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Patrolling Robot Using Embedded C

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ABSTRACT
Nowadays, safety, and rules are the biggest concern in many parts of the world. There are certain areas where women are being harassed, raped, etc. Not to mention that people do not obey the traffic rules or do not wear helmets. Considering the present scenario where the world just has come out of COVID-19 and is yet to deal with its variants like Delta variant and Omicron as well, people must wear masks. All of these rules are followed only if people are under surveillance due to their negligence. Unfortunately, there are no CCTVs in all areas. The government cannot keep an eye on each person. The police officer may not patrol all areas. So here, we suggest a solution to this issue by designing a patrolling robot, an IOT-based robot vehicle so that the monitoring of surrounding areas from one particular area is possible just by using a smartphone.
Keywords- *Patrolling, Smartphone, ESP32 CAM, Streaming, Wi-Fi.*

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I. INTRODUCTION

They say rules are important for one's growth and discipline and also safety is a concern for many. Is there a guarantee that these two or not be compromised? We do know that there are CCTVs only in certain areas and it is also not possible to implement them in all the areas right away. What is the problem with not having CCTV in areas? There are numerous problems like people deviating from rules such as not wearing masks, theft, suspicious persons, looking for wanted criminals, safety, abnormal events [1] etc. There is a need for a system that minimizes these issues, at least to a certain extent. The suggested robot helps users i.e., police officers or any other individual using it, to patrol and monitor the small areas where people tend to ignore traffic rules, not wearing masks as we can see, cases of COVID-19 and its variants are increasing day by day and also harassing women and many such incidents can be monitored. As there are no CCTVs in such areas, this would help reduce such cases and maintain the integrity of the citizens. The purpose is to patrol and surveillance of people in small areas or colonies where police officers do not usually patrol and to monitor people who are deviating from the rules in certain areas, taking advantage of the fact that police officers do not patrol in such areas. Individuals can also use it for purposes like home surveillance and building security. The main feature of this model is that the system uses an ESP32 CAM which is programmed and placed on the robot vehicle for monitoring its surroundings. The model can be operated using a mobile while connected to Wi-Fi and works within the range of the network it is connected to. The user controls this to monitor the live streaming. To patrol at night, an LED light is attached to the robot.

II. LITERATURE SURVEY

M. Selvam et al. have experimented with an android phone [2] and controller in this paper. He has controlled the robot using Bluetooth and the android app for certain strings are required to store in the program. Similar strings are created by the android app, and by synchronizing all together the robot is controlled using a smartphone.

Chinmay et al. designed a surveillance robot that is made with Arduino [3], but in this project, there is still the use of the internet for military applications. In certain situations, in military camps there is no possibility of interest so this system is not useful.

Kunal Borker et al. have experimented with the Android phone and the controller. You can control the robot with Bluetooth, the android app needs to store certain strings in software. Similar strings are generated by the android app, and by synchronizing all devices together, the robot is controlled [4] with a smartphone.

Irfan Rangapur et al. have built a robot in spherical shape which moves on the basis of pendulum. It comprises of Arduino nano, cameras at two ends providing 360-degree view, Pendulum and DC motor. It provides audio and video to user and runs on Bluetooth. The robot is designed to use in military tasks where it is out-of-reach to humans [5].

Mandlik Sachin B. et al. cover descriptive details about the design and implementation of a prototype in their research for an electronic gadget that has the potential to serve as safety [6] wear in the coming years. The device consists of a switch, Arduino Uno Board, GSM module (SIM900), GPS module (Neo-6M), buzzer, and pulse sensor. The device sends emergency messages using GSM.

III. PROPOSED METHOD

We propose a patrolling robot, IOT based vehicle, where the system uses cameras mounted on the robot vehicle for securing or monitoring any premises. It provides continuous monitoring through live broadcasting of the site from mobile. The police officers' control this to monitor the live streaming and when he/she sees something abnormal, then the police officer can directly go to that specific location. Fig.1 depicts the overall architecture of the designed model.

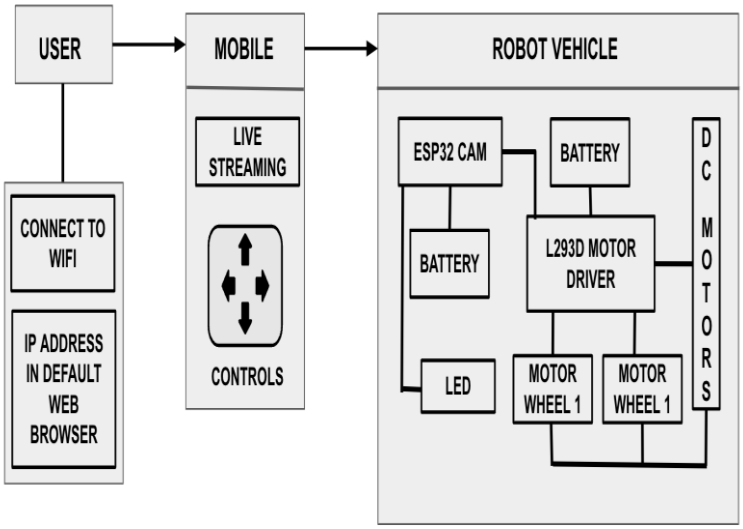

Fig.1: Diagram of Architecture

1. REQUIRED COMPONENTS

The following are the required components:

1.1 L293D Motor Driver

L293D is an Integrated Chip which comprehends two H-Bridge and PWM [7]. It comprises 16 pins with 8 pins on either side. The H-Bridge is used for rotation whereas the PWM deals with the speed of motors. The L293D motor driver drives two motors and provides a two-wheel robot vehicle functioning. It has capacitors to protect the circuit from Back EMF produced by the motors because of their inductive load.

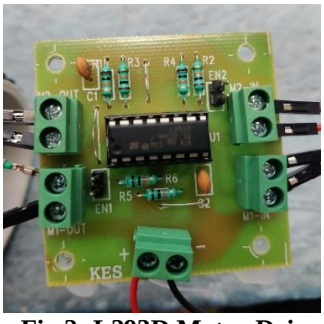

Fig.2: L293D Motor Driver

1.2 ESP32-CAM

It is a camera module comprising an ESP32-S chip [8]. It has several GIPO pins enabling it to connect add-ons or other devices. It has the feature of a microSD card slot which stores the captured images and makes those available to users. The ESP32 CAM is programmed and we embed the code using FTDI cable through serial pins.

Fig.3: ESP32-CAM

1.3 DC Motors

Direct-Current motors are machines which make use of electrical power to convert electrical energy into mechanical energy for rotating the wheels.

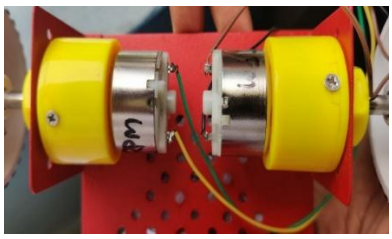

Fig.4: DC Motors

1.4 ESP32-CAM Wi-Fi and Bluetooth Module

This module enables the ESP32-CAM to connect to Wi-Fi or Bluetooth. Connecting to Wi-Fi exposes it to a larger radius [9]. However, Wi-Fi or Bluetooth can be used as per the requirements. Here we have used Wi-Fi.

2. CONNECTIONS

The two wheels are connected to the DC motors of 300rpm and these DC motors are connected to the output pins of the L293D motor driver. The L293D motor driver is an H-bridge type for which the power supply is given through the rechargeable battery and allows the bi-directional movement of wheels. The motor driver prevents back EMF. The ESP32 CAM is programmed using embedded C language. The connections are illustrated in the fig.5.

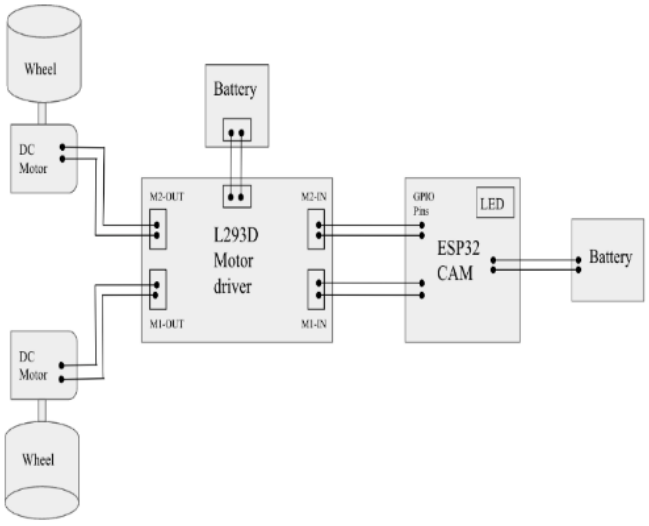

Fig.5: Diagram of Connections

The L293D motor driver comprises four input pins (IN1, IN2, IN3, IN4) which are connected to GPIO pins of ESP32 CAM, respectively [10]. The output pins (M1-OUT, M2-OUT) of the L293D motor driver are connected to each of the DC motors at 300rpm. The DC motors are attached to respective wheels for their movement. We give the power supply to ESP32 CAM through the battery. The ESP32 CAM works in both Wi-Fi and Bluetooth, here we used Wi-Fi.

3. WORKING PROCEDURE OF THE MODEL

The following are the steps involved in order to start the robot vehicle

3.1 Wi-Fi setup

Primarily, the working of the model starts with the Wi-Fi setup. Turn on the mobile's hotspot and change the hotspot name and password to "*elegant*" and "*smartwork*" respectively. Once the setup is done, it will connect the vehicle to Wi-Fi under the name "ESP32 CAM".

3.2 User interface

After connecting it to the hotspot, open the default web browser and type the IP address "192.168.43.220" in the address bar. The page with user controls and live streaming is displayed.

3.3 Controls

The page comprises the "*Forward*", "*Backward*", "*Left*", "*Right*", "*Stop*", "*Light ON*" and "*Light OFF*". We show the screenshot of this in figure 4.2. We can control the movement of the robot using these controls.

3.4 Live streaming

The live streaming of the areas or persons captured is shown in the user interface above the controls. We show the screenshot of this in figure 4.4 with a person standing in front of the robot and the robot being placed on the table.

IV. RESULTS

The image of the developed model is shown below

Fig.6: Image of the Robot Vehicle

1. SCREENSHOTS

The screenshots of the GUI interface are shown below with each feature

1.1 User Interface

The user interface consists of directions i.e., "*Left*", "*Right*", "*Forward*", "*Backward*" and a "*Stop*" button. It also comprises of "*Light ON*" and "*Light OFF*" buttons.

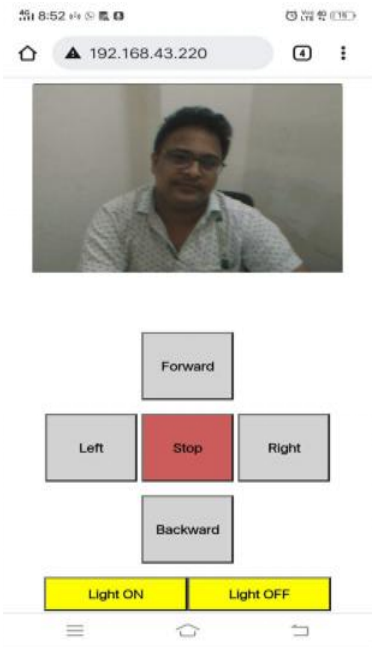

Fig.7: User Interface

1.2 Live Streaming

The fig.8 is the image and screenshot of live streaming respectively

Fig.8: Live Streaming of Person Standing in front of Robot

1.3 LED

The fig.9 is the screenshot of the with LED on and LED off respectively in low light with a person in front of it.

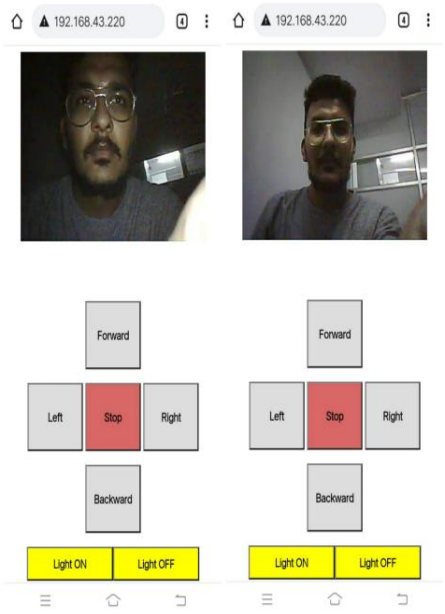

Fig.9: Screenshot of Person under Low Light with Light OFF and Light ON Respectively

V. CONCLUSION

The model offers live streaming of the surroundings and works with Wi-Fi, which can be switched to Bluetooth depending on user needs. It has an LED function that makes it easy to use at night. This designed model helps to monitor the surrounding area and helps to at least partially solve the mentioned problem since it is impossible to install cameras everywhere.

VI. FUTURE SCOPE

The use of artificial intelligence can extend this robot further. It can be trained as per the user's requirement and the detection of actions can be implemented. Though the idea of patrolling may not be new, the implementation of ideas makes it more convenient and readily available to any user to make use of it.

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