Object Detection and Avoidance in Unmanned Ground Vehicle using Arduino1

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Abstract:- The autonomous driving is the recent era in automobiles industry. The systems will be designed and aimed to reduce the manual control from humans also to efficiently manage to operate accordingly to the information obtained from the sensors. Whereas Unmanned Ground Vehicles (UGV) are used for a particular application to perform completely with zero or no direct interaction with that particular vehicle which can be used in military borders, hazardous areas, and industries with repetitive tasks to increase accuracy, consistency, and speed as machines are non-volatile. The only challenge to be precisely taken care of among UGVs must be the sensitivity towards detecting the objects on the way and acting accordingly to avoid a collision. In this proposed model we use ultrasonic sensors and IR sensors

Keywords:- *UGV, Arduino IDE, Object detection, and object avoidance.*

I. INTRODUCTION

The design, development, and implementation of mobile robots has been a huge impact on the industrial sector these days. The development of fast processing controllers using open-source coding has increased the interest of even non-engineering students and teenage kids as well also been bought hyper attraction to this field. To further carry on this field in depth will be working on faster processing communication protocols and intelligent algorithms will result in an increase in research activities in this area.

Unmanned Ground Vehicles (UGVs) can be used in different areas such as exploration of the field, delivery or transportation, gaming competitions, surveillance, huge agricultural fields, and military[1]. Low-cost autonomous UGVs are available and also being developed along with providing enhanced technological applications for mechatronic systems. Further new Algorithms can be implemented such as deep learning and multi-rate control strategies for research work in mobile robotics [2].

In this proposed model we use an ultrasonic sensor and IR sensor for long-range and cost-efficiency. The developed mobile robot system is been interfaced with the user via the internet as the controller signals obtained from the user were uploaded and can be accessed online through the cloud. The system also contains an autonomous drive-through option where the robot uses an embedded algorithm to explore the area, also can record the video on its memory, and find its way to the base.

The paper is formulated as follows: Section Two identifies the system objectives of our work; Section Three provides the related work that we have researched for our requirements and for the architecture design; Section Four provides the working module, Hardware components, and software design and prototype; Section Five concludes the proposed work of paper and projects future recommendations. This work is based on UGV projects developed at REVA University. This project includes the following electronic design, mechanical design, and software logic control over the motors. The processing unit has set a plan to develop intelligent UGVs through four phases. The final goal is to further dump and develop deep learning algorithms for exploration, path projecting, and target tracking using multiple UGVs. This paper presents the electronic components details, setup, and software control for the first two phases which will be used as the basis for further development. The main contributory work of this paper is to share the experience gained in developing a simple UGV prototype that can be used for open-source learning and research.

II. OBJECTIVES

- The main aim of the proposed work is to be applied and should be used for Military purposes like city wars and mobile surveillance systems.
- Model is aimed to be portable to carry, easy to control, maintain and repair.
- System is to be flexible to perform in a long range of temperatures, should consume very less power, and look very simple in construction.

III. LITERARY SURVEY

In Khan et al. (2017), the authors have operated UGVs under a complex scenario [4] that required object detection more often and highlighted the importance of autonomous navigation. Hence they have referred to papers and articles from the 2nd conference for engineering, science, and technology on 29 October 2019 "Design and Implementation of the unmanned ground vehicle using Arduino".

Domenico Guida et al. This conference paper mainly describes the specialties of ultrasound technologies [5] (Ultrasonic sensor HCSR04), system design, motor driving module(L298D), and its wide usage, and mainly how to control the DC motor for the UGVs remotely with the prototype.

Zabbar et. al. in 2017 author mainly focused on wide applications of ultrasonic sensors [6], implementation of the ultrasonic sensor based on the requirement in the project and would show the output values on different parameters of the physical environment.

Srijan et. al. in [2] this paper describes features of Arduino UNO Microcontroller, and Ultrasonic Sensor and they developed a simple code to run the obstacle avoiding UGV. Sulaimon et. al. provided an implementation idea of obstacle-avoiding UGV [7] based on Arduino UNO through some of the flowcharts and a detailed description of main components like Arduino UNO, Ultrasonic sensor, etc.

RELATED WORK
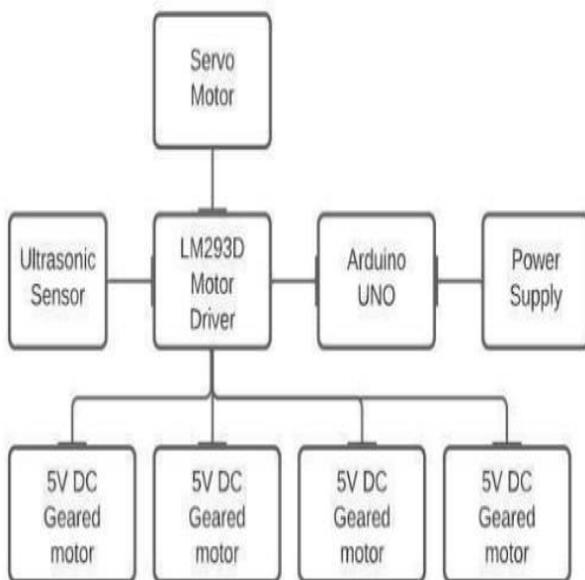
Fig. 1 Block Diagram of UGV layout

As we all know, nowadays self-driving become so popular. But they are only aiming at cars, bikes, etc. In future wars that may occur based on the present situation, we are proposing an unmanned ground vehicle that works automatically. By this, we can reduce the destruction of the life of humans. So, to overcome this and to reduce the number of calamities, our team has come up with this prototype which is "Unmanned Ground Vehicle and Obstacle Detection using Arduino".
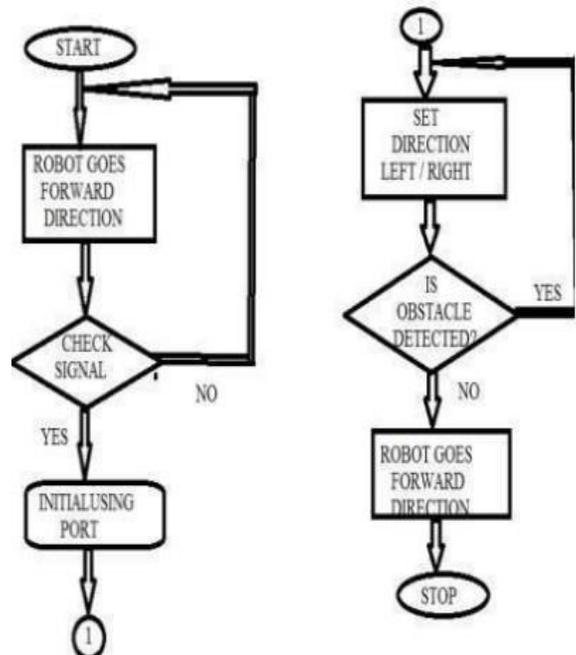
Fig. 2: Flowchart of the working model of obstacle avoiding UGV

IV. METHODOLOGY

This prototype consists of Arduino UNO, 5V DC Geared DC motors, HC-SR04 Ultrasonic sensors, an LM298D Motor driver shield, and a Power supply. In this prototype, Arduino UNO Microcontroller is preferred because of its property of low power consumption and is also relatively cheaper than other modules available on the market. Two sets of 9V power supplies were used to power up the prototype. Two pairs of 5V DC Geared DC motors are used to control 10 the prototype. In this prototype, the motor drive shield is being interfaced with the Arduino which in turn controls the DC motors. Initially, when the prototype is turned ON, the prototype starts moving forward, and also the ultrasonic sensor starts producing the ultrasonic beam. This beam travels at the speed of 37KHz through the air as a medium and then waits to receive a corresponding reflecting signal which is detected using an Ultrasonic receiver module. Based on the time taken by the beam to travel, it is converted into distance based on certain formulae mentioned below.

V. RESULT & CONCLUSION
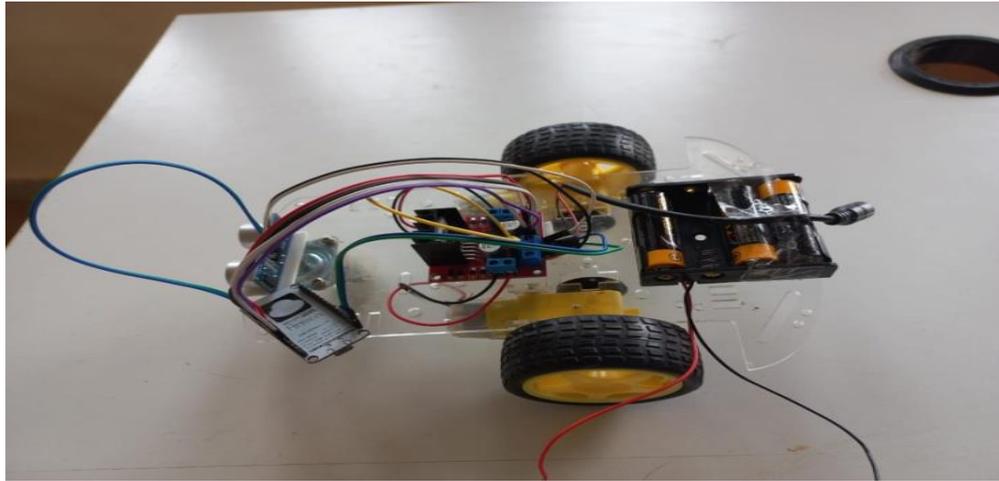
Fig. 3: Design and development of the proposed model

This paper consists of a detailed description of the simple, and low-cost model of the Unmanned ground vehicle and obstacle detection using Arduino Uno. The main component used for the detection of obstacles is the Ultrasonic sensor, it produces ultrasonic waves, if any obstacle or object is present opposite to the sensor at a measurable distance, the sensor detects and sends the signal to Arduino UNO. The Motor driver shield is connected to Arduino UNO, which is programmed to control the entire system. The motor driver controls the DC motors based on the signals from the Arduino UNO. This project definitely will be stepping out for a bright future in India. If we manufacture and make these type of UGV it will be the least cost-effective for the country and also reduces the harm to human resources and it will be one of the main robots for the future country's military sector.

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REFERENCES

[1.] 2nd conference for engineering, science, and technology 29th October 2019 "Design and implementation of the unmanned ground vehicle using Arduino"

[2.] Srijan Srivastava, Samarth Mehta, Shashank Singh, Aakriti Mittal, Obstacle avoiding UGV using Arduino and Ultrasonic sensor, October 2017

[3.] Department of information communication technology, University of Mauritius 18 October 2018, "A low cost autonomous unmanned ground vehicle"

[4.] Khan, "Title of paper with only the first word capitalized," *J. Name Stand. Abbrev.*, in press.

[5.] T. Bozik and G. Gurkan, "An Arduino UNO application: GPS guided unmanned ground vehicle," 2017 10th International Conference on Electrical and Electronics Engineering (ELECO), 2017, pp. 852-855.

[6.] T. A. Tutunji, M. Salah-Eddin, and H. Abdalqader, "Unmanned Ground Vehicle Control using IoT," 2020 21st International Conference on Research and Education in Mechatronics (REM), 2020, pp. 1-5, DOI: 10.1109/REM49740.2020.9313890.

[7.] S. Mandal, S. K. Saw, S. Maji, V. Das, S. K. Ramakuri and S. Kumar, "Low-cost Arduino wifi Bluetooth integrated path following robotic vehicle with wireless GUI remote control," 2016 International Conference on Information Communication and Embedded Systems (ICICES), 2016, pp. 1-5, doi: 10.1109/ICICES.2016.7518916.

[8.] V. R. Prajwal, "Vehicle Detection and Collision Avoidance in Hairpin Curves," 2020 IEEE Pune Section International Conference (Pune Con), 2020, pp. 142-145, DOI: 10.1109/PuneCon50868.2020.9362472.

[9.] N. K. McLellan, B. Gokaraju, R. C. Tesiero and S. Bhattacharya, "Guidance for Specific Target Doors in Hallway using the Computer Vision for Autonomous

Vehicles," 2019 SoutheastCon, 2019, pp. 1-4, doi: 10.1109/SoutheastCon42311.2019.9020554.

[10.] Qi Liu, Ziru Li, Shihua Yuan 10 February 2021 "Vehicle detection technology for Unmanned Ground Vehicles". Department of information communication technology, University of Mauritius 18 October 2018.

[11.] R. Siegwart, I. Nourbakhsh, and D. Scaramuzza, "Introduction to Autonomous Mobile Robots" 2nd edition, MIT Press 2011

[12.] Man, Y. Koonjul, and L. Nagowah "A low cost autonomous unmanned ground vehicle", Future Computing and Informatics Journal 3 (2018) 304-320

[13.] Bradley, D. Russel, I. Ferguson, J. Isaacs, A. MacLeod, and R. White, "The Internet of Things – The future or the end of mechatronics", Mechatronics 27 (2015) 57-74

[14.] L.A. Greico, A. Rizzo, S. Colluci, G. Sicari, G. Piro, D. Di Paolo, and

[15.] Boggia, "IoT-aided robotics applications: Technological implications, target domains and open issues" Computer Communications 54 (2014) 32-47.

[16.] N. Patel, A. Choromanski, P. Krishnamurthy, and F. Khorrami, "A deep learning gated architecture for UGV navigation robust to sensor failures", Robotics and Autonomous Systems 116 (2019) 80-97

[17.] J. Salt, J. Alcaina, A. Cuenca, and A. Barios, "Multirate control strategies for avoiding sample losses. Application to UGV path tracking" ISA Transactions, Article in Press

[18.] T. Maca, C. Copot, D. Tran, R. Keyser ."Heuristic approaches in robot path planning: A survey". Robotics and Autonomous Systems 86, (2016) 13-28

[19.] L. Atzori, A. Iera, G Morabito "The Internet of Things: A survey". Computer Networks 54 (2010) 2787-2805.

[20.] L. Grieco, A. Rizzo, S. Colucci, S. Sicari, G. Piro, D. Paola, and G. Boggia. "IoT-aided robotics applications: Technological implications, target domains, and open issues". Computer Communication 54 (2014) 32-47.

[21.] Abdalqadar, M. Abo Siam, H. Altalla, and A. Harbi, "Mobile Tank Vehicle Control using IoT", Senior Student Project, Philadelphia University, 2019

[22.] M. Salah-Eddin and A. Abushaar, "Unmanned Ground Vehicle Control using IoT: Phase-Two. Senior Student Project, Philadelphia University, 2020