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Hand Controlled Navigation of a System and Obstacle Sensing

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ABSTRACT: — In this study, a hand motion navigation system for automobiles that uses an SR04 ultrasonic sensor for obstacle detection and an accelerometer is presented. Hand gestures are detected with the help of an accelerometer so that it can control the vehicle movements, offering an easy and comfortable control for the users. The SR04 sensor detects the car's surrounds and provides real-time distance measurements to avoid impediments. By combining gesture control with obstacle detection, the safety and overall experience is improved. Experiments indicate the system's ability to increase navigation accuracy and collision avoidance in numerous driving scenarios.

KEYWORDS: accelerometer; ultrasonic sensor navigation system; hazard identification; collision avoidance

I. INTRODUCTION

In the present study, a hand motion navigation system for automobiles that uses an SR04 ultrasonic sensor for obstacle detection and an accelerometer is presented. The accelerometer detects hand gestures to control vehicle movements, providing a convenient interface for drivers. The SR04 sensor monitors the car's surroundings and provides real-time distance measurements to avoid obstacles. This dual approach improves driving safety and convenience by integrating intuitive gesture control and effective hazard detection. Experiments confirm the system's ability to improve navigation accuracy and collision avoidance in various driving scenarios. Hand gesture-based techniques provide a smooth interface for human and car interaction. Systems that rely on monocular vision offer a straightforward method for collecting gesture data from users, though they often face several photometric challenges in the operational environment. To address these issues, the Constant-Q Transform (CQT) has been applied for robust feature extraction from gesture datasets, particularly in environments with poor lighting. A comprehensive analysis has been carried out on various elements and their configurations within the CQT feature domain [1]. The findings confirm its effectiveness in obtaining consistent features from visually compromised sensor data, supporting its practical use in real-world HRI applications. 2 The Internet of Things (IoT) has greatly changed the way everyday objects function by connecting them to the internet. This connection allows these objects to respond to their surroundings without needing direct human input [2]. In situations where safety is a top priority—like handling harmful chemicals or lifting heavy items in factories—smart and reliable solutions are especially important. One such innovation is the concept of hand-gesture controlled vehicles, which brings a new approach to controlling cars through simple hand movements.

II. LITERATURE SURVEY

Wilson and Jelley (2003) showed that using both accelerometers and gyroscopes made it possible to build systems that could understand more detailed and accurate hand gestures. Later, Madgwick et al. (2011) improved on this idea by introducing Inertial Measurement Units (IMUs). These devices combine accelerometers, gyroscopes, and magnetometers to track motion in a very precise way. Because of this, IMUs have become key components in many areas, including robotics and virtual reality (VR), where accurate motion tracking and user interaction are crucial [3]. India has also made strong progress in developing gesture-based technology. Researchers at leading institutions like the Indian Institute of Technology (IIT) have explored various sensors and machine learning methods to make gesture recognition more efficient and accessible. For instance, Gupta et al. (2013) [4] from IIT Bombay developed a low-cost gesture recognition system that uses basic webcams along with simple image processing techniques to detect hand movements. Their work has useful applications in education and healthcare. Recognizing hands and understanding gestures are important tasks in computer vision and are used in many areas like robotics, sign language detection, and how people interact with computers [5]. Some traditional methods for this include using template matching and feature extraction. These rely on manually designed features and usually require expert knowledge and time-consuming adjustments to work well. In contrast, newer methods use deep learning techniques such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs). These approaches can learn features automatically and often perform better across different gesture recognition tasks. These approaches have demonstrated cutting-edge performance in hand detection and gesture recognition challenges [6]. Media Pipe Hands is one example of such a system, which uses RGB data to identify and track the hand's important spots. 3 .Specialized sensors, such as Kinect and Leap Motion, use these methods to offload the major processing to themselves, allowing for real-time hand identification. These algorithms frequently incorporate depth image data or multimodal data to make more precise predictions. However, training neural network models necessitates enormous datasets that are difficult and expensive to get. Gesture control is currently applied in two main areas of robotics: controlling industrial manipulators and operating mobile robots. Műezzinoglu et al. [7] A real-time UAV control system was created using sensor-integrated gloves capable of detecting hand gestures and orientation. The system interprets three distinct hand gestures—closed fist, open palm, and closed palm with the thumb extended—combined with hand tilt data to produce 25 different control commands that reflect movement direction and speed. DelPreto et al. investigated a similar application, using an electromyography-based sensing device for gesture identification. Carneiro et al. [8] A walking robot was controlled remotely through gestures, while Roda Sanchez et al. [9] utilized wrist rotation and position tracking to navigate the robot toward predefined destinations. Additionally, an in-depth evaluation of various component combinations within the CQT feature domain was carried out. The method successfully extracts trustworthy features from photo-metrically damaged vision sensor data, making it suitable for real-world HRI situations. These days, personnel may carry these advanced devices around simply to transmit location data or incorporate them into weapons and vehicles. The military uses GNSS signals to guide guns towards their targets.

III. METHODOLOGY

Mission Design and Hand Gesture Control System

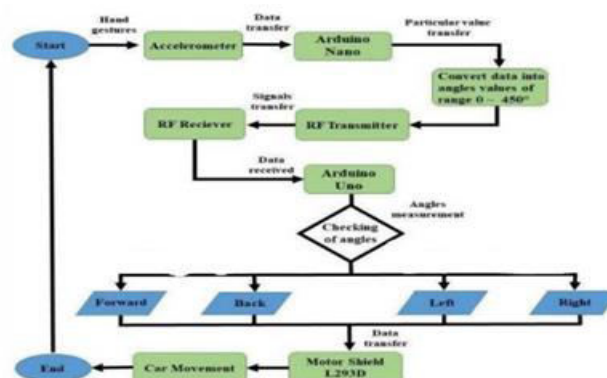


Fig (1): Block diagram of designing of hand-controlled navigation systems

Mission design involves creating a reference trajectory to guide the spacecraft's expected flight path, while route tracking monitors its position during flight. Hand control navigation systems allow operators to control modules through hand movements. An accelerometer detects motions caused by gravity or user gestures, which are processed by an Arduino Nano. The gesture data is wirelessly transmitted from a sender to a receiver attached to the module. Upon receiving these signals, an Arduino Uno interprets the hand angles and movements to control the module's motors accordingly.

A. Accelerometer MPU6050

The MPU6050 is a small sensor module integrating a 3-axis gyroscope and a 3-axis accelerometer, enabling six-axis motion tracking. When paired with an additional 3-axis magnetometer through a separate I2C interface, it can offer a full 9-axis motion fusion output. The module also includes a built-in temperature sensor and communicates with microcontrollers using the I2C protocol, enabling integration with various other sensors such as magnetometers and pressure sensors. (see Fig.2).

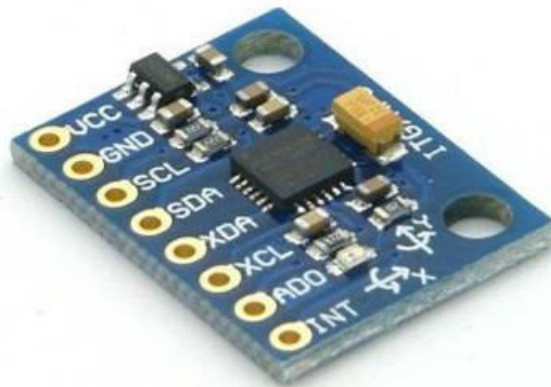


Fig (2): 6-axis Motion Tracking Device (MPU6050)

B. UNO R3

The Arduino UNO is a popular microcontroller board suited for beginners learning electronics and programming. It is similar to the ATmega328P microcontroller, 14 digital IO pins, 6 analog inputs, and a 16 MHz resonator. It has a USB port, power jack, ICSP header, and reset button, the UNO is ready to use out of the box by connecting through USB or powering it through an adapter or battery



Fig (3): Microcontroller board (Arduino UNO R3)

C. NANO CH340

The Arduino Nano CH340 is a small microcontroller board based on the ATmega328P-AU. It is different from the UNO by using the chip for USB-to-serial communication, which needs a specific driver. The Nano includes 14 digital I/O pins, 8 analog inputs, a 16 MHz oscillator, a mini-USB connector. It is normally programmed at the factory, the Nano is ideal for projects needing a full set of input/output options..



Fig (4): NANO CH340

D. L298N Motor Driver

The L298N motor driver module integrates an L298 motor driver IC along with a 78M05 voltage regulator, resistors, capacitors, and a power LED on a single circuit board. The voltage regulator activates only when a jumper is installed and supplies power to internal circuitry if the input voltage is 12V or less. For voltages above 12V, the jumper should be removed, and an external 5V supply used. Motor speed is controlled via the ENA and ENB pins, while direction is managed through pairs of input pins (IN1/IN2 for Motor A and IN3/IN4 for Motor B). (See Fig 5).

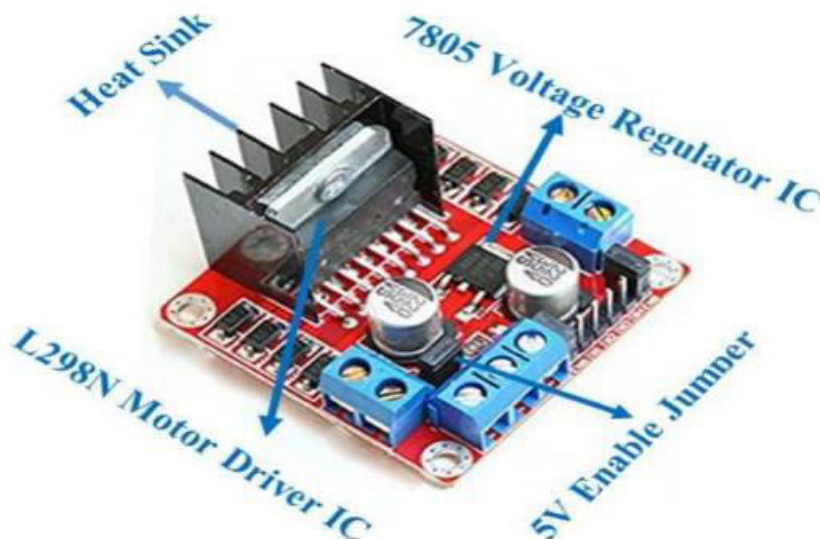


Fig (5): L298N Motor Driver

E. nRF24L01

The nRF24L01 module has wireless communication between Arduino boards using a 2.4 GHz radio transceiver connected to an antenna. It can transmit data rates of 250 kbps, 1 Mbps, and 2 Mbps, it achieves reliable communication ranges of 50 meters, with longer distances in low-interference environments. This module is suitable for far-away controlling devices across rooms or buildings. (See Fig.6).

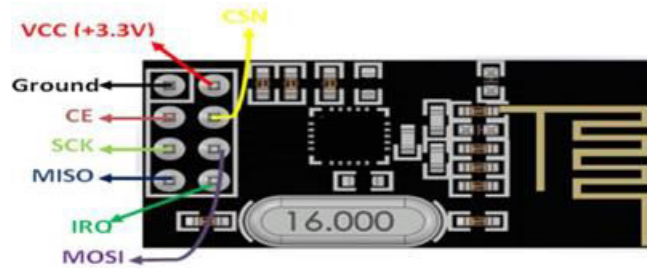


Fig (6): nRF24L01 module

F. HC-SR04:

The HC-SR04 is an ultrasonic distance sensor having of two ultrasonic transmitters, a receiver, and a control circuit. It calculates distance to objects by emitting ultrasonic waves and timing the echo's return after bouncing off nearby surfaces. This method allows for very good distance measurement in a variety of applications..



Fig (7): Ultrasonic transmitters (basically speakers)

G. Piezo Buzzer:

A piezo buzzer is a simple electronic component that produce sound when electrically activated. It is less money, easy to use, and available in many sizes and frequencies, making it a very good choice for alarms, tones, or alerts in many electronic projects.(see Fig.8).



Fig (8): Piezo buzzer

IV. WORKING FUNCTIONAL BLOCK-DIAGRAM

Hand control navigation systems are among the numerous electronics systems that use the well-known Arduino Uno microcontroller board. The Arduino UNO is a programmable microcontroller board that's less cost and simple to use. It's suitable for a variety of electronic operations and systems. The ATmega328P microcontroller serves as the base for the Arduino Uno. It features a 16 MHz quartz demitasse, 6 analog inputs, 14 digital input/ affair legs, a power jack, a USB harborage, and a reset button. The Arduino IDE, which supports C/ C, makes programming comparatively simple(see Fig. 9). Ground bumps are predicated where we use the Arduino Uno, which is powered by a 5V force. Arduino Uno The main regulator. Sensor Input Data collection from hand- attached detectors is the first step in the design. For illustration, an accelerometer can identify the hand's exposure or acceleration, while a flex detector can measure how much a cutlet bends. Data recycling Using its analog or digital input legs, the Arduino Uno reads the detector data. After that, the data is reused to decrypt the movements or gestures. This could number rephrasing undressed detector data into useful instructions. For illustration, a specific navigation command may be associated with a specific hand position. Control sense The Arduino employs control sense to decide on the stylish course of action grounded on the data it has reused. For case, the system may be instructed to turn left if the hand is listed to the left wing. Actuation After that, the Arduino communicates with selectors, similar as servos or motors. In order to navigate the system, these corridor move meetly. They could operate a robotic vehicle's bus, for case. In order to guarantee a further prosperous life, technology is available to palliate our diurnal issues in all forms of scalability.

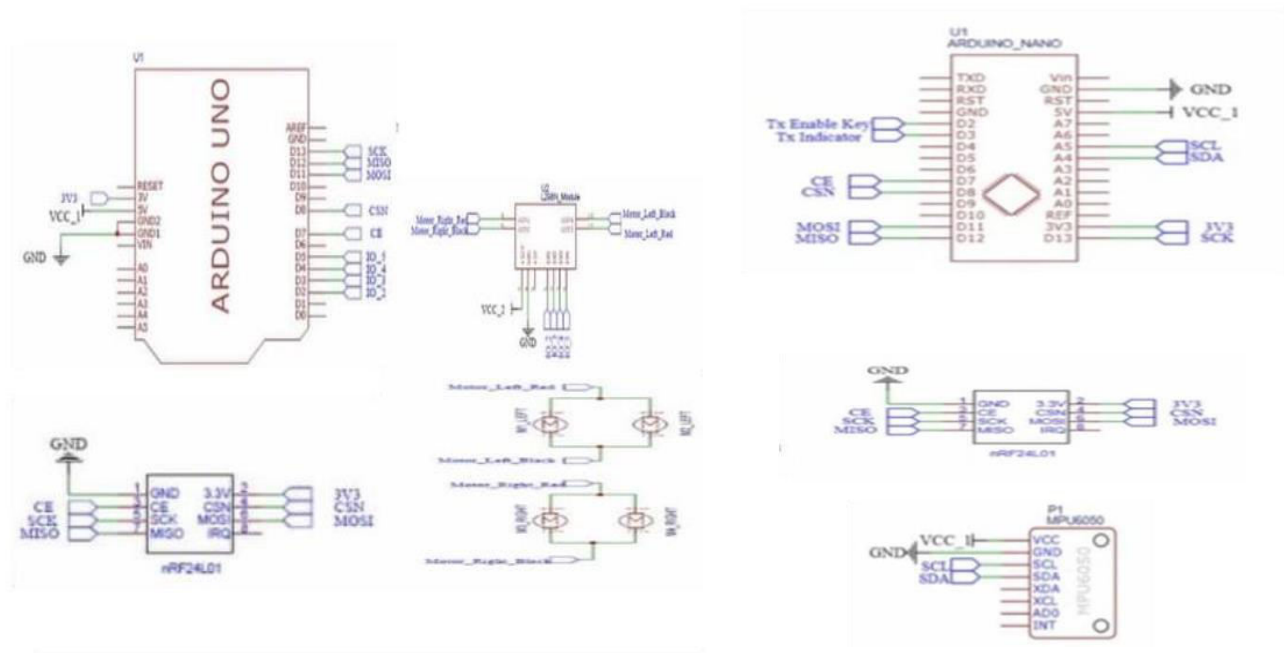


Fig (9): Functional Circuit Connections

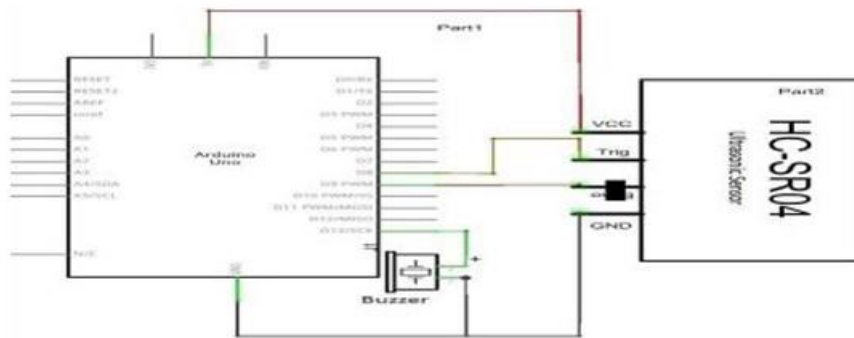


Fig (10): Obstacle Detection

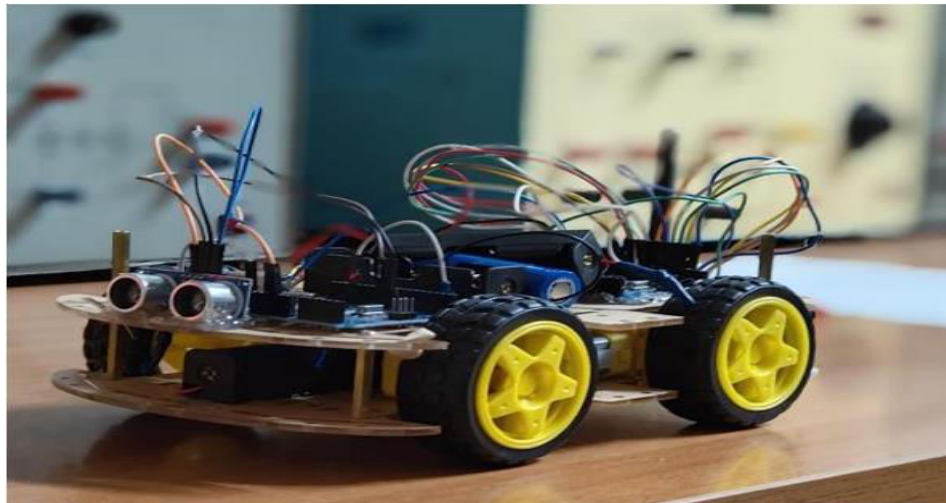


Fig (11): Final Model

V. CONCLUSION

According to the exploration presented in this report, it'll give a new avenue for those who bear a comfortable and good life. With the right artificial support, the exploration could advance significantly. With uninterrupted trouble, it holds strong eventuality for unborn development. With this, we can also use a variety of IOT features. We can soon apply this prototype system with a real wheelchair. To assess the stoner's health, we can install fresh detectors.

REFERENCES

- [1] Ashley, D., Ashley, K., Alqasemi, R., & Dubey, R. (2017, July). Semi-autonomous mobility assistance for power wheelchair users navigating crowded environments. In Rehabilitation Robotics (ICORR), 2017 International Conference on (pp. 1025-1030). IEEE.
- [2] B.K. Sriranga, L.J. Kirthan, Ananda G, The mechanical properties of hybrid laminates composites on epoxy resin with natural jute fiber and S-glass fibers, Materials Today: Proceedings, Vol.6(18),2021,8927-8933, <https://doi.org/10.1016/j.matpr.2021.05.363>
- [3] Wolpaw, J. R., Birbaumer, N., McFarland, D. J., Pfurtscheller, G., & Vaughan, T. M. (2002). Brain computer interfaces for communication and control. Clinical neurophysiology, 113(6), 767-791.

- [4] Ananda Gowda, Shivappa Dassappa, Ramesh Hanumanthappa, Sriranga Kempanna, Effect of reduced graphene oxide as nanofluid on solar parabolic trough collector receiver model, Materials Proceedings, Vol.27(1), 2020, 396-401, <https://doi.org/10.1016/j.matpr.2019.11.234>. Today:
- [5] Botrel, L., Holz, E. M., & Kübler, A. (2015). Brain Painting V2: evaluation of P300-based brain-computer interface for creative expression by an end-user following the user-centered design. Brain Computer Interfaces, 2(2-3), 135-149.
- [6] Ananda Gowda, Shivappa Dassappa, Ramesha Hanumanthappa, Theoretical prediction of solar heat flux intensity on parabolic trough collector systems, Materials Today: Proceedings, Vol.26(2), 2020, 2231-2236, <https://doi.org/10.1016/j.matpr.2020.02.484>.
- [7] LaFleur, K., Cassady, K., Doud, A., Shades, K., Rogin, E., & He, B. (2013). Quadcopter control in three dimensional space using a noninvasive motor imagery-based brain-computer interface. Journal of neural engineering, 10(4), 046003.
- [8] Raviprakash M., Ananda G.K., Prasad H. Nayak, Rahul D., Estimation of stress and deformation on steel coil holder fixtures using finite element analysis, Materials Today: Proceedings, Vol. 42(2), 2021, 660-670, <https://doi.org/10.1016/j.matpr.2020.11.052>.
- [9] Andujar, M., & Gilbert, J. E. (2013, April). Let's learn! enhancing user's engagement levels through passive brain-computer interfaces. In CHI'13 Extended Abstracts on Human Factors in Computing Systems (pp. 703-708). ACM.
- [10] Ramesha Hanumanthappa, Shivappa Dassappa, Ananda G K, Thermal analysis on heat sink made up of aluminium alloys with copper compositions, Materials Today: Proceedings, Vol.42(2), 2021, 493-499, <https://doi.org/10.1016/j.matpr.2020.10.292>.
- [11] Palankar, M., De Laurentis, K. J., Alqasemi, R., Veras, E., Dubey, R., Arbel, Y., & Donchin, E. (2009, February). Control of a 9-DoF wheelchair-mounted robotic arm system using a P300 brain computer interface: Initial experiments. In Robotics and Biomimetics, 2008. ROBIO 2008. IEEE International Conference on (pp. 348-353). IEEE.
- [12] Raviprakash M., Ananda G.K., Prasad H. Nayak, Rahul D., Estimation of mechanical parameters for orthodontic retraction loops using finite element analysis, Materials Today: Proceedings, Vol.42(2), 2021, 686-692, <https://doi.org/10.1016/j.matpr.2020.11.066>.
- [13] Carlson, T., & Millan, J. D. R. (2013). Brain-controlled wheelchairs: a robotic architecture. IEEE Robotics & Automation Magazine, 20(1), 65-73.
- [14] Roy, R. N., Bonnet, S., Charbonnier, S., & Campagne, A. (2013, July). Mental fatigue and working memory load estimation: interaction and implications for EEG based passive BCI. In Engineering in Medicine and Biology Society (EMBC), 2013 35th Annual International Conference of the IEEE (pp. 6607-6610). IEEE.
- [15] K. Stamps and Y. Hamam, "Towards Inexpensive BCI Control for Wheelchair Navigation in the Enabled Environment – A Hardware Survey," Brain Informatics Lecture Notes in Computer Science, pp. 336–345, 2010.

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