a smooth flow to robotic arm task such as pick and place. It is undeniable that the trajectory planning which requires a great deals of kinematic calculation plays an important role during robotic arm task application. Thus, research has been done to ease the trajectory planning of robotic arm through the calculation of direct and inverse kinematics. However, the calculation of direct and inverse kinematics must be flexible enough to adapt any changes in the robotic arm design.

B. OBJECTIVE

Robots are in need in industrial field where tasks and operation are done with high speed and accuracy and in non-industrial fields where assistance to personal and increased convenience are needed. The needs for robots have recently been changed from factory automation to human friendly robot system.

With increasingly aging societies, the realization of robot hand that assists human activities in daily environments. With increasingly aging societies, the realization of robot hand that assists human activities in daily environments such as in offices, homes and hospitals are required. The goal of advanced robotics is to develop combined computer and mechanical structure which can perform operations in a manner analogous to human beings.

II. LITERATURE REVIEW

A. EXISTING SYSTEM:

Research on robot hand design is being carried out to accommodate a variety of tasks such as grasping and manipulation of objects in the field of industrial applications, service robots and rehabilitation robots. Picking of the object is successfully completed as long as the object is within the workspace of the hand and placed the object at the desired position within the workspace by relevant software control using keyboard commands. Results of the experimental work for pick and place application of different objects is enumerated.

G. Sen Gupta1,2, S.C. Mukhopadhyay1, C. H. Messom3 and S. Demidenko4 presented the paper called "Master-Slave Control of a Teleoperated Anthropomorphic Robotic Arm with Gripping Force Sensing" this paper is an methods of solving problems that are encountered when human beings teleoperate robots. The main problem of this choice was linked to non-linear behaviour of pneumatic systems.

G. Carducci, M. Foglia, A. Gentile, N.I. Giannoccad, A. Messha presented on 2004 lEEE International Conference on Industrial Technology (JCIT) the paper presented called "Pneumatic Robotics Arm Controlled By ON-OFF Valves For Automatic Harvesting Based On Vision Localisation". This paper shows the application of a vision feedback on a robotic arm built for agricultural crop. This application uses of a frame acquired by means of a cheap web-cam for locating the position of a single object to grip

"A Unified Control Scheme for a Whole Robotic Arm-Fingers System in Grasping and Manipulation" presented by Ji-Hun Bae, Suguru Arimoto, Ryuta Ozawa, Masahiro Sekimoto, and Morio Yoshida presented on 2006 IEEE International Conference on Robotics and Automation .This paper proposes a novel control method for enabling a robotic arm with a pair of two degrees of freedom (DOFs) robotic fingers as an end effectors to execute a variety of superimposed tasks in a coordinated way.

Jinchun Feng, Charles D. McCurry, and Saleh Zein-Sabatto, on 2008 IEEE presented the paper called "Design of an Integrated Environment for Operation and Control of Robotic Arms". As more advanced control algorithms are becoming available for the control of robotic arms, traditional fixed controller boards and associated code generators are becoming less convenient way to test such control algorithms in real-time. The process of using such boards is complex, time consuming, and inflexible.

"Development of a 6-Axis Robotic Arm ControllerImplemented on a Low-Cost Microcontroller" presented by Agus Bejo1, Wanchalerm Pora1 and Hiroaki Kunieda . This paper presents a case study of development of a 6-axis robotic arm controller. The robot is powered by a hydraulic pump.. At each and every axis, a servo-valve is employed to control a servo motor. The PID inputs are the six voltages from potentiometers and its outputs are the six DC voltages, which command the six servo-valves.

B.PROPOSED SYSTEM:

Implementation is done in wireless communication. Wireless technology which is used in this is RF technology.PC-ROBOARM is the actual robotic arm that has been built through the use of software. Parameters such as work space limitation, degree of freedom as well as movement speed are difficult to be visualized using a hardcopy technical drawing. The error and the mistakes can be found easily by the required software in real time. Thus , it make user work more effective and efficient. From the PC is designed to be linked with Microcontroller to perform desired Robotic arm movement. The Microcontroller is connected through a commonly used serial communication .A specific communication protocol is designed to arrange the instruction data into the special function registers assigned in Microcontroller. The DC Motor is connected to the Robotic Arm which is to perform specific movement. Through the use of point-to-point programming in software the actual robotic arm was capable to traverse from one point to another point which is similar to the simulation result. Therefore, PC-Based Robotic Arm and software are developed to ease the process of designing a DOF robotic arm.

III. FUNCTIONAL BLOCK DIAGRAM

A. TRANSMITTER:

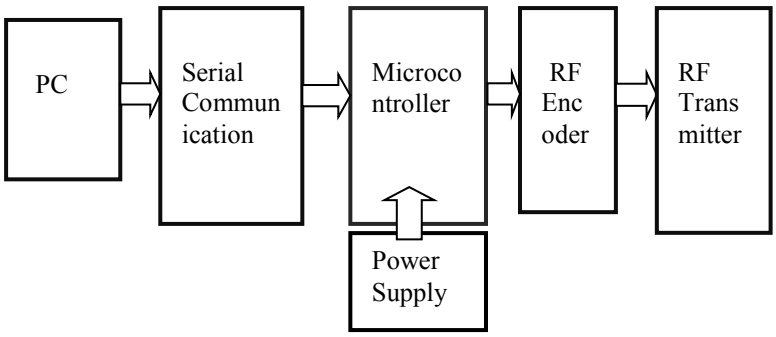


Fig 1 Transmitter Side Block diagram

B. RECEIVER:

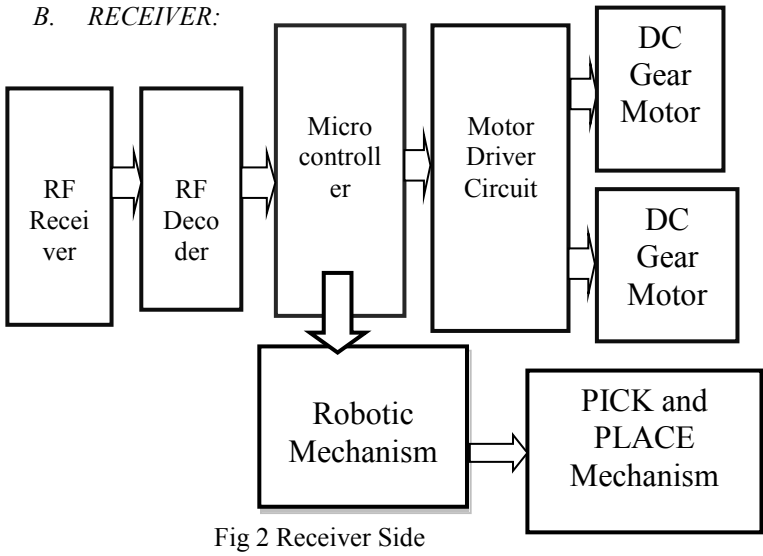


Fig 2 Receiver Side

C. Block Explanation

Transmitter:

In the Transmitter side the following sections are

i. PC
ii. Serial Communication
iii. Microcontroller
iv. RF Encoder and RF Transmitter

The data from the PC is transmitted to Microcontroller through serial communication (MAX232). The data received from the PC is compared with the data stored in the Microcontroller. Depending upon the data received the RF signal is transmitted through RF transmitter. RF Encoder is used to which the signal is encoded. The encoded signal is transmitted through RF transmitter.

Receiver:

The Receiver side consist of the following sections;

i. RF Decoder
ii. RF Receiver
iii. Microcontroller
iv. Motor Driver and DC Motor
v. Robotic Mechanism
vi. Pick and Place Mechanism
vii.

The RF Receiver receives the signal transmitted from the transmitter side. The RF signal received is decoded through RF decoder. The decoded signal is send to the microcontroller. The microcontroller received the signal and depending upon the received signal, the microcontroller controlled the motors by using motor driver circuit. The motor driver circuit drives the motor by stepping the voltage from 5v to 12v. The direction of the robot and arm is controlled by motor control.The corresponding pick and place mechanism will be performed by the robotic arm.

D.SYSTEM ARCHITECTURE

MECHANICAL STRUCTURE

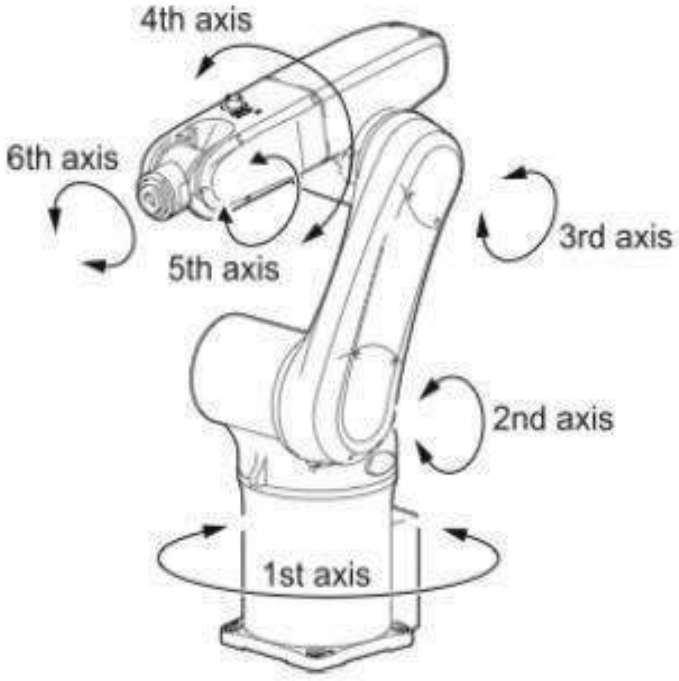


Fig 3. Robotic Arm 6-DOF axis

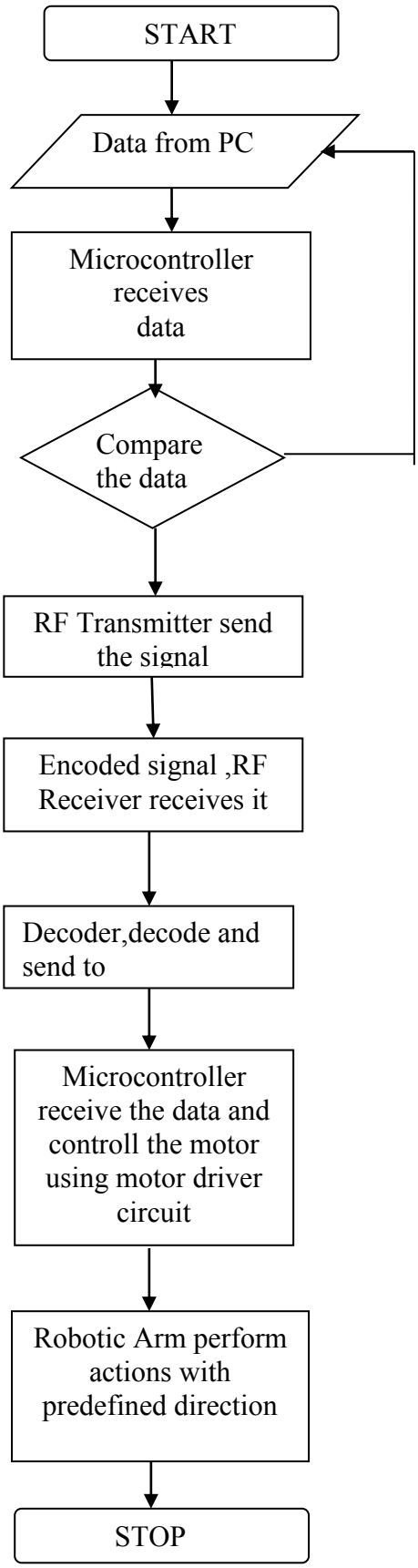
According to the figure shown above ,the 6DOF robotic arm consist of:

1. Base
2. Shoulder
3. Elbow
4. Wrist – Pitch
5. Wrist – Roll
6. Gripper

Each joint is fixed to DC motor with unique torque specification. The characteristic of torque required is assigned according to the work load of the joint.

Accordingly the pick and place mechanism will be performed in easier way.

IV. FLOWCHART



A.GENERAL ALGORITHM

Transmitter:

Step1: Start the project (given power supply)

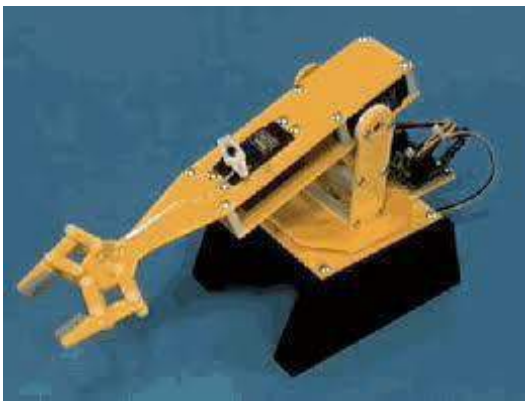
Step2: Send the data from PC through Serial Communication.

Step3: Microcontroller receive the data from the PC

Step4: Compare the data from the PC to the data stored in the microcontroller.

Step5: Depending upon the data the RF signal is transmitted through the RF transmitter.

Step6: The signal is encoded through RF encoder and transmitted through RF transmitter.



Receiver

Step1: The RF signal is received through the RF receiver.

Step2: The receiver RF signal is decoded through the RF decoder.

Step3: The decoded signal is send to the microcontroller.

Step4: The microcontroller received the signal and depending upon the received signal, the microcontroller controlled the motors by using motor driver circuit.

Step5: The motor driver circuit drives the motor by stepping up the voltage from 5v to 12v.

Step6: The direction of the robot and arm is controlled by motor control.

Step7:The robotic arm moves in the required directions and the pick and place mechanism takes place.

V. RESULT:

The robotic arm is able to reach specified coordinates through the means of Direct Kinematics and Inverse Kinematics.

Fig. 4 Robotic Arm Model

The robotic arm Modeled as three-link, with each joint connected with a suitable DC Motor. Implementation is done in wireless communication .Wireless technology which is used in this is RF technology. PC-ROBOARM is the actual robotic arm that has been built through the use of software. Therefore, PC-Based Robotic Arm and software are developed to ease the process of designing a 6-DOF robotic arm.

Thus the pick and place mechanism takes place according to the required torque**.**

A. Future Enhancement:

1.By increasing the number of Degree Of Freedom.

2.It is possible to enhance by having two arms instead of one.

3.Using Remote Controller for controlling instead of PC.

VI. CONCLUSION:

This it is divided into two sections Transmitter side and Receiver side. This is PC- ROBOARM, so the controlling of Robotic Arm is done through PC only .In this, the pick and place mechanism of Robotic Arm is performed . Wireless Technology called RF Technology is used, where the Robotic Arm can travel certain distance.

It can be used in Industrial application where pick and place process is performed and for Smart Home applications etc.The idea of using robotic arm designing software to design a virtual robotic arm . And control an actual robotic arm . The hardware model provides alternatives to test the program written. In **future development**,

i. The required software can be expanded to manipulate multiple robotic arms with similar 3D graphical visualization that helps in simulating the arms' trajectory planning and speed control.

ii. It can be controlled using remote controller instead of PC.

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REFERENCES

1. Baki Koyuncu and Mchmet Guzel(2007), "Software Development for the Kinematic Analysis of a Lynx 6 Robot Arm ".World Academy of Science ,Engineering and Technology,Vol.87, pp:1123-1167.
2. Cowan.N.J, J.D.Weingarten and D.E.Koditchek(2002),"Visual servoing via navigation functions," vol. 18, no. 4, pp. 521–533.
3. Dordevic.G.S, M. Rasic, D. Kostic, and V. Potkonjak,"Representation of robot motion control skill',(2000) vol. 30, no. 2, pp. 219–238.
4. Fan.S, Y. Zhang, Z. Chen and H. Liu (2010) 'Research of a novel miniature tactile sensor for five-finger dexterous robot hand', pp: 422- 427.
5. Goldfeder.C, C.Mater, J.Peretzman, H.Dang and P.K.Allen,(2009) 'Data-driven grasping with partial sensor data', vol55, pp:1278-1283.
6. Hans.M, B. Graf, and R. D. Schraft, "Robotic home assistant care-0-bot: Past-present-Future,"(2002), pp. 380–385.
7. Jeon.P.W and S. Jung, "Teleoperated control of mobile robot using exoskeleton type motion capturing device through wireless communication," (2003), pp. 1107–1112.
8. Kofman.J, X. Wu, T. J. Luu, and S. Verma (2005), 'Teleoperation of a robot manipulator using a vision-based human-robot interface,' vol. 52, no. 5, pp. 1206–1219.
9. Lumelsky.V.J and E. Cheung, "Real-time collision avoidance in teleoperated whole- sensitive robot arm manipulators," (1993) vol. 23, no. 1, pp. 194–203.
10. Leba.M, V.C.Sirba,Pop.E(2008) "Modelling Simulationand Control for and Underground Support as Two Robotic Arms",pp:145-178.
11. Thobbi.A and W. Sheng, "Imitation learning of hand gestures and its evaluation for humanoid robots," (2010) , pp. 60–65.
12. Lee.W.K and S. Jung, "Fpga design for controlling humanoid robot arms by exoskeleton motion capture system',(2006), pp. 17–20.
13. Rosmarm.J and H. Asada,(2006). "Design of vast DOF artificial muscle actuators with a cellular array structure and its application to a five fingered robotic hand", Vol. 43, pp: 2214-2219.

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