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General purpose Industrial Robot

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Abstract: In today's world various automation techniques are being adopted for increase in productivity, for better accuracy, eliminating the human errors. Machine Vision is one such advancement in automatic systems. Machine vision performs the tasks that are similar to human vision. It helps to detect the object of color and sort that object. This paper present color sorting solution with application of image processing. Image processing procedure senses the object in a capture form and then extract its colour and its position information out of it. This information sends as a sequence of sorting command to the controller that does sorting mechanism. After recognizing the color of the object, robotic arm will automatically pick & place it accordingly. If the colour of the work piece is not found in accordance to the required one, then it will be rejected.

Keywords: Robotic Arm, Controller, Teach Pendent, Machine Vision.

I. INTRODUCTION

Robots are devices that are programmed to do work with a tool. Robots are typically used as substitutes for human workers in these tasks Robots can perform a variety of tasks such as loading and unloading machine tools, spot welding automobile bodies, and assembly. An industrial robot consists of a mechanical manipulator to perform other related functions. The controller operates the joints in a coordinated fashion to execute a programmed work cycle. A robot joint is similar to a human body joint and It provides relative movement between two parts of the body. Typical industrial robots have five or six joints.General purpose industrial robot increases productivity, safety, efficiency, quality of products. Robots can be much more accurate than humans. Robots have repeatable precision at all times.General purpose robots carry standard designs and parts and are readily available. They can be easily adapted to the users requirements by attaching suitable end effectors or fingers to them according to the requirement of the work, such as a part picking operation, welding, spray painting operations, etc. such robots are cheaper because they are mass produced. A robot is automatic device that performs the functions normally ascribed to humans or a machine in the form of human. Controller is the interface between the robot and its environment. It provides intelligence and feedback to the robot through the compilation of sensor measurements. It also acts as storage device, retaining the sensory information and inputted programs.

Figure 1: General Purpose Robot

II. LITERATURE SURVEY

The word robotics was derived from the word robot, which was introduced to public by Czech writer Karel Capek in his play R.U.R. (Rossum's Universal Robots), which was published in 1920.

The word robot comes from Slavic word robota, which means labor. The literature is the development or progress of the robotics in some last years, is as follows:

1954: The first programmable robot is designed by George Devol, who coins the term Universal Automation.

1969: Unimate robots enter Japanese market unimation signs a licensing agreement with the Kawasaki Heavy Industries to manufacture and market unimate robots for the Asian market.

1973: first robot to have 6 electromechanically driven axes KUKA moves from using Unimate robots to developing their own robots.

1978: The Programmable Universal Machine for Assembly robot is developed by Unimation with a General Motors design support.

1985: KUKA Germany, introduces a new Z-shaped robot arm whose design ignores the traditional parallelogram. It achieves total flexibility with three rotational movements for a total of six degrees of freedom. The new configuration saved floor space in manufacturing settings.

1995: Emerging applications in small robotics and mobile robots drive 2nd growth of start-up companies and research.

1998: ABB, Sweden, developed the Flex Picker, the world‘s fastest picking robot based on delta robot developed by Reymond Clavel, Federal Institute of Technology of Lausanne (EPFL) in 1998.

2004: Staubli was still making articulated robots for the general industrial and clean room applications.

2006: KUKA, Germany, presents the first "Light Weight Robot" Developed in the cooperation with DLR, Institute of Robotics and Mechatronics, Germany, the outer structure of KUKA lightweight robot is made of aluminium [6].

An industrial robot is officially defined ISO as automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes. The modern concept of industrial robotic manipulators was only introduced in late 1959 by G. C. Devol. It weighed two tons and was controlled by program on magic drum. They use hydraulic actuator and programmed in joint coordinates. The first installation of the Unimate robot for loading/unloading a die-casting machine at GM was in 1961[2].

In 1985 KUKA Germany, introduces a new Z-shaped robot arm whose design ignores the traditional parallelogram. It achieves total flexibility with three rotational movements for a total of six degrees of freedom. The new configuration saved floor space in manufacturing settings. KUKA, Germany, introduces a new Z-shaped robot arm whose design ignores the traditional parallelogram in 1985. It achieves total flexibility with three translational and three rotational movements for a total of six degrees of freedom. Demaurex, Switzerland, sold its first Delta robot packaging application to Roland [3][4].

ABB, Sweden, developed the Flex Picker, the world 's fastest picking robot based on the delta robot developed by Reymond Clavel, Federal Institute of Technology of Lausanne (EPFL) in 1998. It was able to pick 120 objects a minute or pick and release at a speed of 10 meters per second, using image technology. Reis, Germany, introduces integrated laser beam guiding within the robot arm and launches the RV6L-CO2 laser robot model in 1999. This technology replaces the need of an external beam guiding device thus allowing using laser in combination with a robot at high dynamics and no collision contours [5].

ABB launchedworld's first fully electrical, microprocessor controlled industrial robot it took industrial robotics into a new dimension of the speed, the accuracy andthe flexibility. Thirty years later ABB has delivered 115,000 robots worldwide, more than the any other supplier. This success story is the based on a continuous stream of pioneering innovation in robotics that has not yet come to the end. Robots have not only become stronger, they can also operate over larger working areas and can position parts with sub-millimetre accuracy. This geometrical positioning ability replaces specialized equipment and the greatly simplifies production cell design. Welding is the one of the broad application areas of industrial. Robots. In the order to permit the robot to work with experience of a professional welder and with the highest accuracy, the ABB has developed Virtual Arc software. The time consuming and expensive task of robot programming is no issue any more.

Often robots also have to perform tasks in the coordination. Again, ABB has developed a controller, IRC5, which simultaneously controls up to the four robots or positioning devices with a maximum of 36 servo axes. Thus, the robots reach every required seam position without interrupting in the welding. To improved path accuracy and the better repeatability contribute to a higher quality[3].

In 2006 KUKA, Germany, presents the first "Light Weight Robot" Developed in cooperation with DLR, Institute of the Robotics and Mechatronics, Germany, the outer structure of KUKA lightweight robot is made of aluminum. It has a payload capacity of 7kg and, thanks to its integrated sensors, is highly sensitive. This make it ideally suited to handling and assembly tasks. Due to its low weight of 16kg the first robot weighted of just two tons. The robot is energy efficient and portable and can perform a wide range of different task.

III. PROPOSED MODEL

Block Diagram

The block diagram is divided into
1) Robot.
2) Controller.
3) End Effector.
4) Motor and sensor connector.

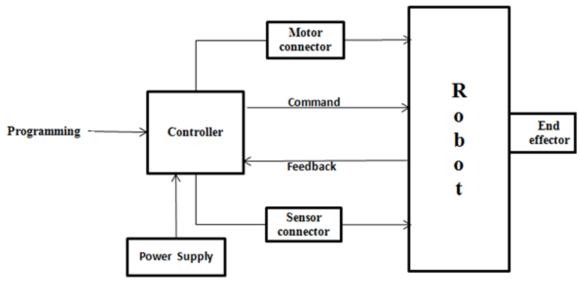

Figure 2: Block Diagram of General Purpose Robot

The block diagram of General Purpose Robot is shown in Figure 2. The block diagram consists of power supply, Controller, Motor Connector, Sensor Connector and Robot. The block diagram explains the simple working of the whole system developed.

Let us take one application of robot such as pick and place object. We give programming of this application to controller, in controller there are three PCB boards such as Input/output PCB, DSP PCB, and CPU PCB. This controller is based on CPU PCB board, the programming which given to controller is saved in this PCB. This is five axis robots with payload 10kg and in this robot there are five hybrid servo motors. To drive this motor there are five drive in controller. This robot is articulated robot which is same as human hand.

Controller

This regulating device initiates one or more functions of the operation in robot arm, such as start, stop, reversing,

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and changing speeds by issuing a preset list of commands. Thecontrolleris a part of a robot that coordinates the all movements of the mechanical system. It also the receives input from the immediate environment through various sensors. The heart of the robot's controller is generally a microprocessor linked to the input/output and the monitoring devices. The commands issued by the controller activate motion control mechanism, consisting of various controllers, amplifiers, and actuators

Technical Specifications of controller are as follows

- Dual-chamber Direct Airflow Path™ design for outstanding cooling potential
- Clever, space-saving design still offers lots of the internal volume
- Includes three High Performance Air Series AF140L fans for better cooling
- Tons of expansion room for high performance air cooling and liquid cooling
- Full side panel window
- Black interior
- Cable routing cut-outs with rubber grommets
- CPU cut-out in motherboard tray for easy CPU cooler swap-out
- Dual front USB 3.0 ports with internal connector
- Headphone, Microphone front ports
- Eight expansion slots for quad GPU installations
- Dual 3.5" hot swap bays
- Four 2.5" tool-free SSD drive cages
- Maximum GPU Length 320mm
- Maximum CPU Cooler Height 170mm
- Maximum PSU length 200mm

Controller contain 4 PCB boards

1. Input/output PCB

The input/output connections are made through this board.

2. Digital Signal Processor PCB

A digital signal processor (DSP) is a specialized microprocessorwith its architecture optimized for the operational needs of processing. The goal of DSP is to measure, filter and/or compress continuous real-world analog signals. Most general-purpose microprocessors can also the execute digital signal processing algorithms successfully, but dedicated DSP usually have better power efficiency thus they are more suitable. DSP often use special memory architectures that are able to fetch multiple data and/or instructions at the same time.

3. CPU PCB

A central processing unit (CPU) is the electronic circuitry within a computer that carries out the instructions of a computer program by performing the basic arithmetic, logical, control and input/output (I/O) operations specified by the instructions.

- This board contains: the main microcontroller chip (Check details)
- Memory
- Peripheral interface

4. Power supply PCB

Four large Capacitors are connected on the board of values:

- 33000µF – 35V
- 10000µF -35V
- Two 6800µF -35V

End Effectors

The end effectors are the robot's hand, or the end-of-arm tooling on the robot. It is a device attached to the wrist of manipulator for the purpose of grasping, lifting, transporting, manoeuvring, or performing operations on a work piece. The end effectors are one of the most important components of a robot system. The robot's performance is a direct result of how well the end effectors meet the task requirements. The area within reach of the robot's end effectors is called its work envelope.

Sensor

For non-contact detection of metallic target at ranges generally under 50mm (2 inches). Inductive proximity sensors emit an alternating electromagnetic sensing field when a metal target enters the sensing field, eddy current are induced in the target, reducing the signal amplitude and triggering a change of state at the sensor output. Advantage of the inductive proximity sensors include: ignores water, oil, dirt and non-metallic particles in sensitive to target colour or target surface finish short circuit resistant with stands high shock and vibration environments.

Technical Specifications of Robot

Payload	10kg
Max reach	800mm
No. of axis	5
Repeatability	70microns
Mounting	Floor
Self Weight	85kg
Controller	20kg
Drive	Hybrid servo
Power	110/220VAC
Temperature	0-50C
noise	<40db

Figure 3: Technical Specifications of robot

Advantages

- No worry for longer controller cable cost.
- Providing repeatability and consistency.
- Working during unfavorable hours.
- Increasing productivity, safety, efficiency and quality of product
- Achieving more accuracy than human being.
- Reduced human efforts.

Disadvantages

- Sensor may get damaged
- The initial and installation costs of equipments of robots are quite high.
- They replace human workers thus causing resentment among workers.

IV. CONCLUSION

We learnt the different types applications that can be performed by an industrial robot such as welding, Pick and place application, Vision based sorting, etc. We were able to work efficiently as we had a basic knowledge in Mechatronics.

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