Autonomous Car Prototype Project

Brian Kelein Ngwoh Visas
Electronics Engineering
Hamm-Lippstadt University of
Applied Sciences Lippstadt,
Germany
brianvisas@yahoo.com

Aluko Tunde Oluwayemi
Electronic Engineering
Hamm-Lippstadt University of
Applied Sciences
Lippstadt,Germany
tunde-
oluwayemi.aluko@stud.hshl.dE

***Abstract*—With the recent research breakthrough in science and technology. Ability for cars to drive autonomously is one of the area of interest of most individuals in the Automobile Industry. This prototype project will show how we can achieve this.**

I. INTRODUCTION

To begin it was interesting project to come up with a small autonomous robotic car which can follow a line and detect objects on its path, helping it move on its own. So, we had to combine and realize all this functionality. In addition, we had to be able to make this system to stream videos while moving and also, we had to make sure we can control it from an external system such as a PC, or a smart phone. Below is how we setup the requirements to realize the subsequent output.

II. PROTOTYPE AND COUPLING:

A. Project requirements

- Refined wood
- A motor (small wheels inclusive)
- An L289N(H-bridge)
- Two IR sensors
- Three Ultra sonic sensors
- A break boards
- Small cables
- A Screw set
- A Raspberry-pi camera

B. Procedure

The first thing we did was to couple the various parts of a disordered set of well-shaped wood, which included a motor with wheels. Then later we had to make this motor move. This was accomplished initially using an Arduino Uno and a CPU as the main source of power, this was a measure taken to avoid accidents in case of wrong commands being sent to the motor.
What happened here was commands were being sent from the Arduino to control the motor using the L289N driver, most microcontrollers, microprocessors, and electronics can only handle a small amount of current. If a lot of current is being pulled out, it may start burning. Because motors most of the times easily exceed this maximum current, you generally don't want to connect a motor of any significant size directly to your processor. So, we will use a device called a moto driver or a motor controller.

III. PREPARE YOUR PA

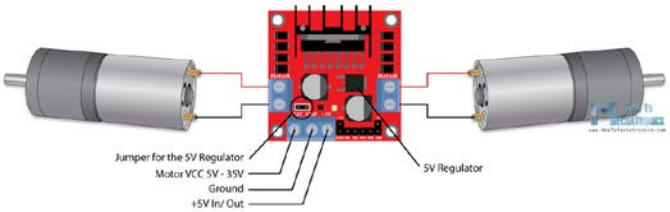


Figure 1: An example of H-Bridge connections with motors

must disconnect the jumper because those voltages will cause damage to the onboard 5V regulator. In this case the 5V pin will be used as input as we need connect it to a 5V power supply in order for the IC to work properly. Later on, all this is connected to the power supply. Motors do convert electrical energy into rotational energy. They are many different types, and the power almost if not everything that moves. The most common type of motor is the simple DC motor, which is even used in many of the other types of motors. To connect the motors.

- First, we properly solder the cables connected to the motor terminals to avoid future disasters.
- The wires for each motor is placed properly in their respective holes indicated Motor A and Motor B on the above diagram.
- The motor is now connected to a battery through the positive and negative terminals.
- The previous setup is now connected to an Arduino-Uno so the motor can be programmed and controlled.
- Furthermore, for connections with the Arduino, the ports ENA, ENB; IN1, IN2, IN3, IN4 on the H-Bridge are connected to the Digital PWM of the Arduino (mostly between pins 0 to 9).
- The both terminals of the battery (positive and negative) are then connected to the +12v and GND (ground) of the H-Bridge and the Arduino connects on this same level with its 5V and GND all these done via the break board.
- Then a program written on the Arduino IDE to make the motor move in a desired direction (In this case just forward and backward).

*A. **Line Follower***

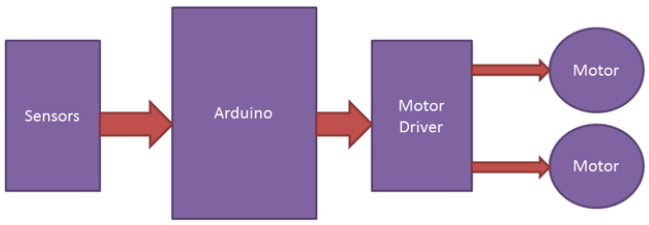


Figure 2 : General Structure of signal transmission

The next thing was to make this model follow a line. In this case two IR sensors were used. This sensor detects a black line on a white surface or a white line on a black surface. An infrared (IR) sensor is any sensor that uses a light detector, tuned for the IR spectrum, to detect an IR signal. Generally, the IR sensor is paired with IR-emitting LED to provide the IR signal. The emissions from the LED are measured for intensity or presence. Infrared detectors are frequently used for build devices that detect edges on a line or a ledge. These sensors acts as a line detector when the contrast between the surface and the line are high; for example, a black line on a white table. When the sensor is over the white surface, most of the IR signal is sent back to the sensor. When the sensor is over the dark line, the quantity of IR signal returned is really less. These sensors normally return an analog signal representing the amount of light sent back.

IR Sensor Module Features

- 5V DC Operating voltage
- I/O pins are 5V and 3.3V compliant

- Range: Up to 20cm
- Adjustable Sensing range
- Built-in Ambient Light Sensor
- 20mA supply current
- Mounting hole.

Circuit Explanation

The whole Arduino line follower robot can be divided into 3 sections: sensor section, control section and driver section.

Sensor section:

This section contains IR diodes, potentiometer, Comparator (Op-Amp) and LED's. Potentiometer is used for setting reference voltage at comparator's one terminal and IR sensors are used to sense the line and provide a change in voltage at comparator's second terminal. Then comparator compares both voltages and generates a digital signal at output. Here in this line follower circuit we have used two comparators for two sensors.

Control Section:

Arduino-Uno is used for controlling whole the process of line follower robot. The outputs of comparators are connected to digital pins of Arduino (here pins could be selected based on what is available). Arduino read these signals and send commands to driver circuit to drive line follower.

Driver section:

Driver section consists motor driver and two DC motors. Motor driver is used for driving motors because Arduino does not supply enough voltage and current to motor. So, we add a motor driver circuit to get enough voltage and current for motor. Arduino sends commands to this motor driver and then it drive motors.

Working of line follower is very interesting. Line follower robot senses black line by using sensor and then sends the signal to Arduino. Then arduino drives the motor according to sensors.

IV. OBJECT DETECTION:

Here we were able to make sure that the car was able to dodge objects on its way. We used the Ultrasonic sensors to achieve this. An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. It uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns. Ultrasound is reliable in any lighting environment and can be used inside or outside. Ultrasonic sensors can handle collision avoidance for a robot, and being moved often, if it isn't too fast. Furthermore, they are independent of the following physical factors, light, smoke, dust, just to name a few.

Technical Specifications

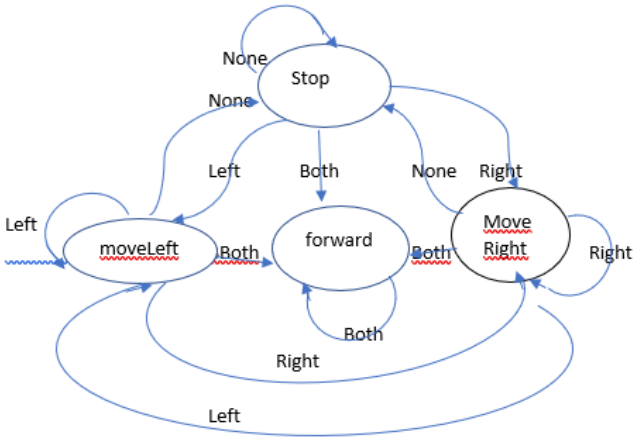
- Power Supply − +5V DC
- Quiescent Current − <2mA
- Working Current − 15mA
- Effectual Angle − <15°
- Ranging Distance − 2cm – 400 cm/1″ – 13ft
- Resolution − 0.3 cm
- Measuring Angle − 30 degree

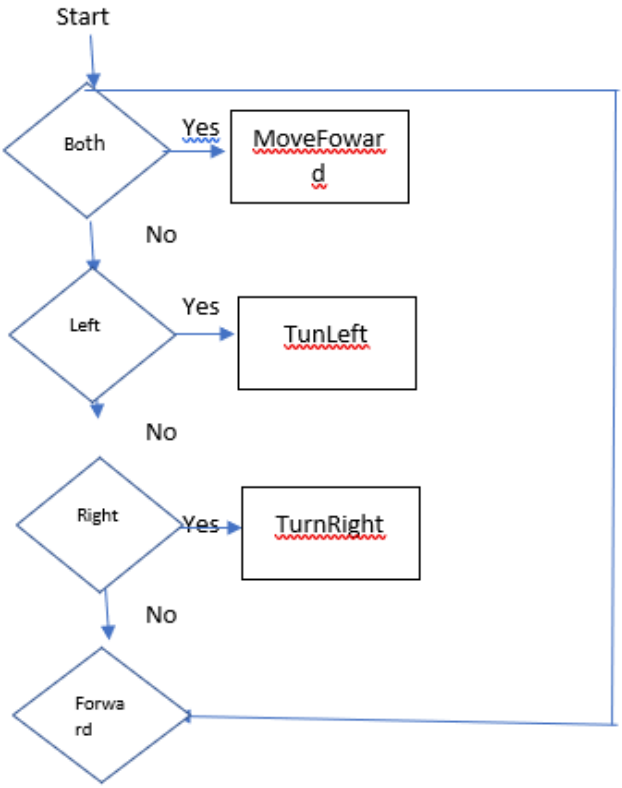
V. SETUP AND ARCHIECTURE WITH RASPBERRY-PI

The Raspberry Pi is a single board computer that is about the size of a credit card. Despite its small size, it is a very capable device. The Pi runs a version of Linux that is customized to work on the ARM processor that drives it. Here we use a Raspberry-pi camera to stream a a live video. The Raspberry Pi Camera Module v2 is a high quality 8-megapixel Sony IMX219 image sensor custom designed add-on board for Raspberry Pi, featuring a fixed focus lens. The Pi allows us to process a video stream from a simple USB camera; whereas the Arduino allows us to gather the information from the various sensors and apply logic to make sense of all that data, and then return concise findings to the Pi. First of all the Raspberry-pi software is installed on an SD card which should be bootable to save memory. From then Open CV is installed. After all the installations then it is connected to the computer. In addition, the card is inserted into the pi and then connected to the Internet Wirelessly.

VI. DESIGN

State Machine for Line Follower





IMPLEMENTATION OF LINE FOLLOWER AND OBSTACLE DETENTION

VII. IMPLEMENTATION

In reference to the code on github, it is clear to see the direct mapping of the state machine diagram to the code.

VIII. REFERENCES

[1] https://howtomechatronics.com/tutorials/arduino/arduino-dc-motor-control-tutorial-l298n-pwm-h-bridge/

[2])https://components101.com/sensors/ir-sensor-module

[3])https://circuitdigest.com/microcontroller-projects/line-follower-robot-using-arduino

[4])https://www.tutorialspoint.com/arduino/arduino_ultrasonic_sensor.htmJ. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.