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# A Conceptual Design of Line Follower Pick-and-Place Robot for Industrial Purpose

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## Abstract

*Mankind is habituated to seek comfort. All the times they are keen to find alternatives of daily activities and works to do by themselves. Concept of object pick-and-place robot which will be functioned following a particular line, may help an industry to attenuate the labor cost or may be alternatives of the labors. Day by day the industries are following the concept of automation and for this purpose robots are the best alternatives. One type of robot is most commonly used in industry is a robotic manipulator or simply a mechanical arm. It is an open or closed kinematic chain of rigid links interconnected by movables joints. We have accumulated a mechanical arm with a line follower robot which will be able to pick an object from a certain place then carry it to the defined place by following a predefined line.*

Keywords: Arduino UNO, Infrared sensor, Sonar sensor, Servo motor, Mechanical arm.

## 1. Introduction

Robotics is the branch of engineering science & Technology related to robots, and their design, manufacture, application, and structural disposition. In highly developing society time and man power optimization is a fundamental issue. To reduce human effort automation is playing important role. Present day industry is increasingly turning towards computer-based automation mainly due to the need for increased productivity and delivery of end products with uniform quality. The use of robots in industrial field intensify the production rate. They can emphasize on simple repetitive tasks. They can be defined as a programmable device which is self-controlled consisting of electronic, electrical and mechanical equipment. More generally, it is a machine which plays a role like a live agent. The main benefits of using robots instead of human are- they never get tired, they can work in the physical conditions that are uncomfortable or even dangerous, they can work in airless conditions, they must not be bored by repetition and finally they cannot be distracted from the task at hand. The term “robot” was first appeared in a Czechoslovakian satirical play, Rossum’s Universal Robots, by Karel Capek in 1920. In early 1800’s mechanical puppets were first built in Europe just for entertainment value. The various parts of the puppets were driven by linkage and cams and the were controlled by rotating drum. The first industrial robots were Unimates developed by George Devol and Joe Engelberger formed in the late 50’s and early 60’s. The first patent was by Devol but Engelberger formed Unimation which was the first maker robots. So Engelberger has been called the “Father of the robotics”. George Devol Jr, in 1954 developed the multi jointed artificial arms which lead to the modern robots. In 2000, Swarm bots resemble insect colonies. Typically, they consist of a large number of individual simple robots that can interact with each other and

together perform complex tasks. Still now, the autonomous robotic are improved day by day. Isaac Asimov proposed the robots as humanoids, free from feelings and he used them in a number of stories. His robots were designed well. They were fail-safe machines whose brains were controlled by human beings. Anticipating the dangers and havoc such a device could cause, he prescribed rules for their ethical conduct. There was a law for robots then named, "Three laws of Robotics' which are also valid for real robots of now a day as well. The three laws for the robots are: A robot should not injure a human being or, through inaction, allow a human to be harmed, a robot must obey orders given by humans except when that conflicts with the First Law, a robot must protect its own existence unless that conflicts with the First or Second law.

Line follower robot is a robot that can move along a path [1]. It is an electronic device that can track out and follow the line schemed on the floor. The line follower robot is a prototype model technic and created for material handling purpose [2]. Normally, the line is individualized a predefined path that can be either perceptible like a black line on a white surface with a high contrasted color [3]. A proper algorithm system and programming is needed to do it with ease. The various movement systems are accustomed to turn the robot. In this system, every astern wheel has a motor while the anterior wheels are uncommitted to rotate. To steering in an outright line, the motors are produced with the identical voltage (same polarity). To conduct a turn of various significance, the motor on the side of the turn requisite is given inferior voltage. To take an intense turn, its polarity is contrary [4]. The object carrying robot is a microcontroller based mechatronic system that finds out the object, picks the object from origin location and places at intentional specific location [5]. In picking the object a robotic arm is used. An intelligent robot system is designed which can give corrective feedback in different colors of light [6]. A pair of wheels balancing robot has developed which has the line following capability and for balancing it, they used infra-red sensor to solve the problem in inclination [7]. A robotic arm is a robot manipulator, usually using a sequence of function by controlled program, with resembling functions to a human arm [8]. An intelligent line following robot is designed which can modify the performance of the movement with the help of different type of magnetic sensors. That robot was based on the V2X sensor which is a type of digital compass [9]. The junctions of such a manipulator are engaged by joints approbating either rotational movement (such as in an articulated robot) or metastasis (linear) displacement. It also has design a small line following robot which used IR sensors to detect the line drawn on floor [10]. The robot arms can be self-explanatory or operated manually and can be used to perform a variety of tasks with great accuracy [10]. In pick and place line follower robot hardware parts as well as software programming are concurrently both improved. Mainly, a fixed microcontroller for the line follower robot attached with the ABB main controller is developed. A sensory system also associated for fulfilling the operational loop [11]. For the purpose object picking an algorithm is used and a controlled program operates it with great accuracy.

In our project, Aurdino Uno was used where the main control system is operated. It is one of the simplest and most easy to use. It response fast and is convenient for light work. Detecting object with the sonar sensor the claw will be used to lift and place the object. An Arduino is one of the simplest and easiest to use microcontrollers out there. Arduino comes with an IDE, which helps burn code onto the microcontroller from owner PC. It is open source and the website has links and extensive documentation on this. An Arduino Uno has everything that one need to get the job done, and lots of computing power to spare.

The PIC (16F877A) Microcontroller is used to control the mobile robot and connected with the RFID reader. Radio Frequency Identification (RFID) is a wireless non-contact use of radio frequency electromagnetic fields to transfer data for identification and tracking the tags associated with the items automatically. For providing bidirectional drive currents up to 600 mA at voltages from 4.5V to 36V L293D is designed. (Reddy et.al,2015). In our project Arduino UNO was used which is economical and time-consuming. L298 was used to control the motor or as a motor controller. For power lippo battery was used which is rechargeable and its power 11.2 amp. For controlling the wheel 12V motor was used In the former there have been many project rechargeable battery is not used for controlling the robotic hand .In most of the former research project creators are working to operate robotic arm through computer terminals, Joysticks, even interfacing them with the internet so they can be operated from anywhere in the world .Usually greater portion of the robotic arms are controlled by a central operator which makes uses of norms taken in from the boundary control that are entered by the user

at the terminal to move the arm to an individual coordinates in space. This vacillates the control very hard as the operating values of the motors are very difficult to prophesy to achieve a particular movement [10]. In comparison with the previous our hand is more easy and specific to control and more efficient in picking object as we use claw to make the task easier. In the most projects two robots have been used, one for carrying the object by following the line and another for picking and placing the object. But in our project, the two features are simulated in one. In that line follower robot claw is joined for picking and placing the object which is very beneficial and unique. The research objectives are, (1) To make a robot which can be carried load by following line, (2) To reduce physical effort in industry, (3) To consume production time.

## 2. Methodology

There are 6 main parts of this robot. Name of the parts and functions are depicted below.

### i. Arduino UNO

It's the main control unit of the robot. It processes all data and provides required command to the parts as it is ordered. This microcontroller board based on ATMega32. It has 14 digitals input and output pins among them 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Program can easily be uploaded from computer through USB cable. It can be powered by both USB connection or external power supply.

### i. IR sensor module

The physics which govern reflection of visible and infrared light are the same. IR LED's are easily available, and so are the sensors to detect IR radiation. Proper placement and shielding of sensors will go a long way to help get accurate readings off the track. One has two options now, to purchase a manufactured IR sensor module, or to build one oneself. A manufactured one has many benefits, like less susceptibility to noise and easy tuning and integration. The biggest disadvantage of a manufactured module is- it is not configurable. Exactly the opposite is true for a DIY module. If anyone only just starting out, it will probably save one quite a bit of trouble if one purchases one, but it does have its limitations. Sensor modules in this sense refers to a circuit which can sense reflected light and convert it into a quantity which can be interpreted by a microcontroller voltage.

### ii. Motor driver module

Motor drivers are circuit which allow control of motors. One need them because one can't power a motor with just a microcontroller's supply. Motor Drivers are available in IC form, implemented in the form of an "H-Bridge". They allow one to switch on and off a motor using an output from a microcontroller, and the best feature is they allow one to run the motor in both forward and reverse. This means each motor has 2 dedicated inputs from a microcontroller, one for direction control and one as an ON-OFF switch. If using PWM one need a pin capable of producing a PWM output to control the ON-OFF switch.

### iii. Claw

A robot claw is a programmable manipulator. The claw is comprised of segments connected by rotary and linear joints. These joints allow for controlled movements. Tasks that utilize robotic claws depend on accuracy and repeatability. There are different types of claws used according to their requirements of work. If we need to pick small and slippery object the gripping system must be better. Among the claws most used worldwide is articulated and has between four to six axes.

### iv. Battery

We use lithium battery. Internal or on-board supply requires batteries, which have to be rechargeable because run through alkaline batteries faster than one know it. If one gets rechargeable ones, l need a charger too. The current capacity, the weight and the rating of the battery also has to be accounted for. If using alkaline batteries,

one can make a pack out of them by connecting them in series and parallel. New technologies like Lithium Polymer and old ones like Nickel Metal Hydride are easily available, though may seem a little expensive. Remember PWM will make the motors draw currents in bursts of a few milliseconds apart. Some battery technologies cannot handle drawing so much current in such little time. This 'abuse' can even damage battery. Consider all these factors in designing on-board power.

### v. Connecting wire

It connects all the components for power and data transfer. Usually it is made of copper with plastic coated on it. It's not so mentionable but most important part of a robot

### vi. Working principle

We have an infrared sensor array beneath the front of our robot. Its senses the line and send a variable voltage signal to the ADC (Analogue to Digital Converter). The ADC send binary signal according to the sensor array to the Microcontroller (Arduino Mega 2560). A sonar sensor which is placed front faced. It senses the object which is placed in front of it. When it senses any object kept in front of it, it sends a signal to the microcontroller and then the controller commands the wheel motors to stop. At the same time, it sends signal to the servo motor to wake up and pick the object up by claw.

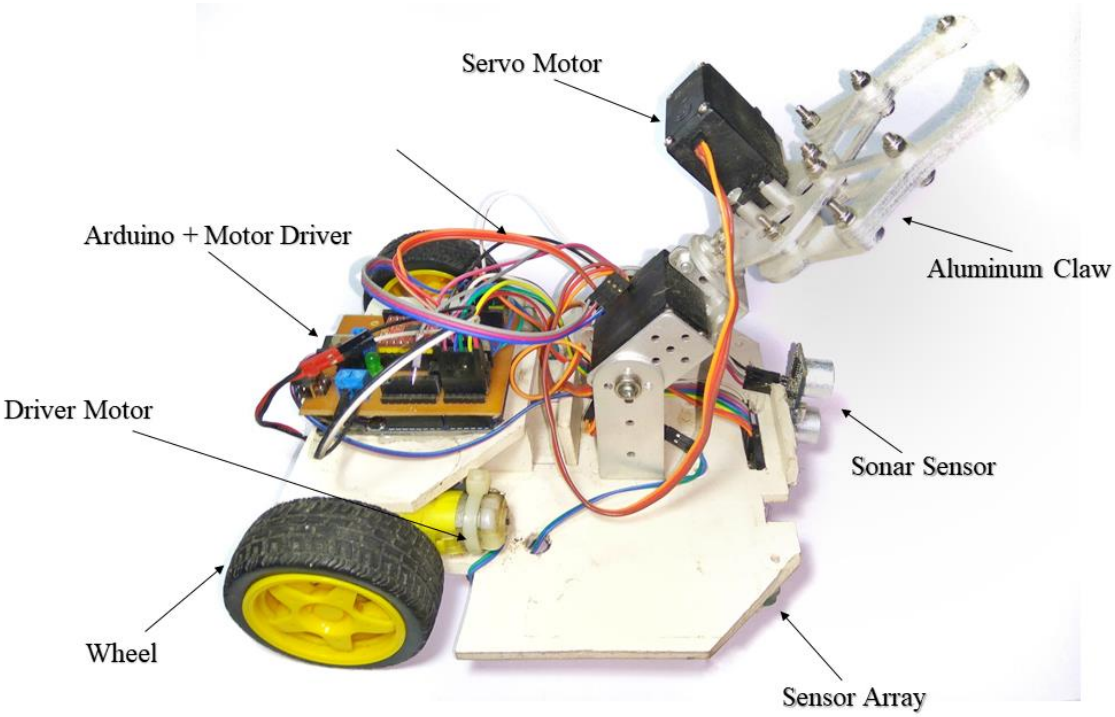


**Fig. 1. Robot body**

We add a buzzer and an indicator light for making a proper understanding between the operator and the robot. When it detects any object by the sonar, it stops and makes a loud sound by buzzer for a couple of seconds and when it reaches to the destination the buzzer begins to make sound continuously till it switched off. A push button is added for manual input. We have made a visualization of the total working principle in essence by the following figure.

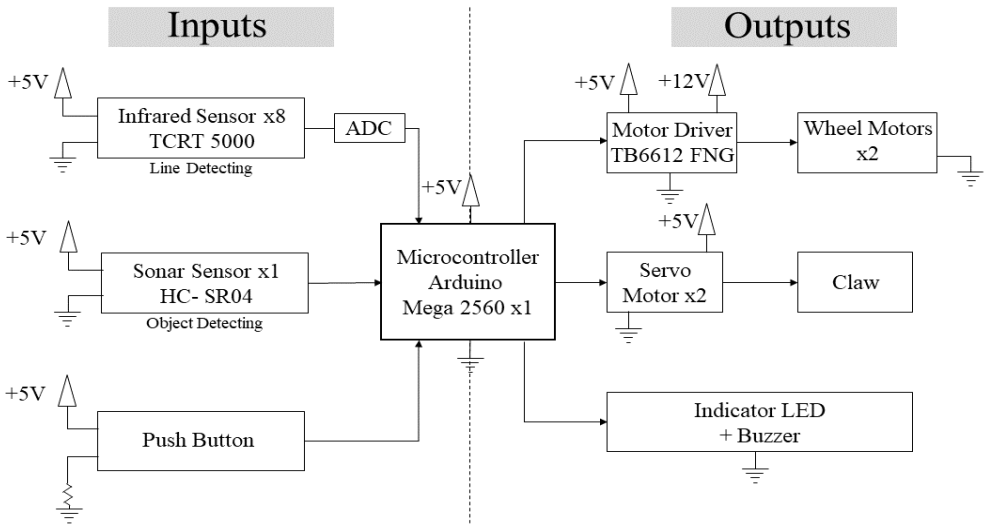


**Fig. 2. Working principle**

### vii. Power supply

Our robot is powered by 3 cell lipo battery. A circuit is made due to deliver constant voltage to the main circuit of the controlling system. The battery has a capacity of 11.1V. We attach a switch and indicator LED light to ensure whether the circuit power up or not. Following figure illustrate the of power supply circuit.

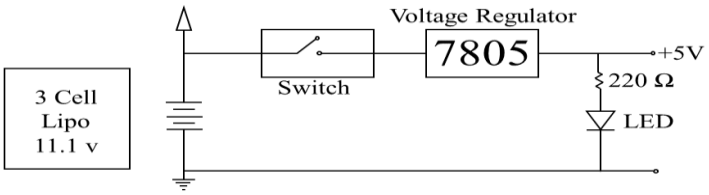


**Fig. 3. Power supply circuit diagram**

## 3. Result Analysis

The industrial purpose robot is capable enough of carrying object and pick and place it to specific position/ location. A conceptual design of line follower pick-and-place robot for industrial purpose is well produced by the author. The industrial purpose robot many advantages, such as it is possible to carry objects, pick the object and place the object in a specific location. The robot has some limitations too. Its load carrying capacity must be limited. Besides its travelling area also must be defined, not unlimited. It is instable on hard angles. After fixed time interval the battery has to be changed. As a prototype, the cost of manufacturing the robot is high but

for the production of large scale, the cost will be minimize and it will be beneficial to all types of industry where material handling are needed and the material handling cost will be minimum.

## 4. Discussion

The robot is capable enough of carrying object and pick and place it to specific position/ location. Having many advantages, it has some limitations too. Its load carrying capacity must be limited. Besides its travelling area also must be defined, not unlimited. It is instable on hard angles. after fixed time interval the battery has to be changed. As a prototype, the cost of manufacturing the robot is high but for the production of large scale, the cost will be minimized.

## 5. Conclusion and Future works

Instead of manpower, the robot will be used in factories, industries to reduce labor and cost of carrying objects. Besides following fixed line, the robot will carry the necessary amount of load It will be greatly useful to RMA industry, super market, library, healthcare and home application. It will satisfy the maximum need of them for carrying objects load in a proper way. Though it is a prototype but there may be some imperfections but the actual product can maintain all the following features. For this reason, its confidence level will be 93 percent. Most importantly, the robot will save time which is one of the main factors for rapid production. So, without any doubt, it can be chosen where necessary. In future to make this line follower robot much better, microcontroller can be used which will reduce the cost. Long termed charged battery can be used which will get rid of changing the battery often.

## 6. Funding

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