International Journal of Image Processing and Vision Science

Volume 1 | Issue 3 Article 12

January 2013

PERSONAL COMPUTER BASED ROBOTIC ARM WITH VISION

AARTI S. HAJARI HAJARI
Department of Electronics & Communication Engineering Bhabha Engineering and Research Institute, Bhopal, INDIA, aarti_hajari07@yahoo.co.in

SAAKSHI A. SHANKARPURKAR
Department of Electronics & Communication Engineering Bhabha Engineering and Research Institute, Bhopal, INDIA, saakshiavinash@gmail.com

Recommended Citation
HAJARI, AARTI S. HAJARI and SHANKARPURKAR, SAAKSHI A. (2013) "PERSONAL COMPUTER BASED ROBOTIC ARM WITH VISION," *International Journal of Image Processing and Vision Science*: Vol. 1 : Iss. 3 , Article 12.
DOI: 10.47893/IJIPVS.2013.1039
Available at: https://www.interscience.in/ijipvs/vol1/iss3/12

PERSONAL COMPUTER BASED ROBOTIC ARM WITH VISION

AARTI S. HAJARI[1] & SAAKSHI A. SHANKARPURKAR[2]

[1,2]Department of Electronics & Communication Engineering Bhabha Engineering and Research Institute, Bhopal, INDIA
Email:aarti_hajari07@yahoo.co.in, saakshiavinash@gmail.com

Abstract – The visionary robot i.e. a robot with a vision which is controlled by the personal computer is being studied in this paper. A new visual serving concept for dynamic grasping for image color identification is presented. By optimal fusion of both camera information using a fuzzy decision making algorithm a robust visually controlled grasping of objects is achieved even in the case of disturbed signals or dynamic obstacles. The colors are also identified for the identification of the object the user requires.

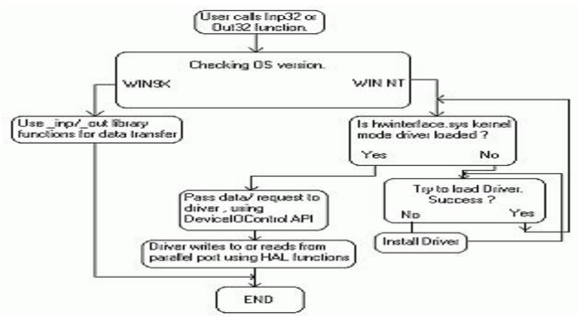
Keywords- *Robotic Arm, Robotic Rehabilitation System, data acquisition, Visual Basic.net*

I. INTRODUCTION

In this topic we are going to build a mechanical hand which will controlled by PC having number of motions for all activities right from holding things, pickup things to individual working of each finger. It has motions same as human hand and also humb motion. All motions are controlled using centralized controller which is connected to PC on parallel port (25 pins). This arm will be build up using aluminum plate to make it light weight, easy to fold, drill, shaping etc. The arm is mainly mechanical so no more circuits are required. No wireless devices are used, for control it will be connected to parallel port of a PC and for angle to angle movement stepper motor are used. The joint of palm with the arm is just like joystick-hand joint, to make it turn at any direction.

A. INTRODUCTION TO FRONT-END

For making the robot arm the project code is developed in VB because implementation of GUI is easy. VB don't have function or module to directly get or set value to/from parallel port. For that we will use some 3rd party functions or modules (controls), which are able to get or set data to/from parallel port. Software will generate different code for different motion and passes code to controller circuit and circuit will control the mechanism or motions of hand.'



B. WORKING / LOGIC

Logic behind project is each motion will operated using some special cables. Same as we have in our bike or moped as we use accelerator cable for acceleration, break cable for break etc. Each cable consists of another small cable inside which is responsible for motion. In case of software part, the functions/software used to interact with the arm mechanism, send data in binary which will convert later into voltage signal. This voltage signal (+5V or 0V) will activate the mechanism controller circuit through some transistor switches, which in turn give movements to the arm. Putting it all together we can say first used driver loading by getting driver info from system. Then get the camera window and load single frame in memory as variable. Then create 3D array of pixel detail now to comparing any of the pixel we can used direct condition as per show above.
Consider an example where if R is 255 and other is 0 then it is clear that this is red color pixel.

II. USE OF A PC PRINTER PORT FOR CONTROL AND DATA ACQUISITION

A PC printer port is an inexpensive and yet powerful platform for implementing projects dealing with the control of real world peripherals. The printer port provides eight TTL outputs, five inputs and four bidirectional leads and it provides a very simple means to use the PC interrupt structure. This article discusses how to use program the printer port. A larger manual which deals with such topics as driver circuits, op to isolators, control of DC and stepping motors, infrared and radio remote control, digital and analog multiplexing, D/A and A/D is available.

A. Printer Port Basics

1) A. Port Assignments

Each printer port consists of three port addresses; data, status and control port. These addresses are in sequential order. That is, if the data port is at address 0x0378, the corresponding status port is at 0x0379 and the control port is at 0x037a. The following is typical.

Printer	Data Port	Status	Control
LPT1	0x03bc	0x03bd	0x03be
LPT2	0x0378	0x0379	0x037a
LPT3	0x0278	0x0279	0x027a

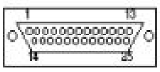
My experience has been that machines are assigned a base address for LPT1 of either 0x0378 or 0x03bc. To definitively identify the assignments for a particular machine, use the DOS debug program to display memory locations 0040:0008. For example:

```
>debug
-d 0040:0008 L8
0040:0008     78 03 78 02 00 00 00 00
```

Note in the example that LPT1 is at 0x0378, LPT2 at 0x0278 and LPT3 and LPT4 are not assigned. Thus, for this hypothetical machine;

Printer	Data Port	Status	Control
LPT1	0x0378	0x0379	0x037a
LPT2	0x0278	0x0279	0x027a
LPT3	NONE		
LPT4	NONE		

An alternate technique is to run Microsoft Diagnostics (MSD.EXE) and review the LPT assignments. 2) B. Outputs Please refer to the figures titled Figure #1 - Pin Assignments and Figure #2 - Port Assignments. These two figures illustrate the pin assignments on the 25 pin connector and the bit assignments on the three ports.



View is looking at Connector side of DB-25 Male Connector.

Pin	Description	
1	Strobe	PC Output
2	Data 0	PC Output
3	Data 1	PC Output
4	Data 2	PC Output
5	Data 3	PC Output
6	Data 4	PC Output
7	Data 5	PC Output
8	Data 6	PC Output
9	Data 7	PC Output
10	ACK	PC Input
11	Busy	PC Input
12	Paper Empty	PC Input
13	Select	PC Input
14	Auto Feed	PC Output
15	Error	PC Input
16	Initialize Printer	PC Output
17	Select Input	PC Output

Pin Assignments

Note: 8 Data Outputs
4 Misc Other Outputs

5 Data Inputs

Note: Pins 18-25 are Ground

Fig 1. Pin Assignments

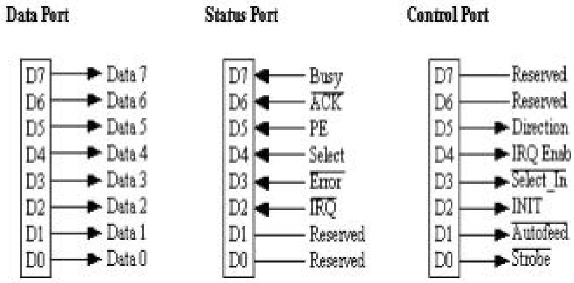


Fig 2. Port Assignments

Note that there are eight outputs on the Data Port (Data 7(msb) - Data 0) and four additional outputs on the low nibble of the Control Port. /SELECT_IN, INIT, /AUTO FEED and /STROBE. The modern nonlinear control theorem's failure in taming planets which suffer from problems like lack of certainty or unknown parameters in their modeling, complex or prolix regnant equations and etc are predictable sequent of this fact that all classical control theorems are based on the exact identification of systems. This has caused the domination of conventional control theories, like PID, over today's practical systems [16]. Common mechanical manipulators are vastly used systems which make an example of mentioned issue; in [16] and even in discrete form in [17] the famous sliding mode method has been utilized to control robotic manipulator with its dynamic equations which has caused to tremendous design and computational efforts, in [7] another common nonlinear control method ,feedback linearization, has been used for the purpose with similar results, more computationally voluminous adaptive control has been implied on such system in [10], even more recent approaches like neural networks has been used to adjust conventional PIDs in [10]&[3], even most recent neural networks based approaches like NARMA could be used only for single variable systems as mentioned in [1]and[11]; In this thesis after describing the relations over a three dimension robotic arm a new control strategy is introduced with aim of inflicting the reference input trajectory behavior on its wrist point movement.

B. Related work

The existing work in tracking and modeling addresses subsets of the problem we are trying to solve; however, no one paper addresses them all. We make use of depth, visual, and encoder information to provide a tracking and modeling solution for enabling active object exploration for personal robotics. Below, we discuss a number of areas of research related to our own work. Krainin et al. 3. In addition to the robots and their subsystems, extensive work has been devoted to command systems that drive the robots. Command systems have been: playback supervisors, teleoperation masters, and various higher level approaches based on work from the AI community. Playback interfaces have included motion capture mechanisms that provide movement-stream information to storage systems configured for later, repeated and coordinated, operation of many robots and associated mechanisms. Play-back command systems use human commands, from an "earlier" time, to command motions that are played out, over and over, mindlessly. Teleoperation" masters", that operate in real-time with the robot, have ranged from simple motion capture devices, to more complex force reflective exoskeletal masters. Teleoperation interfaces have been composed of complex kinematic structures designed to perform motions compatible with operator movements and are attached via appropriate soft tissue interfaces. The masters emit lower level commands (joint angles) in real-time using the natural intelligence and sensory systems of the operator. AI-based command sources, blend higher level The International Journal of Robotics Research (simple) commands, with system and existing environmental states, to make decisions for the management of the robot. As with the playback systems, AI-based systems are programmed earlier to perform later operations. In the AI case, however, adaptive intelligence and sensory capabilities reside in the robot. Broadly speaking, object modeling techniques in robotics can be divided into two categories: ones where a sensor is moved around a stationary object and ones where the object is picked up and moved in front of a sensor. The first category avoids the difficult problem of robotic grasping and can be applied even to objects too large or delicate to be picked up. The second category, into which our technique falls, has the advantages of being able to move the object to see previously occluded sides and also lends itself to extracting further properties such as weight and stiffness. The first category of papers is closely related to the problem of 3D mapping as it involves motion of a depth sensor in a stationary scene. Triebel et al. (Triebel et al., 2004) mount a SICK laser range finder on a four DOF manipulator for 3D volumetric modeling and exploration. They use the manipulator encoder values for sensor pose estimation.Other approaches for environment and object modeling with a depth sensor include Henry et al.'s RGB-D mapping (Henry et al., 2010) and Strobl et al.'s Self-Referenced DLR 3D-Modeler (Strobl et al., 2009). Both use visual feature tracking as the primary means of camera pose estimation. The former uses ICP to improve pose estimates, while the latter uses an IMU to provide better image flow predictions. In the second category, Kraft et al. (Kraft et al., 2008) model contours of objects using a robotic manipulator and a stereo camera. The representations they learn, however, are not complete surface models but rather sparse sets of riented 3D points along contours. Another important difference to our approach is that the authors assume precise camera to robot calibration and precisely known robot state at all times. We believe these assumptions to be too restrictive for the technique to be generally applicable. Ude et al. (Ude et al., 2008) use robotic manipulation to generate training examples for object recognition. Their approach involves generating motion sequences to achieve varied views of an object, segmenting the object from images, and extracting training examples for a vision-based classifier. Unlike Kraft's work, their paper assumes neither known camera calibration nor precisely known joint angles. However, the paper does not deal with constructing 3D models and therefore does not require precise object pose. Similarly, Li and Kleeman (Li and Kleeman, 2009) use a robotic manipulator to achieve varied views of an object for visual recognition. They store Scale-Invariant Feature Transform (SIFT) features for frames at discrete rotation angles and perform detection by matching the features of an input image against each viewpoint of each modeled object. The authors mention that such models could be useful for object pose estimation. We assert that this requires estimating the motion of the object between viewpoints using techniques such as those we propose in this paper.

C. Robotic Rehabilitation Systems

In the case of wheeled mobile platforms, which include a large part of the land mobile manipulators, except mainly humanoids and all-terrain systems, the rolling without slipping (r.w.s.) of the wheels on the ground introduces specific difficulties in the modeling. The platform, which cannot move instantly in any arbitrary direction, is then said to be nonholonomic. If we restrict our study to that large category of wheeled mobile platforms, we must evoke the excellent contribution of Campion, Bastin, and D'Andréa-Novel (1996), which offers good tools for the generic modeling of robotic systems built from wheeled mobile platforms. We propose this modeling in this paper after we introduce the kinematic modeling of the subsystems: platform and robotic arm. This is the purpose of Section 2. This reveals, in particular, the existence of the control of mobility of the mobile manipulator, which represents the control producing instantaneous velocities of the end effector (EE) of the mobile manipulator. Also we obtain the instantaneous kinematic location model (IKLM) of the mobile manipulator, which sets the derivative of the EE location as a function of the control of mobility. Prior work has studied the ability of the MIME (Mirror- Image Motion Enabler) device (Burgar et al. 2000) to assist limb movements and facilitate recovery of motor function in subjects with chronic hemiparesis due to stroke. MIME incorporates an industrial robot and operates in three unilateral modes and one bimanual mode. In unilateral operation, passive, active-assisted and guided movements against a resistance are possible. The bimanual mode enables the subject to practice bilateral, coordinated movements with rate and range under his or her control. In the current version of MIME, subjects are seated in a wheelchair modified to improve seating support and reduce movements of the upper body. They can sit close to either the front or rear of an adjustable height table. A PUMA-560 robot is mounted beside the table. It is attached to a wrist-forearm orthosis (splint) via a six-axis force transducer, a pneumatic breakaway overload sensor set to 20 Nm torque, and a quick release coupling mechanism. The subject's arm is strapped into the splint with the wrist in neutral position. Robot/forearm interaction force and torque measurements from the transducer are recorded and archived by a personal computer. The control program monitors these data and the motion of the robot in order to prevent potentially hazardous situations from occurring. Switches and mechanical stops are strategically placed to permit rapid de-activation of the robot, if necessary. In an initial study with MIME including 28 subjects (two groups of 14) all had improved motor function as a result of therapy (Burgar et al. 2000). The robot group, compared to the control group, had larger improvements in the proximal movement portion of the Fugl-Meyer (FM) test after one month of treatment and also after two months of treatment. The robot group also had larger gains in strength and larger increases in reach extent after two months of treatment. At the six-month follow-up, the groups no longer differed in terms of the Fugl- Meyer test, however the robot group had larger improvements in the Functional Independence Measure (FIM). As a conclusion of our project we declare that our project has been completed successfully and working properly as per problem definition. During the project many problems occurred but using some proper logic those problem are solved. Project takes total seven month including seminar preparation, logic designing, study regarding project and study of programming language. In future development we are tying following things

- If implemented with bio technology then can be work as arm for handicap people.
- Smooth and more option can be provided.

The ability to recognize and manipulate objects is important for mobile robots performing useful services in everyday environments. In recent years, various research groups have made substantial progress in recognition and manipulation of everyday objects (Ciocarlie et al., 2007; Berenson and Srinivasa, 2008; Saxena et al., 2008; Collet Romea et al., 2009; Glover et al., 2009; Lai and Fox, 2009; Rasolzadeh et al., 2009). While the developed techniques are often able to deal with noisy data and incomplete models, they still have limitations with respect to their usability in longterm robot deployments in realistic environments. One crucial limitation is due to the fact that there is no provision for enabling a robot to autonomously acquire new object models as it operates in an environment. This is an important limitation, since no matter how extensive the training data, a robot might always be confronted with a novel object instance or type when operating in an unknown environment

REFERENCES

[1] D.Beldekas. ”Comparative Control of A Nonlinear First Order Velocity System By A Neural Network NARMA Method”. Issn 1392 – 1215 Elektronika Ir Elektrotechnika.2004. Nr. 6(55):1-4, 2004.

[2] R.Bishop. “Mechatronics”, Taylor & Francis Group, PP. 129-136 (2006).

[3] C.Cox. “Modern Adaptive Control with Neural Networks”. International Conference on Neural Networks InformationProcessing, Iconip 96, Hong Kong, 1996.

[4] M.Haggan. “neural networks design”, PWS publishing company, PP.391-399 (1996).

[5] S.Hawkins. ” Neural Networks”, Prentice Hall, PP. 130-170 (1999).

[6] Hen Yu, Hen. “Handbook of Neural Network Signal Processing”, CRC Press, PP. 34-39, 42- 71, 249-267 (2002).

[7] M.Koot. “Identification And Control Of The RRR-Robot”. M.Sc thesis, Eindhoven University Of Technology,Serbia, 2001.

[8] R.Lippmann. ” An Introduction To Computing With Neural Nets”. IEEE ASSP Magazine: 4-22, 1987.

[9] L.Guoping. “Variable Neural Networks for Adaptive Control Of Nonlinear Systems” IEEE Transactions On Systems, Man, And Cybernetics—Part C: Applications And Reviews: 1-3, 1999.

[10] L.Marton. “Robust-Adaptive Control of Nonlinear Single variable Mechatronic System”. PhD thesis, Budapest University of Technology And Economics, 2006.

[11] H. Mokri. “Real Time Implementation of NARMA Control of a Single Link Manipulator”. American Journal Of Applied Sciences 5 (12): 1642-1649, 2008.

[12] G.Moleykutty. “Speed Control of Separately Excited Dc Motor”. PhD Thesis, Multimedia University Melaka Campus, 75450 Melaka, Malaysia, 2008.

[13] Narendra.“Identification And Control Of Dynamical Systems Using Neural Networks”. IEEE Transaction of Neural Networks: 4-27, 1990.

[14] H.NIJMEIJER. “NONLINEAR DYNAMIC CONTROL SYSTEMS”. SPRINGER, PP.130-160 (1990)

[15] Pandian, Shunmugham. “Model-Based Sliding Mode Control of Underwater Robot Manipulators”. International Journal of Offshore and Polar Engineering (ISSN 1053-5381) Vol. 16, No. 3, September 2006: PP. 210–217, 2006.

[16] M.Spong. “Robot Dynamic And Control”, Springer, PP: 61-83,99-153,175-193,231-300 (2004).

◈◈◈