DESIGN AND VALIDATION OF VISIONBOT: SMART PHONE - CONTROLLED IMAGE CAPTURING ROBOT

Nethi Sai Mounika Devi
Department of ECE
Siddhartha Institute of Technology and Sciences
Hyderabad, India

Vukanti Sravanthi
Department of ECE
Siddhartha Institute of Technology and Sciences
Hyderabad, India

Abstract: **This project introduces an image-capture robot that uses the Raspberry Pi 3B+ and is intended for autonomous navigation, real-time monitoring, and surveillance. Using a DC adapter, the system's 12V battery is transformed into a steady 5V so that the Raspberry Pi may run securely. To allow the robot to view its environment, a USB camera attached to the Raspberry Pi records live photos or video. Using computer vision techniques and libraries like Open-CV or Tensor Flow, the recorded data is processed for tasks like obstacle avoidance, motion tracking, and object recognition. The data is saved on an SD card. A motor driver receives control signals from the Raspberry Pi and uses them to operate the DC motors in response to remote orders or input from image processing. This allows the robot to move. This connection enables the robot to move either fully or partially on its own, using visual information in real time to make judgments. Compact and affordable, the system may be used for a variety of tasks, including environmental monitoring, instructional robotics, and residential or industrial surveillance. It demonstrates the promise of fusing vision-based robotics with low-cost computers, providing a solid basis for increasingly sophisticated AI and automation-based applications.**

Keywords: **Raspberry Pi, Open-CV, USB Camera, L298N Motor Driver**

I. INTRODUCTION

The project's goal is to use a Raspberry Pi processor and a mobile phone-based DTMF to operate the robot. A key component of every robotic endeavor is robot control. Robots must be able to move to the right, left, forward, backward, and stop in numerous applications. We suggest a system that allows the user to apply a variety of digital instructions to move the wireless robot around the surroundings. The primary goal is to leverage DTMF technology to provide the user a dependable and more organic method of navigating a wireless robot in the surroundings. With this approach, the user controls the robot from [1] a control station, which may be a smartphone with an external or high-quality built-in camera. In order to provide orders for the robot, this camera records hand movements in real time. when we use DTMF technology to make a call to the IVRS (Interactive Voice Response System). mobile number, and the user may press the associated key to pick the appropriate choice after the call has been initiated. It will produce [2] a complicated frequency that the placed mobile device can hear. Thus, four different command types, Forward, Backward, Right, and Left will be used to transmit DTMF tones from the caller mobile to the called mobile. Image processing is used to process the input image frame. It then extracts the command from the processed picture. Of the four commands listed, this command may have any one of them. The Raspberry Pi CPU [3] serves as the project's motor control device. The processor-connected DTMF module will receive the data transmitted by the mobile phone using DTMF technology via the audio jack connection. After reading the data, the Raspberry Pi CPU determines the direction and controls the assigned robots. Embedded Linux is used to program the Raspberry Pi CPU. The proposed method and the paper as organized as I. Introduction Section II as literature survey section III as existing method and its operation section IV Proposed method block diagram and its operation and section V conclusion and its future scope.

II. LITERATURE SURVEY

There have been a number of previous attempts to include the Eye Aspect Ratio and the Haar Cascade Classifier into their project. To create effective eyes and face Haar Cascade Classifier detectors before they were integrated into the hierarchical system, for instance, the Haar Cascade Classifier was tested for training on the author's face and eyes [4]. Using a series of test photos, our system was able to identify and pinpoint the eye region. However, the Eyes Aspect Ratio for the driving monitoring system has been the subject of further study [5]. A video camera was used for the experiment, taking pictures of the driver's face to feed into the system. The goal was to employ facial features and face recognition to track driver alertness. The problem of close collinear relationship between eyelid movement variables is addressed by driver drowsiness detection using multi-eyelid movement features based on the information fusion approach partial least square regression (PLSR), which predicts the likelihood of somnolence. Validation of the model's prediction accuracy and robustness demonstrates that it offers a unique method of integrating many characteristics to improve our capacity to identify and forecast sleepiness [6].

The study was based on a visual assessment of the driver's eye health and head posture (HP) to track their level of awareness. Numerous existing techniques for visualizing non-alert driving behaviors rely on angles of head shaking or eye shutting to assess the degree of distraction or drowsiness of the driver. A sequence of video segments is either classified as warning or non-alert driving occurrences using the help vector machine (SVM) [7].

The included block diagram shows how to use an Arduino Uno to operate a simple robot system over Bluetooth. The Arduino

Uno and the motor driver are both powered by a 12V battery, which also powers the complete arrangement. With the help of a Bluetooth module, the [8] Arduino Uno may communicate wirelessly with an external device, such a smartphone.

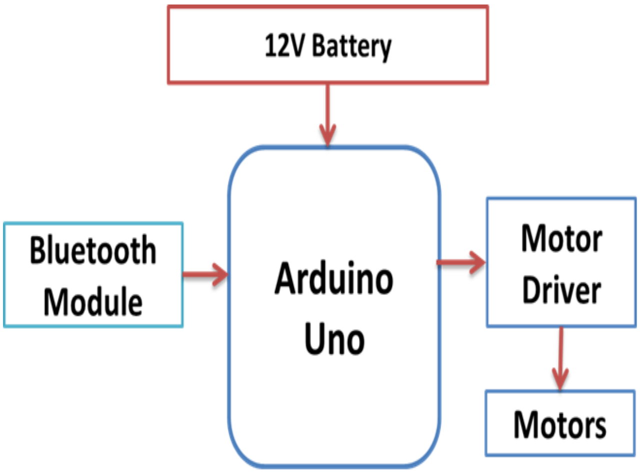

Fig.1. Existing block diagram

The Bluetooth module receives and delivers orders to the Arduino Uno from the user using a mobile application. These commands include forward, backward, left, and right. After processing these commands, the Arduino notifies the motor driver (usually an L298N or L293D module) with the appropriate control signals. The robot may then travel in the desired direction thanks to the motor driver's control over the motors. The motor driver ensures appropriate voltage and current regulation by serving as a link between the higher power motors and the low-power Arduino. Automation projects and simple wireless robotic cars often employ this method. When more sensors are added, it may be used for tasks like surveillance robots, smart automobiles, and obstacle-avoiding robots since it can be operated and controlled remotely. The design's ease of use and adaptability make it perfect for novices in robotics and embedded systems.

III. PROPOSED METHOD

The block diagram shows [9] a Raspberry Pi 3B+-based image capturing robot system. Because the Raspberry Pi runs at 5V, the system is powered by a 12V battery that is adjusted [10] to 5V using a 12V DC to 5V DC adapter. Using a USB camera, the Raspberry Pi can record live video or take pictures.

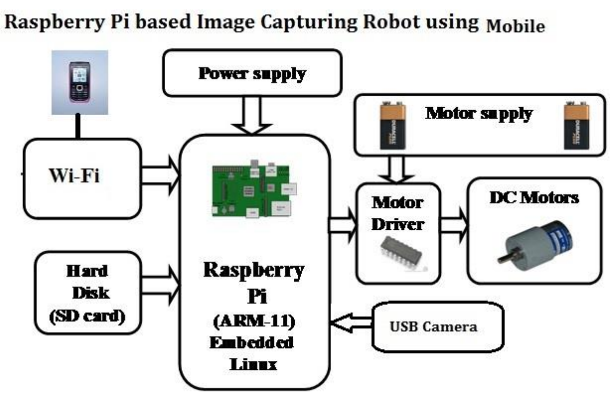

Fig.2. Proposed block diagram

The SD card, which houses the Raspberry Pi's operating system and picture data storage, may either handle these [11] photos locally on the Pi or put them straight onto it. You can do motion detection, face recognition, and object identification using Python-based image processing packages like OpenCV

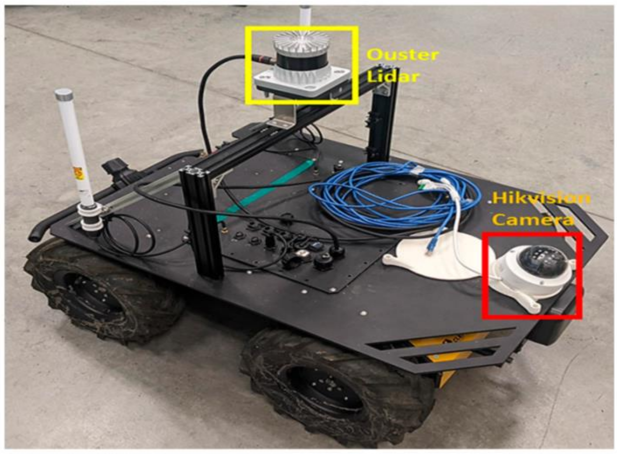

Fig.3. Construction of proposed method

Additionally, the Raspberry Pi manages the robot's motion. To move the robot in the required direction, it transmits the proper signals to a motor driver, which then turns on the motors. This enables the robot to maneuver either manually or automatically in response to commands from a remote control system or the camera. [12-15] Applications like as autonomous navigation, object tracking, and surveillance are best suited for this configuration. AI-based smart robots that can interact with their surroundings in real time might benefit from the combination of mobility and imaging.

IV. RESULTS

The implemented robot system, powered by the Raspberry Pi 3B+, demonstrated effective performance in autonomous navigation and real-time image-based decision-making. Live video was successfully captured through a USB camera and processed using computer vision libraries such as Open CV and Tensor Flow. Tasks such as obstacle avoidance, motion tracking, and basic object recognition were achieved with a high degree of reliability under controlled conditions. As shown in Table.1 the performance of the proposed system shows enhancement in the parameters such as, Processing Power, Image Processing, Camera Support, Control Logic, data storage, Power Management.

Power supply conversion from a 12V DC battery to a stable 5V using a DC adapter ensured safe and uninterrupted operation of the Raspberry Pi. Control signals derived from processed image data were transmitted to the motor driver module, which accurately controlled the motion of the robot via DC motors. The system responded appropriately to both remote commands and locally processed visual inputs, enabling both manual and semi-autonomous operation modes.

All captured data was successfully stored on an SD card for later analysis. The compact and cost-effective design proved suitable for practical applications such as surveillance and environmental monitoring. Overall, the results validate the feasibility of combining real-time computer vision with low-power embedded systems for intelligent robotic control.

V. CONCLUSION AND FUTURE SCOPE

The security forces would greatly benefit from this robotic technology in detecting any cross-border invasion. This device can monitor any situation, even places that are hard for security personnel to get to. Since the internet facilitates communication, there is no operational range restriction, allowing us to monitor even the most distant locations. The suggested approach makes it simple to transport messages from the main station to their destination. The sender has the option to deliver the message to many classrooms or just one. Type messages on a computer or mobile device, which ZigBee may then show on a display unit. This will save manpower since we are not utilizing any written formats. As a result, the information might reach the recipient promptly. There is no information transfer latency.

REFERENCES

[1] K. Watanabe, J. Tang, M. Nakamura, S. Koga, T. Fukuda, Mobile Robot Control Using Fuzzy-Gaussian Neural Networks, Proceedings of the 1993 IEEE/RSJ International Conference on Intelligent Robots and Systems Yokohama, Japan July 26-30,1993.

[2] K. Ogata *Modern Control Engineering* (4th Edition), copyright 2002 by Pearson Education, Inc.
Google Scholar

[3] Rafael C. Gonzalez, Woods Richard E. : *Digital Image Processing* (2nd Edition) Copyright 2002 by Prentice-Hall, Inc.

[4] Karl Astrom, Tore Hagglund : *PID Controllers*, 2nd Edition, Copyright Instrument Society of America 1995.

[5] .Panos J. Antsaklis, Kevin M. Passino,eds.: *An Introduction to Intelligent and Autonomous Control* : Kluwer Academic Publishers, Norwell, MA, 1993. Available: http://www.ece.osu.edu/~passino/books.html.

[6] Michail G. Lagoudakis, Anthony S. Maida : Neural Maps for Mobile Robot Navigation, International Joint Conference on Neural Networks, 1999. IJCNN '99, vol. 3, pp. 2011–2016.

[7] Guilherme N. DeSouza, Avinash C. Kak: Vision for Mobile Robot Navigation: A Survey, *IEEE transactions on pattern analysis and machine intelligence*, vol. 24, no. 2, February 2002.

[8] Jonathan Dixon, Oliver Henlich: *Mobile Robot Navigation*.Available: http://www.homes.doc.ic.ac.uk/~nd/surprise_97/iournal/vol./imd/.

[9] J. Yen and R. Langari : *Fuzzy Logic Intelligence, Control, and Information*. Prentice Hall, 1999.

[10] Dementyev, A., and C. Holz. 2017. DualBlink: A Wearable Device to Continuously Detect, Track, and Actuate Blinking For Alleviating Dry Eyes and Computer Vision Syndrome. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 1, 1: 1–19.

[11] Divjak, M., and H. Bischof. 2009. Eye blink based fatigue detection for prevention of computer vision syndrome. MVA 2009 IAPR Conference on Machine Vision Applications; pp. 350–353.

[12] Doughty, M. J. 2001. Consideration of Three Types of Spontaneous Eyeblink Activity in Normal Humans: during Reading and Video Display Terminal Use, in Primary Gaze, and while in Conversation. *Optometry and Vision Science* 78, 10: 712–725.

[13] Ferhat, O., F. Vilariño, and F. J. Sánchez. 2014. A cheap portable eye-tracker solution for common setups. *Journal of Eye Movement Research* 7, 3: 1–10.

[14] Freudenthaler, N., H. Neuf, G. Kadner, and T. Schlote. 2003. Characteristics of spontaneous eyeblink activity during video display terminal use in healthy volunteers. *Graefe's Archive for Clinical and Experimental Ophthalmology* 241: 914–920.