A Multifunctional Robotic Arm for Industrial Application

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Abstract— Robotics playing a vital role in the modern era of technology. A robot can be defined as a mechanical device programmed to perform a manipulative task under automatic control. Robots are normally used in conjunction with auxiliary devices such as machines and fixtures. Due to technological advancement robot has become an integral part of automation in a manufacturing process. Because of rapid advancement in technology, automation is must in all areas of manufacturing and in human comfort. We propose a designing model which gives an idea about how robotics can improve production, accuracy in industrial applications as well as reduce human casualties in hazardous area.

Keywords: Robotics, Automation, Industrial Application, Manufacturing

I. Introduction

Programmable automation is a major part of modern industrial automation. The designed robotic arm is reprogrammable, multifunctional manipulator designed to move material, parts and tools. The designed model can be operated in three ways. We can control it using Joystick, using serial communication (using PC) and automatic control. In which joystick control does not need microcontroller. In serial communication we have used keyboard keys to control robotic arm. In automatic control system we are implementing colour recognizing system and sorting the ball accordingly

II. Block diagram

The functional Block Diagram of the Robotic Arm is shown in fig.1

III. Design methodology

A. P89v51rd2 Microcontroller:

The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of data RAM. A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI.

The Flash program memory supports both parallel programming and in serial In-System Programming (ISP). Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible. The P89V51RD2 is also In-Application Programmable (IAP), allowing the Flash program memory to be reconfigured even while the application is running.

B. In-System Programming (ISP):

In-System Programming is performed without removing the microcontroller from the system. The In-System Programming facility consists of a series of internal hardware resources coupled with internal firmware to facilitate remote programming of the P89V51RD2 through the serial port. This firmware is provided by Philips and embedded within each P89V51RD2 device. The Philips In-System Programming facility has made in-circuit programming in an embedded application possible with a minimum of additional expense in components and circuit board area. The ISP function uses five pins (VDD, VSS, TxD, RxD, and RST). Only a small connector needs to be available to interface your application to an external circuit in order to use this feature.

C. L293d Motor Driver:

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

On the L293, external high-speed output clamp diodes should be used for inductive transient suppression. A VCC1 terminal, separate from VCC2, is provided for the logic inputs to minimize device power dissipation. The L293 and L293D are characterized for operation from 0°C to 70°C.

D. Lm 324 Comparator:

The LM124 series consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, DC gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example, the LM124 series can be directly operated off of the standard +5V power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional ±15V power supplies.

E. Max 232 Line Driver:

It is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals.

The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V.

The later MAX232A is backwards compatible with the original MAX232 but may operate at higher baud rates and can use smaller external capacitors – 0.1 μF in place of the 1.0 μF capacitors used with the original device. The newer MAX3232 is also backwards compatible, but operates at a broader voltage range, from 3 to 5.5V

F. Colour Sensor:

We are using the ir transmitter and receiver as a colour sensor to sense the colour of ball. This IR pair is used along with lm324 comparator to compare between red and green ball.

G. Motors:

We have used 4 dc geared motors. Among them three are 10 rpm and one is 3.5 rpm. They are operated on 12 v dc power supply

H. RS232 Cable:

In telecommunications, RS-232 (Recommended Standard 232) is a standard for serial binary single-ended data and control signals connecting between a *DTE* (Data Terminal Equipment) and a *DCE* (Data Circuit-terminating Equipment). It is commonly used in computer serial ports.

I. Computer:

We are using computer to burn the program into p89v51rd2 and we are using serial port using hyper terminal to communicate with microcontroller to control the arm using keys on the keyboard.

J. Power Supply:

We have used two different power supplies + 9v dc and + 12v dc. + 9v is for microcontroller, sensor circuit and another for motors

IV. CONTROL METHODS

A. Automatic Control:

In this we are using the arm to sort the balls as per colour. We are using the IR transmitter and receiver as a colour sensor to sense the colour of ball. This IR pair is used along with lm324 comparator to compare between red and white ball.

1) Operation of colour sensor:

The above circuit diagram shows the colour sensor arrangement. In this first by applying the power to IR pair, and keeping the red ball in front of IR pair, the voltage at point X is measured by millimeter . After that the 10k pot connected at pin 3 of lm 324 is adjusted such that the voltage at pin 3 is slight greater than the voltage at point X.

Similarly by keeping white ball in front of IR pair , the voltage at point X is measured and then the another 10k pot connected at pin 12 of lm 324 is adjusted in such a way that the voltage at pin 12 is greater than the present voltage at point X. Now

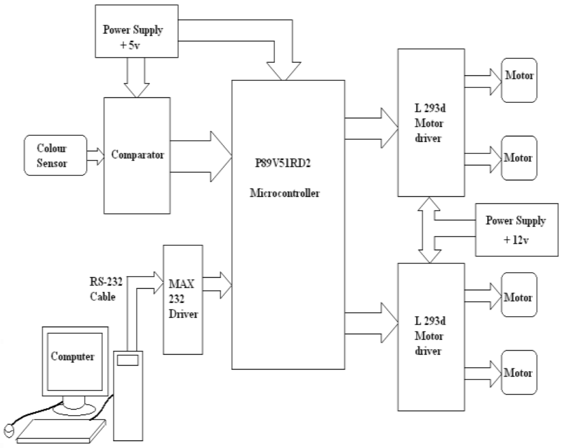

Fig. 1: Block Diagram of Robotic Arm

When there is no any ball in front of IR pair, the voltage at point X is greater than voltage at pin 3 and 12 of lm 324 . This happens because, since there is no any ball, the rays transmitted by IR transmitter do not fall on IR detector and it will not conduct. And hence voltage at point X remains high. As the point X is connected to pin 2 and 13 (inverting terminals) of lm 324 and is greater than voltage at pin 3 and 12 (non inverting terminals) of lm 324, it gives zero at output pins 1 and 14. These two pins are connected to pin p1.0 and p1.1 respectively. These two pins are input pins of microcontroller. Thus when there is no any ball, these pins get low logic and controller will sense that there is no any ball.

B. PC Controlled:

In this we are using serial communication between microcontroller and computer.

For this we require:

1) RS 232 cable
2) Max 232 driver
3) 10 uf electrolytic capacitors

1) Operation:

Depending on the key pressed on the keyboard, the ASCII value of that key is transmitted to microcontroller. Each key is assigned a particular function. The microcontroller compares the received ASCII value and accordingly gives the signal to 293d motor driver. And the required motor is moved to control the arm as we need.

C. Joystick Controlled:

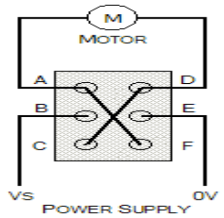

Fig .2: Connecting up a DPDT Switch

The figure 2 shows the arrangement of wires to control the single dc motor in both forward and reverse direction using a single DPDT(double pole double throw) switch with single power supply connection

We have used similar connection for four DPDT switches to control the four dc motors of our arm. These switches are basically momentary switches. The power is delivered to motor until we keep the switch pressed. As we remove the pressure the power is stopped and hence the motor.

This technique is simplest of all and it does not require the microcontroller. It is just the game of switching and changing the direction, polarity and flow of power supply to different motors.

V. APPLICATION

- For material handling in industries.
- In space application.
- In domestic application.
- In hazardous conditions where we can't afford risk of human life such as handling radioactive material, in space application for maintenance.

VI. LIMITATION

- Wooden assembly poor the strength of mechanical assembly. This problem is overcome by using steel assembly.
- Accuracy of the system is less. Remedy is solved by using stepper motor.

VII. FUTURE SCOPE

- Wireless control.
- By changing end effecter, we can change the application.
- By making base movable we can move assembly in any direction.

VIII. CONCLUSION

We have implemented this model successfully. The product prepared by us can be used by AVR and pick microcontroller as well. By changing end effecter we can use this robot for different applications. Three way controls makes it more user friendly. Along with human safety it provides more accuracy and reliability.

REFERENCES

[1] www.google.com
[2] www.roboticsindia.com
[3] www.8051.com
[4] www.datasheetcatalog.com
[5] 8051 microcontroller by Mazidi.
[6] Mechatronics by V.S.Bagad.