DESIGN OF IOT BASED SURVEILLACNE ROBOT USING ARDUINO UNO

Dr. A.Gangadhar, University College of Engineering, JNTUK Narasaraopet

Abstract: A robot is an autonomous machine capable of sensing its environment, carrying out computations to make decisions, and performing actions in the real world. Two types of robots are available, autonomous, and non-autonomous. The autonomous robot is an intelligent machine which accomplish tasks without interference of humans whereas non-autonomous can be controlled by humans. Robots are widely used because of their simplicity and ability to modify to meet changes of needs. The project is designed to develop a robot using IOT for remoteoperation and line following for automatic movement attached with wireless camera for monitoring purpose. The Wi-Fi technology has huge potential of its growth and practical application. The purpose of this robot is to roam around and provide video information from the environment and to send the obtained information to the user.In this approach, the robot can be controlled with the help of mobile or automatic movement can be achieved by line following and obstacle detecting. It provides livevideo both in daytime as well as night with the help of ESP-32 CAM and collects information with the help of sensors then forward to microcontroller for processingas well as to control the robot behavior.

Keywords: IoT, Surveillance, Robot, Sensors, Wi-Fi, Arduino, ESP32 CAM, Obstacles, line following, video streaming

1. INTRODUCTION

The Internet of Things is a simple concept, it means taking all the physical places and things in the world and connecting them to the internet. By means of low-cost computing, the cloud, big data, analytics, and mobile technologies, physical things can share and collect data with minimal human intervention. Today we find most robots working for people in industries, factories, warehouses, and laboratories. Robots[1] are useful in many ways. For instance, it boosts economy because businesses need to be efficient to keep up with the industry competition. Therefore, having robots helps business owners to be competitive, because robots can do jobs better and faster than humans.

2. RELATED WORK

According to the recent Research paper in 2019 titled 'Design and Construction of Line Following Robot using Arduino' [2], Line following robot is an autonomous vehicle which detect black line to move over the white surface or bright surface. In this paper, the line following robot is [3] constructed by using Arduino [4] nano microcontroller as a main component and consists of three infrared (IR) sensors, four simple DC motors, four wheels and a PCB frame of robot chassis. The infrared sensors are used to sense the black line on white surface. When the infrared signal falls on the white surface, it gets reflected and it falls on the black surface, it is not reflected. In this system, four simple DC motors attached with four wheels are used to move the robot car's direction that is left, right and forward. The Arduino nano [7] is used as a controller tocontrol the speed of DC motors from the L2953D driver circuit.

According to the Research paper in 2018 titled 'Surveillance Robot [9] using Raspberry Pi and IoT', Remote [7] surveillance and monitoring of our homes has seen a growing needin emerging times. By means of this paper, we put forward a surveillance robot which can be integrated into any kind of household. The base controller of the bot will be the powerful Raspberry Pi 3 Model B. A webcam attached to the Pi monitorsthe area and sends a notification when any trespassing or obtrusion is detected. The camera also possesses face recognition algorithm which will possess the ability to identify the person responsible for the motion triggering. If it is authorized personnel, the on-board voice assistant [5] will start talking with the person. The notification will be sent only when it's unauthorized personnel and will contain pictures clicked of the trespasser and activate live streaming of the webcam feed. The live streaming ability of the Pi allows the camera feed to be analyzed from anylocation using internet. With such a system, every user will feel more sheltered while they're not at their place of residence or when they've left their children and old ones alone at home.

According to the Research paper in 2018 titled 'IoT based Surveillance Robot [7]', the main objective

behind this paper is to develop a robot to perform the act of surveillance in domestic areas. Nowadays robot plays a vital role in our day-to-day life activities thus reducing human labor and human error. Robots can be manually controlled or can be automatic based on the requirement. The purpose ofthis robot is to roam around and provide audio and video information from the given environment and to send that obtained information to the user. In this project, one can control the robot with the help of mobile or laptop through Internet of Things (IoT) [8] and can get the live streaming of video both in daytime as well as at night with the help of wireless camera[6] from the robot. The robot can be controlled both in manual as well as in automated mode with the help of Arduino microcontroller. This robot also uses various sensors that collects data and sends it to the Arduino microcontroller which controls the robot behavior. Along with the obtained live streamed video output, user can also obtain the presence of metal bombs using metal detectors. Thus, the action of surveillance can be performed. Further advancement in our project can provide surveillance even in defense areas.

3. METHODOLOGY

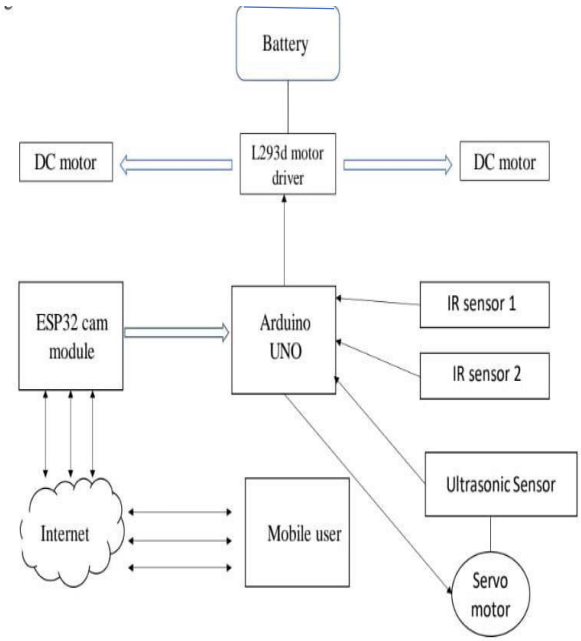
This robot combines the features of autonomous, non-autonomous and surveillance through internet. Initially, robot starts working as automatic linefollower and provides live video streaming with **ESP32 CAM** through internet which does not require human intervention. The line following robot is one of the self-operating robots, that detects and follows a line drawn on the area. The line is indicated by black line on a white surface.

This Line follower robot [2] has an obstacle sensor (**HC-SR04 Ultrasonic Sensor**) that detects any type of obstacle in front of the robot and finds alternate path so that there is no accident happening with the robot. It consists of two IR sensors which senses the black line. When the left **IR sensor** senses the black line,then the robot turns on the left side and if the right IR sensor senses the black line,then the robot turns the right side. Until both the left and right IR sensors sense thewhite area, the robot moves forward continuously. If the robot comes across a pathwhere there is another black strip lying perpendicular to the path, then the robot stops at that moment.

The control option is provided where the automatic can be switched to manual control by sliding control bar on the web user interface. When it is switched on, the user will be able to control the robot using a web server that displays a livevideo streaming. The wireless communication [6] is established between the user and the robot through internet, this is made possible with the help of ESP32 CAM Wi-Fi module.

The **AI-Thinker ESP32-CAM module** [8] comes with an ESP32-S chip, a very small size OV2640 camera and a microSD card slot. The user receives video streaming from the OV2640 camera over the web browser, the web page will also have buttons to move the car in Left, Right, Forward, and Reverse directions. The wireless commands are received by ESP32 and forwarded to the Arduino microcontroller to process and move the robot. The speed and direction of robot iscontrolled by **L293d** motor shield which operates based on the inputs received from**Arduino UNO**.

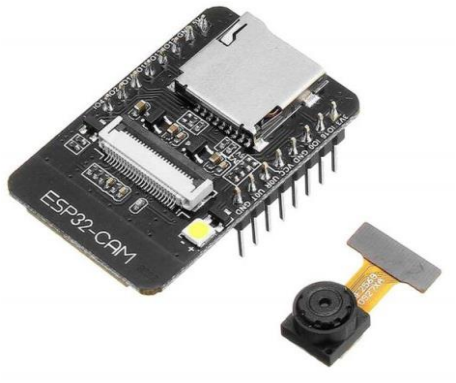
4. BLOCK DIAGRAM



The block diagram consists of two sections Line follower and manual control. Line follower [2] consists of IR sensors, Ultrasonic sensor, and Servo motor. Control section consists of ESP32 CAM, Internet, and User. Line following is achieved by using sensors. The sensors used are IR sensorand Ultrasonic sensor. The car consists of two IR sensors on left and right, these sensors make the car follow the line. Ultrasonic sensor is used to detect obstacles present in the path. Along with line following, the robot can be controlled manually with the help of internet. The user interface is provided where the user can switch the operation from line following to manual control. The user can connect to ESP32 Wi-Fi [6] and enter IP address in browser which displays a web page containing video, controlbuttons and sliders for light and operation switching.

5. TECHNICAL STUDY

A. ESP32 CAM

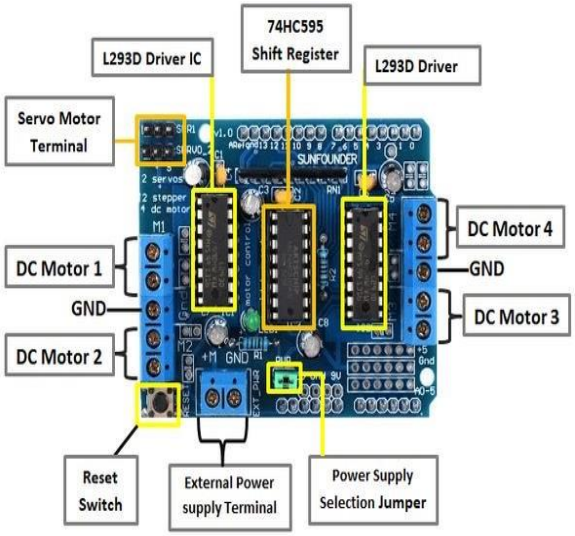


The ESP32-CAM AI-Thinker [8] is one of the most popular ESP32 development boards with camera – it comes with a lot of useful features and costs around **$7 or less**! It features a ESP32-S chip and comes with a "regular" 2MP OV2640 [8] camera. This board has 4MB PSRAM, which is used for buffering images from the camera into video streaming or other tasks and allows you to use higher quality in your pictures without crashing the ESP32.

B. ARDUINO UNO

Arduino [7] can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even your smart-phone or your TV! This flexibility combined with the fact that the Arduino software is free, the hardware boards are cheap, and both the software and hardware are easy to learn has led to a large community of users who have contributed code and released instructions fora huge variety of Arduino-based projects. For everything from robots and a heatingpad hand warming blanket to honest fortune-telling machines, and evena Dungeons and Dragons dice-throwing gauntlet, the Arduino can be used as the brains behind almost any electronics project.

C. L293D MOTOR DRIVER SHEILD



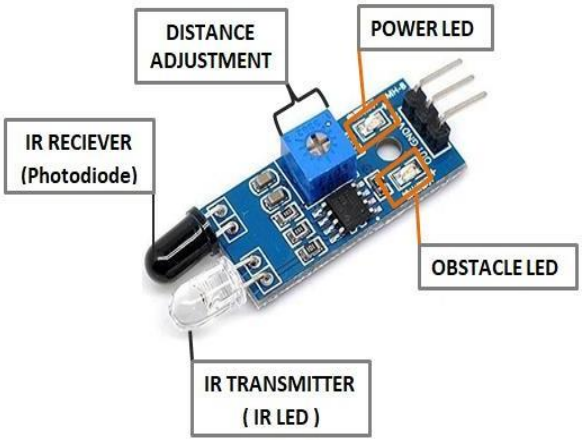
The Arduino L293D motor driver [2] shield guide is a robotics project that involves driving various types of motors. The most common types used for robotic applications include DC, servo, and stepper motors. However, these motors typically cannot be driven directly by Arduino or another microcontroller. This is because of their higher current and power ratings, so motor shields or driver ICs areused instead. These shields or ICs isolate a motor's power supply and use control logic from the microcontroller circuitry. One of the most popular motor driver shields used with Arduino [3] is the L293D. The full-featured L293D motor driver shield can control up to four bi-directional DC motors with 8-bit speed selection, two stepper motors, and two servo motors.

D. ULTRASONIC SENSOR

Ultrasonic sensing is one of the best ways to sense proximity and detect levels with high reliability. An ultrasonic [8] sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensoruses 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.

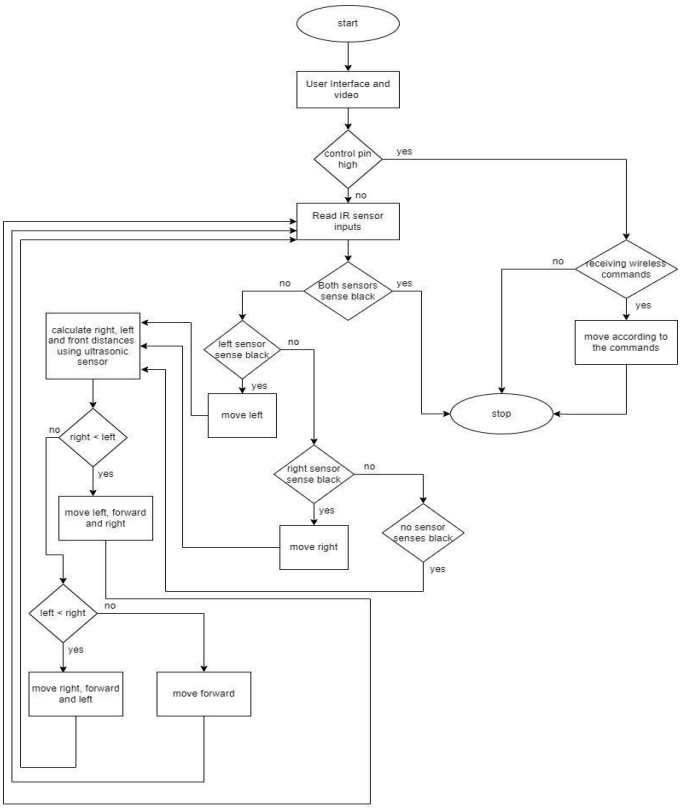
The HC-SR04 ultrasonic sensor [4] includes a transmitter & a receiver. This sensor is used to find out the distance from the objective. Here the amount of time taken to transmit and receive the waves will decide the distance between the sensorand an object. This sensor uses sound waves by using non-contact technology. By using this sensor, the distance which is required for the target can be measured without damage and provides accurate details. The range of this sensor available between 2cms to 400cms.

E. IR SENSOR



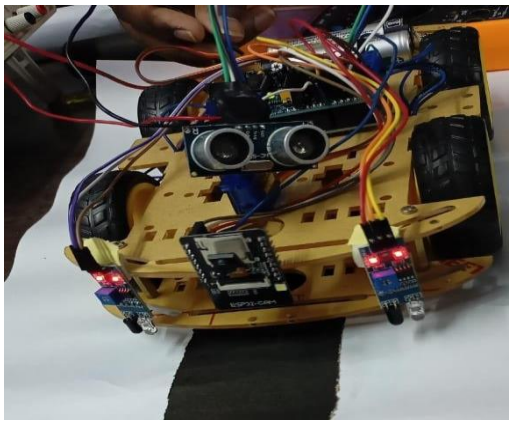
IR technology is used in daily life and in industries for different purposes. For example, TVs use an IR sensor to understand the signals which are transmittedfrom a remote control. The main benefits of IR sensors are low power usage, their simple design & their convenient features. IR signals are not noticeable by the human eye. The IR radiation in the electromagnetic spectrum can be found in the regions of the visible & microwave. Usually, the wavelengths of these waves range from 0.7 μm 5 to 1000μm. The IR spectrum can be divided into three regions like near-infrared, mid, and far-infrared. The near IR region's wavelength ranges from 0.75 – 3μm, the mid-infrared region's wavelength ranges from 3 to 6μm & the far IR region's infrared radiation's wavelength is higher than 6μm. These types of radiations are invisible to our eyes, which can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) [9] and thedetector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

6. FLOW CHART



7. RESULTS

The line following robot is one of the self-operating robots, that detects and follows a line drawn on the area. The line is indicated by black line on a white surface. Line following consists of two IR sensors which senses the black line. When the left **IR sensor** [9] senses the black line, then the robot turns on the left side and if the right IR sensor senses the black line, then the robot turns the right side. Until both the left and right IR sensors sense the white area, the robot moves forward continuously. If the robot comes across a path where there is another blackstrip lying perpendicular to the path, then the robot stops at that moment.



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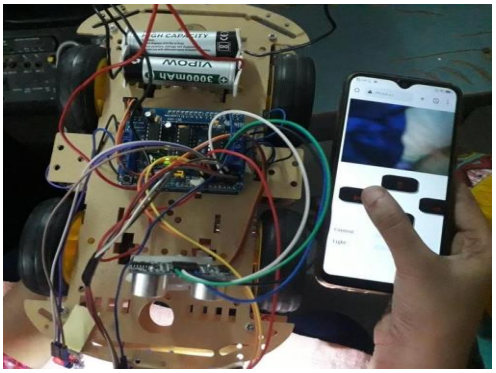

8. CONCLUSION

The line following robot [2] is automobile system that has ability to recognize its path, move and change the robot's position toward the line in the best way to remain in track. The robotcan detect its path in case it is out of path. The line following robot project challenged the group to cooperate, communicate, and expand understanding of electronics, mechanical systems, and their integration with programming. We can control the robot with the help of laptop/mobile manually. Our proposed robot is small thus maneuvering into area where human access is impossible. Wireless technology is one of the most integral technologies in the electronics field.

9. FUTURE SCOPE

Hence, the merger of these technologies has created the Internet of Robotics [8]Things (IoRT) to represent intelligent devices that can monitorevents, gather data through sensors and determine the best action accordingly. Considering the importance of IoT and robotics in daily life, the real-life applications of these two technologies have been discussed in this article along with highlighting their current market and future scope.

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