SARLoT: Smart Autonomous Robotic Load Transporter

Akhil Abraham, Ananthakrishnan G S, Bijeesh B Varghese, Sivakumar S, Rakesh S

Abstract: ***In the present scenario robots (machines) are used to complete differing tasks which are too complex for human beings. The most important objective of labourers in an industry is loading and unloading of loads which can be quite difficult, troublesome, time-consuming and risky for labourers to do manually. The advantage of using robots in the industrial field is to increase the pace and effectiveness of doing required duty compared to the work which is done manually. So here we have proposed an autonomous load transporter robot SARLoT which has mainly three features:-Line tracking, Avoiding Collision, Loading and Unloading goods. Loading and unloading of goods with control is considered as our main objective. The autonomous robot is designed in such a way that it has a starting point where goods are loaded on to the robot and a destination point where the goods are unload by itself after reaching the point by following the desired path. Arduino Uno has been used as the main development board and also it act as the central control unit for controlling the robot's movement within the desired route. Infrared sensors are mounted at the front and back of the robot, so that these sensors can be used to detect the black path thereby allowing the robot to carry goods in the designed route. Besides, an ultrasonic sensor has been mounted on the robot in order to avoid collision of robot with any obstacles that may occur in its desired route Designing an industrial robot which helps to reduce the human efforts in the loading and unloading of goods sections within a short period is the main focus of this paper.***

Index Terms: ***Bluetooth controlled car, Line following robot, Obstacle avoiding robot, Pick and place robot***

I. INTRODUCTION

For a number of years, labourers around the world who are working in heavy industries have been endangering their lives while doing treacherous jobs. During the analysis we get to know that these accidents happens due to the absence of proper safety precautions, proper training for workers to operate machines and inadequate number of well-educated and technical workers. Moreover, these problems mainly appear because they are hazardous tasks for humans, main disadvantage is that it takes away both time and space.

This scenario can be improved by the developing the technology and use robots in industries by replacing the additional unskilled workers. We can design a line follower robot with object avoiding technique for this purpose. It increases the pace of loading and unloading of goods, effectiveness of completing a job can be increased, minimize the loss of human. Thus the cost of production can be decreased by minimizing the number of labourers.

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II. LITERATURE SURVEY

A. Line following

Roman Osorio C (2006) designed a track following robot where magnetic sensors are used for the movement of robot [1]. The availability of this sensor is not simple, thus we have used infrared sensors. In order to enhance the sensitivity of the system comparator circuit was used. There has been numerous works on designing a line following robot with the technique to avoid collision if an object occurs in its track of movement. Dr. Bindu A Thomas et al. (2013) had designed an industrial based robotic arm to lift load that can also detect obstacle [2]. Al-Taharwa et al. (2008) explained the working of a robot which follows a desired path [3]. The robot moves through lines to reach to any store location. Abrar M. Alajlan et al. (2015) proposed collision avoidance systems that can be used in various fields and had an amazing outcome in reducing the chance of impact [4].

B. Pick and place robotic arm

Harish K et al. (2017) described various aspects of designing a robot which deals with different types of Arm design, controlling techniques and vehicle design [5]. Harshavardhan B P et al. (2013) developed the notion of designing machines that has the freedom to act independently [6]. Throughout history, robots have been often considered to copy human behavior and organize tasks in an identical manner. Lee et al. (1999) studied how to balance the work load of drivers for transportation [7]. Their definition of work load involved the time to complete the route and how much loading or unloading was accomplished at each location.

C. Implementation of robotic system to transport disabled people

Amal Elawad et al. (2013) designed Robotic wheelchairs as a navigation systems for handicapped ones [8]. The use of automatic wheelchairs can help the severely physically disabled and mentally handicapped people therefore it can be considered as a great invention. Kazi Mahmud Hasan.et.al (2013) proposed a line follower robot that can follow a desired path under perfect precision these robots have an onboard central control circuit [9]. This technology can be used in many sectors: - example-Airport

D. Design implementation of high-performance line following robot

Milan Shah et.al (2017) a proposed mobile machine which is basically a robot that can detect and follow the desired route [10],where the desired path can be created on a white surface. Gadhvi Sonal et al. (2017) designed a robot that can recognize among these three colours (Red Blue Green) and depending upon the given command it will follow the desired lane out of these three colours [11]. Masami Kobayashi et al. (1996) described robotic systems that had been used to enhance the speed and efficiency of manufacturing tasks [12].

E. A conceptual design of line follower pick-and-place robot for industrial purpose

Maruf Ar Rusafi et.al (2015) proposed an infrared sensor array beneath the front of robot [13]. Its senses the line and send a variable voltage signal to the Analog to Digital Converter. Y. Ma et al. (1999) designed a robot in which a sonar sensor is placed front faced [14]. It senses any object in front of it. When it senses any object in front of it, from there microcontroller receives a signal and then the controller sends a signal to the wheel motors to stop. At the same time, servo motor also receives a signal and picks the object up by claw. K.Hashimoto et al. (1997) designed a robot which have two different function one is that it act as line follower robot and the second function is that it have the ability of object avoidance[15].

III. PROPOSED SYSTEM

In our proposed system, SARLoT starts its movement from a point where goods to be transported are loaded on it. According to the given instructions, it moves through a black track and after reaching a destination point, the goods placed on the SARLoT will be unloaded. This industrial robot has mainly three features namely Line Tracking, Collision Avoidance, Loading and Unloading heavy goods. Two Arduino Uno are used for the SARLoT as programmable development boards. One Arduino Uno has been used for the robots' movement. For the movement of robot through the black track, Infrared sensors are used. They are mounted on both the front and back side of the robot. The central controller of SARLoT uses another Arduino Uno, for controlling the robot's unloading and loading of goods, its movement from starting point to the destination and for changing the course of the movable black track. The course of black track can be changed according to the selected destination point. The two processes are controlled through wireless channel using Bluetooth. This central controller also controls the movement of movable track through wired connection. The movement of movable track is possible the help of servo motor.

IV. HARDWARE

The hardware part is further divided into following parts:

A. Open Source Microcontroller Board

The Arduino Uno is a development board microcontroller, which is easier for programming and interfacing. The Arduino Uno is easily available and cheap in price and development software is free. An ATmega8U2, microprocessor is used in Arduino Uno for the programing. The text data can be transferred to and from the Arduino board.

B. IR Sensors

IR sensors consist of IR transmitter and receiver. It consists of three pins: 5v, ground, and output. The IR transmitter sends IR signal when voltage supply is given. The IR receiver receives this IR signal and produces output voltage. The reception of IR signal occurs when the transmitter signal is reflected by any light colored object. When the IR signal is incident on black surface it will get absorbed and will not get reflected. Thus it doesn't produce output.

C. Bluetooth module

Bluetooth module is a wireless communication module. We can configure Bluetooth module as master or slave. Mainly used Bluetooth module is HC-05 and HC-06. It consists of 6 pins: transmitter, receiver, enable and state pin. Most of Bluetooth modules have reset button.

D. Ultrasonic sensor

Ultrasonic are mainly used to detect any presence of object. It has a transmitter and a receiver. Its working principle is similar to sonar. It has four pins they are 5v, Trigger, Echo and Ground

V. SOFTWARE

Coding and uploading the code to the Arduino Uno board can be done with the help of Arduino software (IDE) which an open source software. This software can used in windows, Mac OS X, and Linux. Interfacing of all the Arduino hardware with software is by using Arduino embedded language.

VI. SYSTEM ARCHITECTURE

A. Robot

The block diagram of the robot is shown in figure 1 and it represents all the components that are used in the robot and how each component is interfaced with other components. The robot has mainly three features namely Line Tracking, Collision Avoidance, Loading and Unloading heavy goods. In the block diagram Arrows are used to indicate transfer of signals between different components. Arduino Uno is the main and central block of the system which is programmed to make decisions depending on the output sensor value. Infrared Sensors are called Digital Line Following Sensors assigned to detect the path. DC motor is driven by motor driver with the help of rechargeable battery. The Infrared sensors send signals to the Arduino Uno and this signal will be forwarded to the motor driver. This makes the corresponding motors to move in clockwise or anticlockwise, which makes the robot to move in desired direction according to the track.

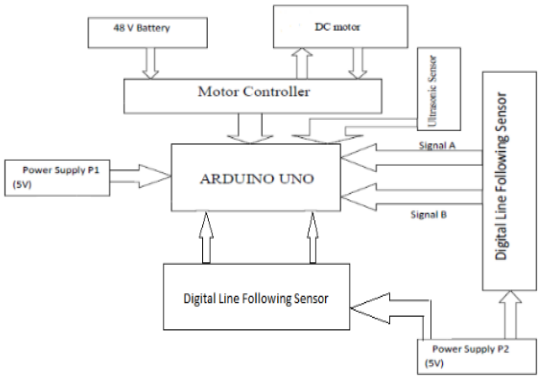

Fig.1 Robot's block diagram

B. Track for the robot

The block diagram in figure 2 shows the destination Selector used for selecting preferred destination. Loading Unit used to loading mass on to the robot. Unloading unit used to unloading the mass from the robot. Servo motor changes the course of the path to desired path.

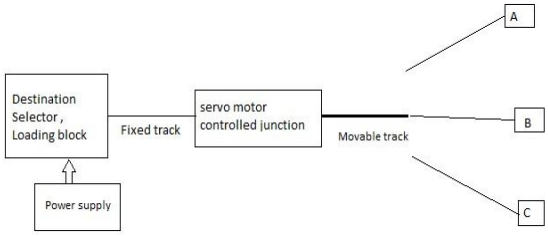

Fig.2 Track for the robot

C. Central Controller

Figure 3 shows how the Robot unit is communicated with the central unit via Bluetooth.

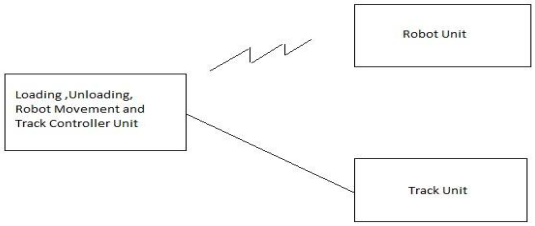

Fig.3 Central controller

Track unit is communicated with central unit via channel. Central unit controls overall movement of the robot and track. These are the main three simple blocks are used by the SARLoT. Here we need to use two Arduino Uno and Two Bluetooth modules, one for the central controller called master block, and another for the robot called Slave block. In the Master block we need a Arduino Uno, a Bluetooth module, switches, power supply, etc. In the Slave block we need a Arduino Uno, a Bluetooth module, IR sensors, motor drivers, servo motors, power supply, ultrasonic sensor, etc.

VII. RESULT AND DISCUSSION

A robot that can be used for shifting loads faster is designed and developed. The main aim is to transport heavy goods safely to the desired location. The developed smart load transporter could carry about 0.5kg of weight. SARLoT detects the black track effectively and follows the predefined path. It efficiently avoids any obstacles in its way. The prototype of SARLoT is shown in figure 4.

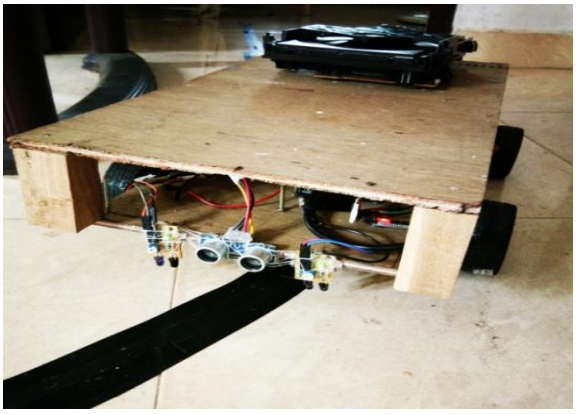

Fig.4 SARLoT

VIII. CONCLUSION & FUTURE WORK

Here a smart robot that can be used for shifting loads faster is designed and developed. The time required to complete the tasks when compared to that of humans is less. Thus the efficiency is more since, it takes only less time. The main aim is to transport the goods safely. Besides, the robot effectively avoids collisions with any obstacles on its way. They require only 3 parts: central unit, track, robot which can be made with a minimum level of cost. Building an autonomous robot with good efficiency in transporting goods within a short time to reduce human suffering has been the main focus.

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