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Research Paper

SORTING OF OBJECTS BASED ON COLOUR BY PICK AND PLACE ROBOTIC ARM AND WITH CONVEYOR BELT ARRANGEMENT

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In many situations, autonomous robots can provide effective solutions to gruelling tasks.In this case, it is desirable to create an autonomous robot that can identify objects from the conveyor belt and relocate them if the object meets certain criteria. Dealing with a large number of objects is a very menial task, this is an excellent application for a robot of this type. In this case, to keep costs and design complexity low, the robot is designed around the platform and uses several different sensors to collect information about the robots environment to allow the robot to react accordingly. This paper aims at the problem I am attempting to solve is to create an autonomous robot that can identify objects when placed on the conveyor belt based on color sensing and then sort by relocating them to a specific location. It will be using a picking arm which uses a controller motor to pick the particular object from the conveyor belt and place it according to the color sensing. Micro controller (AT89S52) allows dynamic and faster control. Liquid Crystal Display (LCD) makes the system user-friendly. AT89S52 Micro controller is the heart of the circuit as it controls all the functions.

Keywords: Micro controller (AT89S52), Robotic arm, Conveyor belt, Material handling system, Infrared (IR) LED sensors, Automation

INTRODUCTION

Robot is an integral part in automating the flexible manufacturing system that one greatly in demand these days. Robots are now more than a machine, as robots have become the solution of the future as cost labour wages and customers demand. Even though the cost of acquiring robotic system is quite expensive but as today's rapid development and a very high demand in quality with International Standard Organization (ISO) standards, human are no longer capable of such demands. Research and development—of future robots is moving at a very rapid pace due to the constantly

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improving and upgrading of the quality standards of products.

Robot and automation is employed in order to replace human to perform those tasks that are routine, dangerous, complex and in hazardous area. In a world of advanced technology today, automation greatly increases production capability, improve product quality and lower production cost. It takes just few people to program or monitor the computer and carry out routine maintenance.

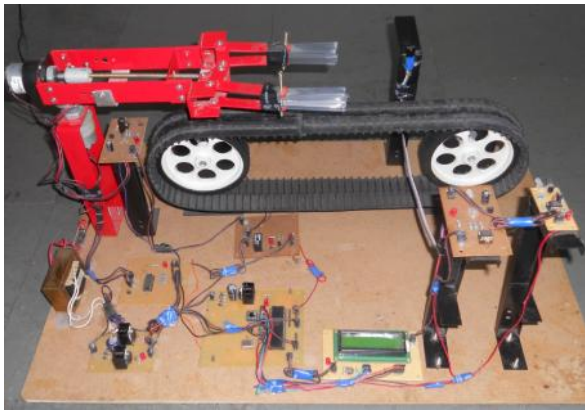
This paper aims at fully automated material handling system. This can be done by using a pair of IR sensors interfaced with AT89S52 Micro Controller Unit. It synchronizes the movement of robotic arm to pick the objects moving on a conveyor belt. It aims in classifying the coloured objects which are coming on the conveyor by picking and placing the objects in its respective pre-programmed place. Thereby eliminating the monotonous work done by human, achieving accuracy and speed in the work. This robot involves colour sensors that senses the object's colour and sends the signal to the microcontroller. The microcontroller sends signal to eight relay circuit which drives the various motors of the robotic arm to grip the object and place it in the specified location. Based upon the colour detected, the robotic arm moves to the specified location, releases the object and comes back to the original position.

METHODOLOGY

The pick and place robotic arm is a mechatronics system that detects the object on the conveyor belt, picks that object from source location and places at desired location. For detection of object, infrared sensors are used which detect presence of object as the transmitter to receiver path for infrared sensor is interrupted by placed object. As soon as robotic arm receives the signal from the controller, picks it with end effectors and places it on the respective destination depending on the respective colour of the object that is black or white. If another object causes interrupt, it again does the same job. The system uses AT89S52 Micro Controller Unit as its controller for performing different operations by the robot.

- It is based on microcontroller equipped with IR object vision sensors to sense color of object.
- After sensing object and its color, robotic arm place them accordingly of conveyer belt accordingly.

Figure 1: Object Sorting Robot



HARDWARE COMPONENTS

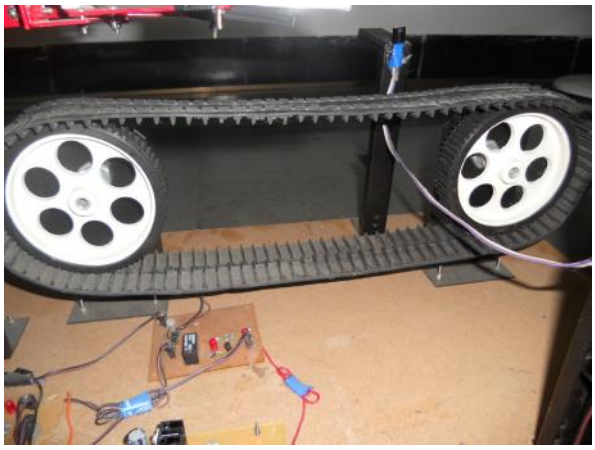
This section describes about the hardware components used in the robot

Conveyor Belt

The conveyor belt used here consists of two wheels which serve the function of pulleys, with a continuous loop of material—the conveyor

belt—that rotates about them. One of the wheels is powered by a 60 rpm DC motor, moving the belt and the material on the belt forward. Here, the conveyor motor receives power and signal from the central supply through rectifier and control circuit.

Figure 2: Conveyor Belt with Two Wheels



Robotic Arm

The work space of this arm is a circle in which it rotates to pick and place the job and position itself. The base of the arm is provided with a dc motor to rotate the arm, the motor rotates in both clockwise and anti clockwise directions to place the job. The motor is interfaced with the microcontroller and relay. The robotic arm movements are controlled by the DC motor of 60 rpm. Here micro controller controls the movement of the arm depending on the color of the object (Black or White) placed and relay drives it that is it supplies power to arm. When the job is picked up the arm moves through a particular angle to its left or right, if the colour of the job is white then the robotic arm moves towards its right and releases the job at a particular place and if the color of the job is black then the robotic arm moves towards its left and releases the job at a specified place or

Figure 3: Robotic Arm

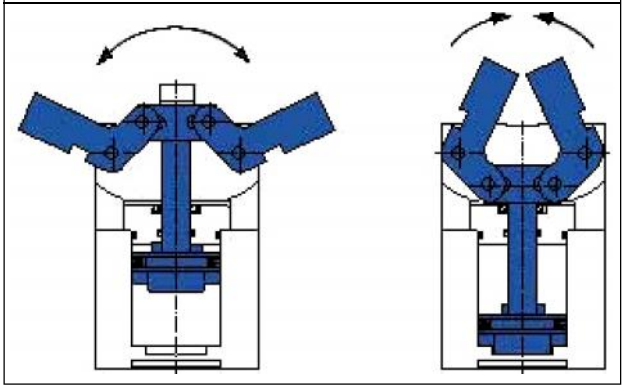
may be releases it onto another conveyor moving the job to packing shop or a paint shop used in manufacturing units. Once it releases the job, the robotic arm automatically comes back into its initial position onto the conveyor to pick up another object.

Gripper

9 V, 60 rpm, DC motor is used to control the gripper movement, for opening and closing of the gripper. The DC motor receives its signal from the controller for performing gripping and dropping operations. The gripper has been specially designed in order to grip rectangular or square objects from the running conveyor and dropping them at programmed locations. An industrial robot is defined as automatically controlled, reprogrammable, multipurpose manipulator programmable required axes. The parameters such as Degree of freedom, Work Volume, Payload, accuracy, repeatability, acceleration and robot kinematics are considered before designing the robotic arm.

Its motion is restricted by placing the IR sensor and programming the controller accordingly to limit the robotic arm's movements. When the motor rotates in

Figure 4: Gripper Movement by Rack and Pinion Mechanism



clockwise direction the gripper closes and holds the job tightly and when the motor rotates in anti clockwise direction the tends to release the job. Here the mechanism used for the movement of the grippers is rack and pinion mechanism.

ELECTRICAL COMPONENTS

This section describe the electrical components involved in the robot.

Transformer

Usually, DC voltages are required to operate various electronic equipment and these voltages are 5 V, 9 V, 12 V or 18 V. But these voltages cannot be obtained directly. Thus the A.C input available at the mains supply, i.e., 230 V is to be brought down to the required voltage level. This is done by a transformer. Thus, a step down transformer is employed to decrease the voltage to a required level.

DC Motor

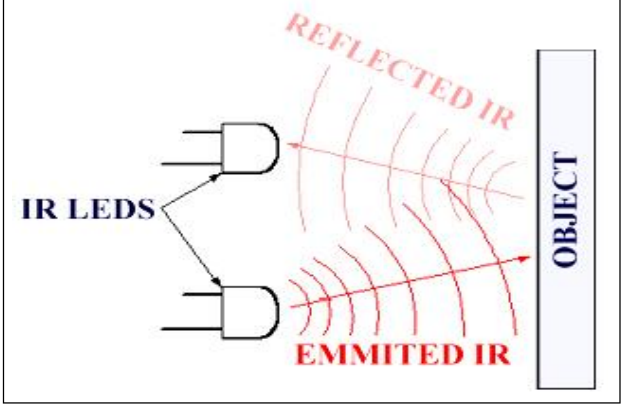
Three 60 RPM 12 V DC motors are used in this machine.

ELECTRONIC COMPONENTS

Infrared LED Sensors (IR Sensors)

An Infrared sensor is an electronic device that measures infrared (IR) light radiating from objects in its field of view. IR sensors are often used in the construction of IR-based motion detectors apparent motion is detected when an infrared source with one temperature, such as a human, passes in front of an infrared source with another temperature, such as a wall. It is the same principle in all Infra-Red proximity sensors. The basic idea is to send infra red light through IR-LEDs, which is then reflected by any object in front of the sensor. Then all one have to do is to pick-up the reflected IR light. For detecting the reflected IR light that was emitted from another led of the exact same type. This is an electrical property of Light Emitting Diodes (LEDs) which is the fact that a led Produce a voltage difference across its leads when it is subjected to light. As the name implies, the sensor is always ON, meaning that the IR led is constantly emitting light. This design of the circuit is suitable for counting objects on the conveyor belt. However this design is more power consuming and is not optimized for high ranges in this design, range can be from 1 to 10 cm, depending on the ambient light conditions. As one can see the schematic is divided into 2 parts the sender and the receiver.

Figure 5: IR Sensor Working Mechanism



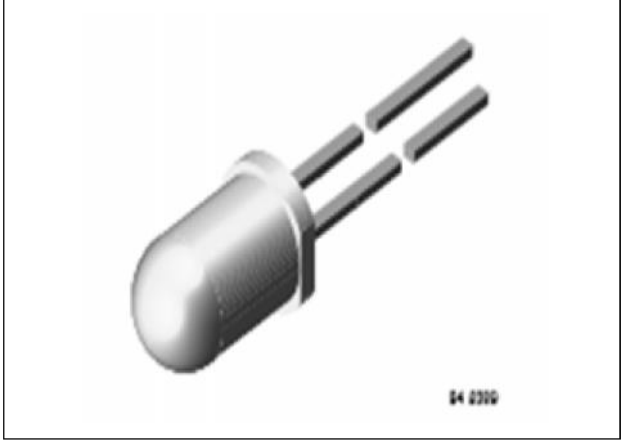
IR Transmitter

TSAL6200 is a high efficiency infrared emitting diode in GaAlAs on GaAs technology, moulded in clear, bluegrey tinted plastic packages. In comparison with the standard GaAs on GaAs technology these emitters achieve more than 100% radiant power improvement at a similar wavelength. The forward voltages at low current and at high pulse current roughly correspond to the low values of the standard technology. Therefore these emitters are ideally suitable as high performance replacements of standard emitters.

Features

- Extra high radiant power and radiant intensity.
- High reliability.
- Low forward voltage.
- Suitable for high pulse current operation.
- Standard T-1¾ (Φ5 mm) package.
- Angle of half intensity ¤ = ± 17°.
- Peak wavelength ^{a}p = 940 nm.
- Good spectral matching to *Si* photodetectors.

Figure 6: IR Transmitter



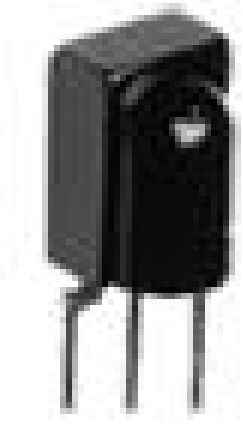
IR Receiver

The TSOP17-series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter. The demodulated output signal can directly be decoded by a microprocessor. TSOP17XX is the standard IR remote control receiver series, supporting all major transmission codes.

Features

- Photo detector and preamplifier in one package.
- Internal filter for PCM frequency.
- Improved shielding against electrical field disturbance.
- TTL and CMOS compatibility.
- Output active low.
- Low power consumption.
- High immunity against ambient light.
- Continuous data transmission possible (up to 2400 bps).
- Suitable burst length 0.10 cycles/burst.

Figure 7: IR Receiver



Liquid Crystal Display (LCD)

LCD screen is employed on the robot to display the colour of the object moving on the conveyor belt and also shows number of objects sorted. The status and the parametric performance of the robot can be seen on the LCD.

Figure 8: LCD Screen

SOFTWARE REQUIREMENTS

Microcontroller-AT89S52

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8 K 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 pinout. 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

Figure 9: ATMEL Microcontroller

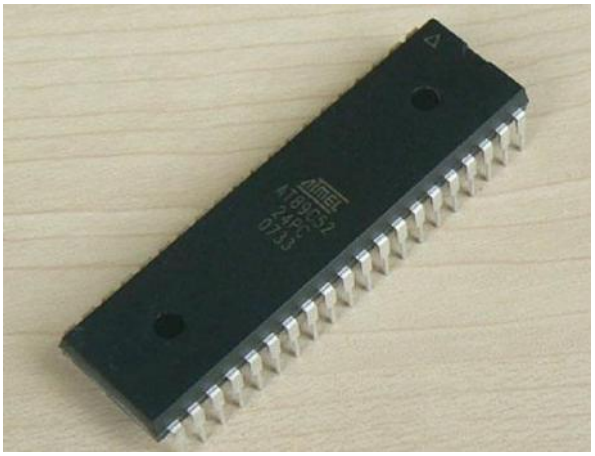
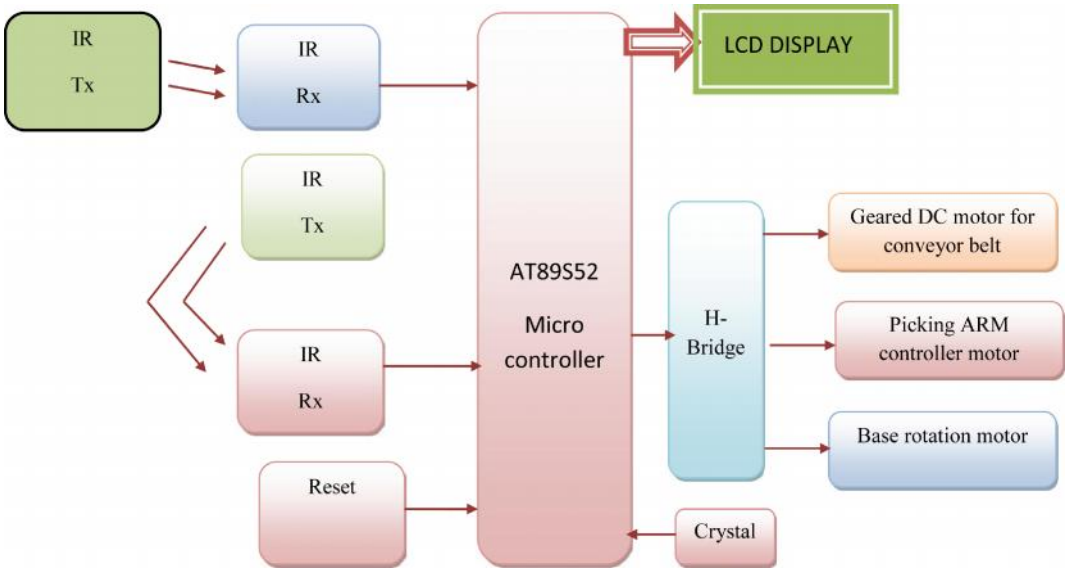


Figure 10: Block Diagram of the System



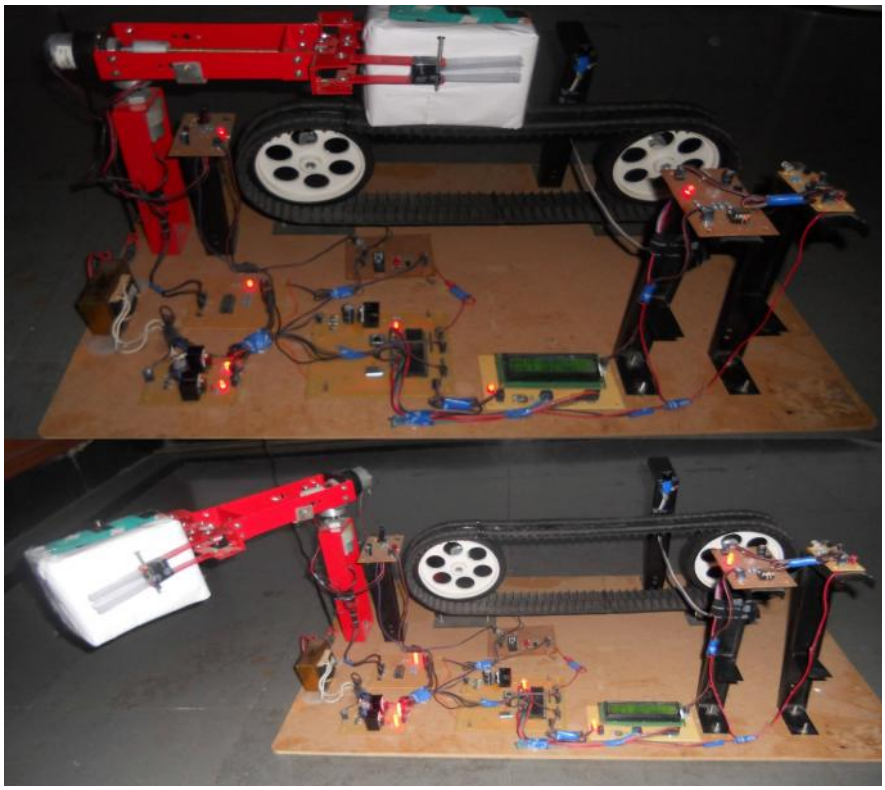
chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

Microcontroller is a programmable device. A microcontroller has a CPU in addition to a fixed amount of RAM, ROM, I/O ports and a timer embedded all on a single chip. The fixed amount of on-chip ROM, RAM and number of I/O ports in microcontrollers makes them ideal for many applications in which cost and space are critical. 8052 is an 8-bit processor, meaning that the CPU can work on only 8 bits of data at a time. Data larger than 8 bits has to be broken into 8-bit pieces to be processed by the CPU. 8052 is available in different memory types such as UV-EPROM, Flash and NV-RAM. This robot is implemented on Keil uVision. Keil compiler is a software used where the machine language code is written and compiled. In order to program the device, proload tool has been used to burn the program onto the microcontroller. This microcontroller has a program in it written in such a way that it accepts the hex file from the keil compiler and dumps this hex file into the microcontroller which is to be programmed.

Applications

- Industrial applications such as manufacturing and material handling systems
- Airports
- Museums
- Shopping malls

Figure 11: Execution of Work by the Robot



CONCLUSION

This robot involves sorting of objects through colour sensors, the future advancements can be done by increasing the efficiency of the colour sensor. This method is verified to be highly beneficial for automated industries. The sensor is key component of project which aides in distinguishing the objects. Failing of which may result in wrong material handling. Thus it becomes vital that the sensor had a very high sense of sensitivity and ability to distinguish between colours. There is a reset button provided on the base which can used to restart the system from the begining when there is a stuck or hang situation. There are two main steps in colour sensing part, objects detection and colour recognition. This paper is depicting the prototype of sorting systems which are used in industries.

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