VIDEO STREAMING PICK AND PLACE ROBOT USING ARDUINO UNO CONTROLLER

Chaitrashree S R, Fatima Duha, Uzma Kousar, Maheen Shariff

Assitant professor, Student, Student, Student,

Department of Electrical and Electronics Engineering,

GSSS Institute of Engineering and Technology for Women, Mysuru, Karnataka, India.

Abstract : The use of robotics in industries has become more popular in the recent years. The trend seems to continue as long as the robotics technology meets diverse and challenging needs of the industries. Rapid developments in digital computers and control systems technologies have significant impact in robotics like any other engineering fields. A robot can be defined as a programmable, self-controlled device consisting of electronic, electrical, or mechanical units. This project leads to a low cost manufacturing in any industries as once the robot is implemented it can work repeatedly without any cost. This helps to increase the accuracy in manufacturing of goods, lifting and placing the objects in the required position and also to carry delicate or heavy goods without damaging goods from source to destination. Therefore, the purpose of this project is to design and implement a video controlled microcontroller based reliable and high performance robotic system for industries. The robot in this project is capable of picking materials and placing them at their destination. A gripper is used to pick and place the materials with flexibility. Finally, we can develop a suitable video streaming application to analysis the live video of robot works or movements.

I. INTRODUCTION

A robot can be defined as a programmable, self-controlled device consisting of electronic, electrical, or mechanical units. More generally, it is a machine that functions in place of a living agent. Robots are especially desirable for certain work functions because, unlike humans, they never get tired; they can work in physical conditions that are uncomfortable or even dangerous; they can operate in airless conditions; they do not get bored by repetition; and they cannot be distracted from the task at hand.This project is about an autonomous robot which is used in various industries. The robot is powerful, reliable and is mainly used to reduce manpower and therefore in increasing the economy of the country.
The most apparent reasons that are associated in installing of robotic systems are:
1) Saving of manpower.
2) Improved quality & efficiency.
3) Ability to work in any hostile environment.
4) Increased consistency & flexibility.
5) Increased yields and reduced wastage.The robot in this project is independent and intelligent. This robot uses a rechargeable battery, Atmel series microcontroller, an LCD, IR sensors, motor drivers and motors. The components mentioned belong to the hardware section of the project and the programming language i.e., Embedded C and the platform used for this language i.e., Kiel software form the software section.

II. LITERATURE SURVEY

- Robotic Arm Mechanical Robotics
  - "Robotic Arm Mechanical Robotics" is used in place of a human hand to perform a set of functions. This robotic arm is programmable in nature and can be manipulated.
  - In this project, a self-sufficient Robotic arm is fabricated by using components like micro controller and motors.
  - The main part of this project's design is an AT89C51 micro controller which coordinates and controls the product's actions. This micro controller is a high performance CMOS 8-bit microcomputer and has a flash memory of 4 kilobytes. It consumes low power and is erasable read only memory (PEROM).
- Hybrid Pick and Place Robot:
  - In this paper we present the constructive heuristic to optimize the component pick and place operation of a hybrid pick and place machine, which is a new type of surface mount device placement machine.
  - The ordered nozzle selection heuristic begins by choosing the best nozzle pair that is most effective for picking and placing component onto the printed circuit board.

- Finally, when all the available PCB points, have been scheduled, we then reutilize the schedule by minimizing the nozzle changes. Computational results are presented.

- Pick and place of hard disk media using electrostatic levitation
- This paper focuses on a practical application of handling contact sensitive objects such as silicon wafers or hard disk media without any contact using electrostatic levitation.
- Stable electrostatic levitation can be realized by controlling and electrostatic force on the basis of measured suspension air gaps.
- Two control approaches, namely centralised and de-centralised control and the influence of an integrator in the controller, are discussed with regard to the specific tasks of pick up and place.
- The final goal is to realize a handling tool that allows human operators to perform these object handling tasks.

AUTONOMOUS MOBILE ROBOT

A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry. Robotics is the branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. A robot is a combination of physics, mechanical engineering, electrical engineering, structural engineering, mathematics and computing. In some cases biology, medicine, chemistry might also be involved. This technology deals with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and/or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics.

The concept of creating machines that can operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century. Throughout history, robotics has been often seen to mimic human behavior, and often manage tasks in a similar fashion. Today, robotics is a rapidly growing field, as technological advances continue; research, design, and building new robots serve various practical purposes, whether domestically, commercially, or militarily.

The following are the necessary features of a robot:

1. Sensing: The robot should be able to sense its surroundings. It would do this in ways that are not similar to the way that humans sense the surroundings; like: light sensors (eyes), touch and pressure sensors (hands), chemical sensors (nose), hearing and sonar sensors (ears), and taste sensors (tongue) will give the robot awareness of its environment.

2. Movement: A robot needs to be able to move around its environment. Whether rolling on wheels, walking on legs or propelling by thrusters a robot needs to be able to move. Either the whole robot moves or just parts of the robot moves.

3. Energy: A robot needs to be able to power itself. A robot might be solar powered, electrically powered, battery powered etc. The way the robot gets its energy will depend on what the robot needs to do.

4. Intelligence: A robot need to be "smart." This is where programming enters the picture. A programmer is the person who makes the robot 'smart.' The robot will have to have some way to receive the program so that it knows what it is to do.

III. HARDWARE IMPLEMENTATION

The following are the hardware's used in this project:

1. Microcontroller
2. LCD
3. Robotic arm
4. IR proximity sensor
5. Gear motors
6. Motor Driver
7. Power supply

Microcontroller AT89S52

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry- standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes.

LCD

A 16 x 2 LCD is used which can display upto 32 characters. It displays information related to the direction taken by the robot. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller. LCD is connected to the microcontroller. It receives information from the microcontroller through the port 2.

The LCD here is an additional feature which is used to guide the user about the various ongoing processes taking place in the robot like initialization and the various movements and directions taken by the robot.

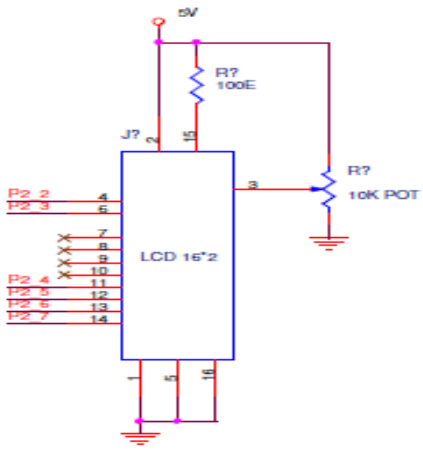

Fig 1: LCD connections

Robotic Arm

A Robotic arm [3] is a type of mechanical arm as shown in Fig 4.6, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand. The end effector, or robotic hand, can be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application.
For example robot arms in automotive assembly lines perform a variety of tasks such as welding and parts rotation and placement during assembly. In some circumstances, close emulation of the human hand is desired, as in robots designed to conduct bomb disarmament and disposal.

Fig 2 :Robotic Arm

IR Proximity Sensor

The LM358 Op-Amp as shown in the Fig 4.7, is used in the comparator mode. The IR photodiode (receiver) is used in a potential divider in a reverse bias mode.

A threshold voltage is set at the inverting terminal of the Op-Amp using a potentiometer. So when the IR light reflects from a lighter surface, say white, the resistance of the photodiode would decrease and this in turn when exceeds the threshold voltage will make the output of the op-amp goes high. LM 358 has two Op-Amps in its 8 pin package, thus two sensors could be built out of 1 IC. We can also use LM 324 which has 4 Op-Amps inside it.

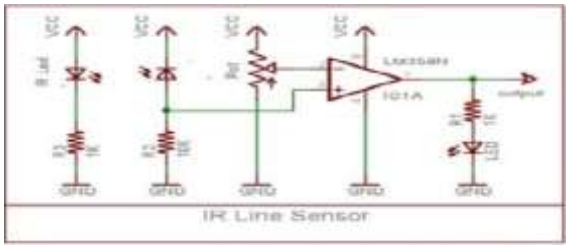

Fig 3: IR Line Sensor

Gear motors

A geared DC Motor as shown in the Fig 4.8 , has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM . The gear assembly helps in increasing the torque and reducing the speed.

Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

Working of the DC Geared Motor

The DC motor works over a fair range of voltage. The higher the input voltage more is the RPM (rotations per minute) of the motor. It can be explained by the principle of conservation of angular momentum. The gear having smaller radius will cover more RPM than the one with larger radius. However, the larger gear will give more torque to the smaller gear than vice versa. The comparison of angular velocity between input gear (the one that transfers energy) to output gear gives the gear ratio.

Fig 4: Gear Motor

When multiple gears are connected together, conservation of energy is also followed. The direction in which the other gear rotates is always the opposite of the gear adjacent to it. In any DC motor, RPM and torque are inversely proportional.Hence the gear having more torque will provide a lesser RPM and converse. In a geared DC motor, the concept of pulse width modulation is applied.

L293D Dual H-Bridge Motor Driver

L293D as shown in the Fig 4.9, is a dual H-Bridge motor driver, so with one IC we can interface two DC motors which can be controlled in both clockwise and counter clockwise direction and if you have motor with fix direction of motion that you can make use of all the four I/Os to connect up to four DC motors. L293D has output current of 600mA and peak output current of 1.2A per channel. Moreover for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver.

L293D motor driver can control two motor at one time or called is a dual H-Bridge motor driver. By using this IC, it can interface DC motor which can be controlled in both clockwise and counter clockwise direction.

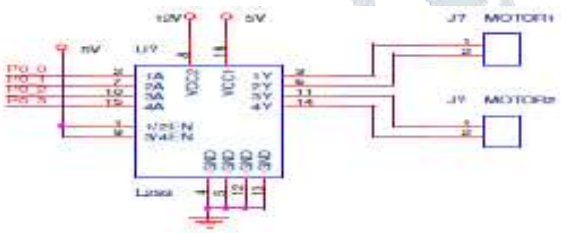

Fig 5:Circuit of a Motor Driver

The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. L293D has output current of 600mA and peak output current of 1.2A per channel.

IV. SOFTWARE IMLEMENTATION

This chapter deals with the software details used by the manufacturer of pick and place robot for industrial purpose. The programming is done in embedded c language using Keil µvision.

- **Embedded C**

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations.

In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing.

Embedded C use most of the syntax and semantics of standard C, e.g., main() function, variable definition, data type declaration, conditional statements (if, switch. case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, unions, etc.

The advantages of using embedded c language are:

1. It is small and reasonably simpler to learn, understand, program and debug.
2. Compared to assembly language, C Code written is more reliable and scalable, more portable between different platform.
3. C Compilers are available for almost all embedded devices in use today, and there is a large pool of experienced C programmers.
4. Unlike assembly, C has advantage of processor-independence and is not specific to any particular microprocessor/ microcontroller or any system. This makes it convenient for a user to develop programs that can run on most of the systems.
5. As C combines functionality of assembly language and features of high level languages, C is treated as a 'middle-level computer language' or 'high level assembly language'
6. It is fairly efficient
7. It supports access to I/O and provides ease of management of large embedded projects.
8. Java also used in many embedded systems but Java programs require Java Virtual Machine (JVM), which consume lot of resources. Hence it is not used for smaller embedded devices.

V. RESULTS AND DISCUSSION

The pick and place robot which is assembled and programmed here is used to pick an object from a source and place it at the destination. The locomotion of the robot is made possible by using two gear motors. The gear motors are driven by programming them in embedded C using Keil µVision software. The robot peregrinates so that it picks an object from the source and places it at the destination. Thus by developing the proposed project the industries can be automated reducing the workload.

VI. FUTURE WORK

1. The visual sensing system can be based on anything from the traditional camera, sonar, and laser to the new technology radio frequency identification (RFID), which transmits radio signals to a tag on an object that emits back an identification code. All four methods aim for three procedures—sensation, estimation, and matching.

Image quality is important in applications that require excellent robotic vision. Algorithm based on wavelet transform for fusing images of different spectra and different foci improves image quality. Robots can gather more accurate information from the resulting improved image.

Visual sensors help robots to identify the surrounding and take appropriate action. Robots analyze the image of the immediate environment imported from the visual sensor. The result is compared to the ideal intermediate or end image, so that appropriate movement can be determined to reach the intermediate or final goal.

2. Automated robots require a guidance system to determine the ideal path to perform its task. However, in the molecular scale, nano-robots lack such guidance system because individual molecules cannot store complex motions and programs. Therefore, the only way to achieve motion in such environment is to replace sensors with chemical reactions. Currently, a molecular spider that has one streptavidin molecule as an inert body and three catalytic legs is able to start, follow, turn and stop when came across different DNA origami. The DNA-based nano-robots can move over 100 nm with a speed of 3 nm/min.
3. The microcontroller programming can be replaced by PLC, as a new technology.
4. Making magnetic gripper more powerful can increase the payload property of the robot.
5. The gripper can be modified for different operations in different industries.

VII. ACKOWLEDMENT

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