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Development of Miniaturized All-terrain Vehicle For Surveying of Tunnels

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Abstract

Generally, working in tunnels is a dangerous work. So, our robots can help us to overcome employees' lives. In the previous system the robots and software cannot run through rugged surfaces. This paper analyzes that the robot design is capable to get the better of existing system. This robot contains four wheeled motor to move efficiently over the irregular surface in underground. It is furnished with sensors for sensing fatal gases and cameras for capturing the live. At last, we use python-uv4l package and Arduino-ide to run the vehicle.

Keywords: Wi-Fi-module, Arduino, raspberry pi

1. Introduction

Surveying Lands and Exploring Tunnels is a major task in public relations. In today's scenario, an engineer supervises this task, while employees work in unison to record details about the land. Surveying the lands is necessary in several fields like Tunnel Exploration, Civil Engineering, Disaster mitigation, Agricultural Research, etc. The time consumed in complete data collection from a region is massive. Exploring new tunnels is dangerous for employees because all major fatal gases occur in in these areas.

It has always been difficult to explore certain areas like New Tunnels, building crash sites, rough terrains, large garages, waste disposal fields, etc. Even though we have connectivity. Working on such rough terrains requires a lot of manpower and patience. Sometimes these areas can be dangerous. To avoid any complications, it is necessary to employ machines to survey these lands.

2.Existing system

In existing system, human intervention is compulsory to check the percentage of the fatal gases. Here they use a handheld portable device. As they need to take the portable device with them there is chance of breathing those fatal gases which lead their lives to death.

3.Proposed system:

The robot chassis is modelled for a four-wheel drive. The chassis is then integrated with high torque motors with low rotations per minute. The motors are then connected to a motor driver circuit. L298N motor driver is preferred over L298D motor driver because of its ability to handle more current. The potential drop across the motor driver amounts to about 1.5V and this is bearable for our requirements.

The ESP8266 Node MCU is then integrated along with the motor driver circuit and Wi-Fi commands are tested over the local server. An Android application is developed using MIT App Inventor using the TCP standards for the remote control of the robot.

A Raspberry Pi model 3-B is preferred over the Beagle Board variants due to the ease of access to the Raspberry Pi. UV4L UDP package available for Raspberry Pi is used to stream the video live on to the local server. This video stream is received and viewed on any browser window from a node in the same network. This video quality and frame rate is dynamic and can be varied.

4.Block diagram

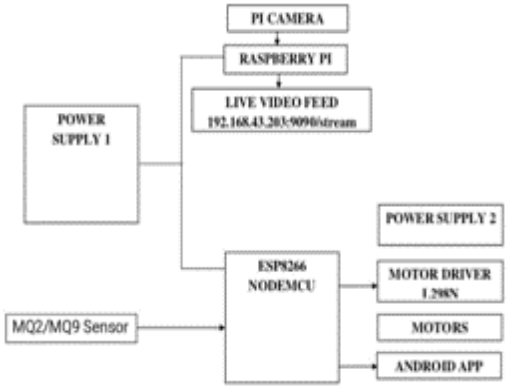

Fig.1 Block Diagram

Firstly, the power supply is given to raspberry pi and ESP8266. The sensors MQ2 and MQ4. These sensors detect the fatal gases present in the tunnel. The detected values of those fatal gases are given input to ESP8266 module. Pi camera will help us to capture the live video feed. The motor driver will move the vehicle even in rugged surface. The signals from the android application are sent to ESP8266 module and these signals are sent to motor and it drives the motor into tunnel.

5.Methodology

5.1ESP8266 NODEMCU

The microcontroller used here is ESP 8266 because it has an inbuilt Wi-Fi module that can connect to any router as it is being programmed. So, it is connected to the Internet at all times. It has a set of registers that function as a general-purpose RAM.

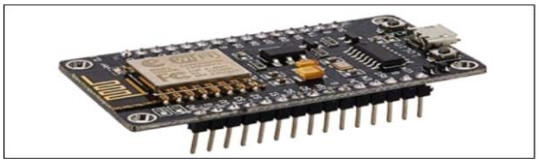

Fig.2 ESP8266 NODEMCU

5.2.Raspberry pi

Raspberry Pi is a small microcomputer. Raspberry Pi 3 Model B, is a latest 64-bit quad core processor with operating frequency 1.2 GHz.

It includes various features like on-board Wi-Fi, Blue- tooth and four USB (Universal Serial Bus) port capabilities.

It has a Broadcom BCM2835 System on Chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU (Graphics Processing Unit) .It was first developed with 256MB and later the RAM size was increased to 512 MB. It was developed to operate with open source platform which increases the use of various applications.

For storage purpose of data, it uses a SD cad or MicroSD Rasberry Pi uses a Python as the main programming language because of its simplicity. It is a tiny computer with low cost that runs on Linux operating system, and has GPIO pins (General Purpose Input Output) mainly to control any electronics components.

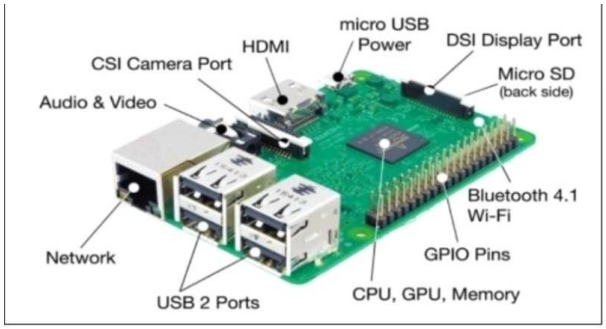

Fig.3 Raspberry p

5.3.PI-camera

This Pi- camera is used for taking videos and still photographs Time-lapse, slow-motion, and another video processing is possible using this device. Libraries are available for interfacing the camera with raspberry pi.

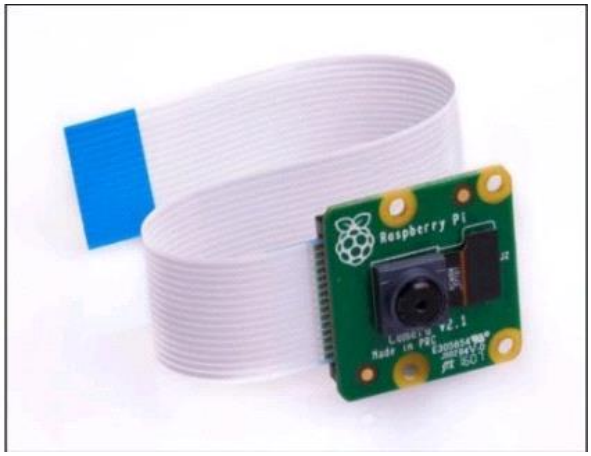

Fig.4 PI-camera

6.Hardware Result

A continuous track belt sturdy setup is used for the purpose of outdoor navigation. Four DC motors, 200 rpm and 10kgcm torque, are used for supporting the system. The motors are powered by a 12V Lead Acid battery. The setup also contains a H-bridge circuit, which aligns the control of the microcontroller with the turning and navigation of the wheels. The H-bridge circuit is primarily an L298N chip connected to a heat sink. It is interfaced to the microcontroller, which provides the input to be fed to the motors and thus controls the motion of the robot. The bot is controlled by the user using the android application.

The special continuous track belt allows the bot to be maneuvered at very difficult and hard to move terrains. This feature permits it to be hovered at unmanned areas easily.

In this paper, a miniaturized gas inspection bot with a durable design is proposed. The implementation of this design enables the robot to detect harmful gases inside the tunnel and navigate to any region of tunnels and pipes with ease.

A Real Time gas inspection robot that could traverse tunnels with a live video stream was constructed and tested. An Android application as User Interface to control the robot's navigation based on the video stream, was rendered as seen in the figure. A compact device within a casing was created.

The aim is to build an android app to control the navigation system of the robot using a Wi-Fi module and a live stream video footage from the integrated camera on the bot. This enables remote navigation of the robot inside the tunnels eliminating the risk factors. The gas sensors provide accurate distribution of various gases inside the tunnels, thus helping in better maintenance. The ‘Inspection robot’ effectively reduces complexity and power consumption issues.

Fig.5 Hardware setup

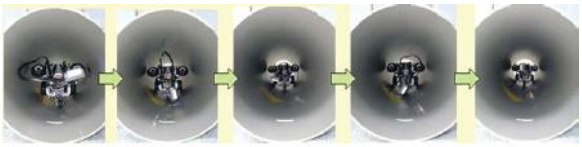

Figure 6 PIR during pipeline inspection process

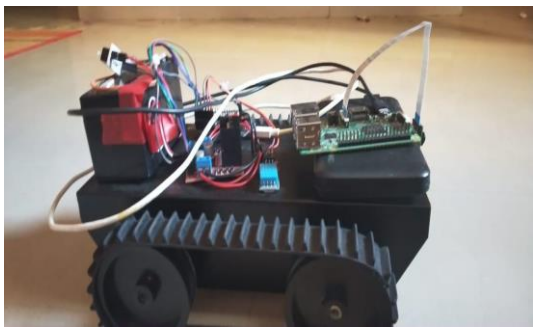

Figure 7. Side View of the Full System Model

7.Conclusion

The risk factor involved in exploring uninhabited areas is as high as exploring a damaged building. In such scenarios, human life is always in danger. There is still a huge number of unexplored areas in our hill and forest terrain. Thus, the focus is on reducing this risk factor by building a robot which will scout the required region based on our instructions and give us the required data. In this project, a miniaturized all-terrain vehicle with a durable design is proposed. The implementation of this design enables the robot to clear larger obstacles and navigate through rough terrains with ease.

The PIR is a remote controlled, mobile video capturing robot. The focus of this project was to design and implement a robust chassis with Wi- Fi enabled remote control system with a microprocessor and a camera mounted on it. The L298N motor shield provides the appropriate H-bridge circuit for moving the wheels, which perform the actual movement. The PIR is controlled using an Android application on a smart phone.

Control of the device by a voice recognition system. The mobile bot can be made autonomous. Thermal cameras can be integrated for surveillance purpose. UV or color sensors can be attached to the bot which is used for crack detection. In order to be controlled from anywhere around the globe, port forwarding mechanism can be implemented and this bot can have a very superior power of a rover kind of bot. This could prove very useful for large diameter tunnels and pipes.

References

[1] Jeffrey Martz, Wesam AI-Sabban, Ryan N.Smith on survey of subterranean exploration,March 2020.
[2] .Robert Losch, Steve Grehl, Marc Donner, Claudia Buhl, Bernhard Jung on design of autonomous robot

for mapping and navigation underground mines, IEEE october 2018.

[3] Nikam Radhika R. et al., "Underground Cable fault finding Robot Using GSM Technology and AT MEGA 16 interfacing" in International Journal of CivilMechanical and Energy Science, Infogain Publication, vol. 2, no. 2, pp. 027-029, 2016, ISSN 2455-5304.

A. Dudwadkar, A. Gajare, Y. Tembe and A. Sonje, "IoT based Autonomous Tunnel Electrical Cable Fault Detection and Maintenance Robot," *2019 International Conference on Advances in Computing, Communication and Control (ICAC3)*, Mumbai, India, 2019, pp. 1-7, doi: 10.1109/ICAC347590.2019.9036834.

[4] . Jitendra Pal Singh, Narendra Singh Pal, Sanjana Singh, Toshika Singh and Mohd. Shahrukh, "Underground cable fault distance locator", *International Journal of Scientific Research and Management Studies (IJSRMS)*, vol. 3, no. 1, pp. 21-26, ISSN 2349-3771.

[5] .J. Paskarbeit, S. Beyer, A. Gucze, J. Schröder, M. Wiltzok, M. Fin-gberg, A. Schneider, "Ourobot-a self-propelled continuous-track-robot for rugged terrain", Robotics and Automation (ICRA) 2016 IEEE International Conference, pp. 4708-4713, 2016

[6] Dumbre K, Ganeshkar S, Dhekne A., (2015), 'Robotic vehicle control using internet via webpage and keyboard', Int J Comput Appl, Vol.114, No.17.

[7] .Ujjainiya L, Chakravarthi MK, (2015), 'Raspberryepi based cost effective vehicle collision avoidance system using image processing', ARPN J Eng Appl Sci, Vol. 7, No.4.

[8] Hasdak O., (2015), 'Programming a self-driving car' [Doctoral dissertation]. BRAC University.

[9] ..H. H. Yan and Y. Rahayu, "Design and Development of Gas Leakage Monitoring System using Arduino and ZigBee," Proceeding of International Conference on Electrical Engineering, Computer Science and Informatics (EECSI 2014), Yogyakarta, Indonesia, August 2014