Automatic control speed of vehicles near schools and colleges

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Article Info

ABSTRACT

Presently, accidents are increasing because people drive very quickly, therefore we have lost important lives as a result of simple driving errors near schools, colleges, and hospital zones. So, the highway authority has placed signboards in such spots to prevent similar accidents and notify drivers and manage their vehicle speed. However, it is sometimes possible to see that type of signboard, and there is a risk of an accident. The major aim of this project is to create a smart display controller that can control the vehicle's speed to prevent road accidents caused by vehicles driving too fast in an area where it is prohibited. The project is composed of two components: a transmitter unit (zone status) and a receiver unit for speed display and control. A transmitter unit is a wireless type (HC-12 wireless transceiver module), which sends signals and controls the vehicle's receiver unit (HC-12 wireless transceiver module). A receiver unit receives data from the transmitter and analyzes the data. The controller automatically reduces the vehicle's speed to the specified speed due to the data transfer from the transmitter to the receiver. This project supports many sustainable development goals (SDGs), especially the fourth goal "quality education" and the ninth goal industry, innovation, and infrastructure ".

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1. INTRODUCTION

Safety is an important aspect of people's everyday lives. More attention is needed to the construction of an efficient car driving helping system due to the daily accident incidents recorded on major roads in all sections of developed and emerging countries. If such a device is built and integrated into our cars as a road safety device, it is predicted to reduce the number of accidents on our roads and in other locations [1]-[4].

The objective of this proposed project is to automatically manage the speed of any vehicle in cities as well as in restricted locations such as schools, parks, hospitals, and speed-limited places. Outwork demonstrates how to control speed without endangering others. The speed is controlled automatically by the suggested embedded system; thus the driver does not need to control it while driving [5]-[8].

According to the report of the world health organization (WHO), every year over 1.25 million people died in vehicle accidents because 40% to 50% of drivers exceed the speed limit [9]-[13]. This project can reduce the number of accidents and save the students' life, as a result, the fourth goal of sustainable development goals which is "quality education" is achieved. Gummarekula *et al.* [14] construct an electronic display controller for vehicle speed control and zone monitoring utilizing intelligent systems in (2021), and it's designed to show zone information on the dash-board.

Sathiskumar *et al.* [15] aim to design an automatic system for controlling the speed of the vehicle that is feasible, compact, and simple to apply in schools, colleges, hospitals, and sharp-turning regions to limit the frequency of accidents. The Arduino UNO board's microcontroller-based platform was used to create this automatic speed control system. Amulya [16] focused on automatically avoiding vehicle collisions due to their excessive speed in speed-limited zones. Intelligent systems, radio-frequency (RF) transmitter modules, and RF receiver modules can be used to accomplish this.

Niranjane and Mandavgade [17] described how the system works in three regions where the speed wants to drop automatically using the "ZigBee module". The speed is lowered by using the microcontroller 8051 to reverse the motor's rotational orientation. Amarnarayan *et al.* [18] control the speed of vehicles to prevent accidents near the hospital, curving roads, and severe cuts caused by speeding. Using ZigBee technology and an arm-7 microcontroller, this is achievable.

2. TARGET SPECIFICATIONS

After studying the problem statement and the market requirements for the system, the objective specifications for the systems are created. The system's adaptation, compacting to a vehicle, and the system's procedure are discussed in this situation. The following are the most important parameters that will be used to construct the system: (low cost; low power consumption; reliability; durability; quick response; compact process; easy vehicles adaption; and high security).

3. THE PROPOSED DESIGN

The proposed system consists of a radio frequency transmitter unit. The mentioned unit is responsible for transmits the frequency over a short distance. The wireless reception unit, and a control unit that is programmed to regulate the motor and is attached to the car tires. The total system components are depicted in Figure 1.

The hardware components of the system can be listed in: i) Transmitter Unit: this consists of (an HC-12 wireless transceiver, Arduino nano, and direct current (DC) power supply (5V)); ii) Receiver unit: which consists of (an HC-12 wireless transceiver, Arduino UNO, L298N motor driver); iii) Robot car chassis: which contains (a DC motor reducer x2 and Lithium battery x2). Figure 2 shows a block diagram of the transmitter unit, and the system`s components are illustrated.
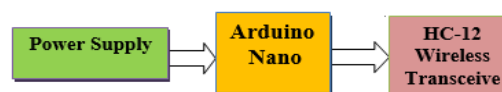

Figure 1. Overall system components

Figure 2. Block diagram of transmitter

- DC power supply: the dc power supply used in this project is (5 V).
- Arduino nano: Based on the "ATmega328", the Arduino-nano is a tiny, comprehensive, and breadboard-friendly board (Arduino nano 3. x) as shown in Figure 3. It has many of the same functionality as the

Arduino Duemilanove, but it is packaged differently. It just features a direct current (DC) power port and a small universal serial bus (USB) cable instead of a normal one [19].

- HC-12 wireless transceiver module: The HC-12 is a multi-channel wireless transceiver with a power output of 100 mW that can send and receive serial data. The HC-12 is a half-duplex wireless serial communication module with 100 channels that can transmit up to 1 km in the 433.4-473.0 MHz frequency, the operation voltage is (3.2V-5.5 VDC), and the dimensions are (27.4 x 13.2 x 4 mm) [20]. Its shown in Figure 4.
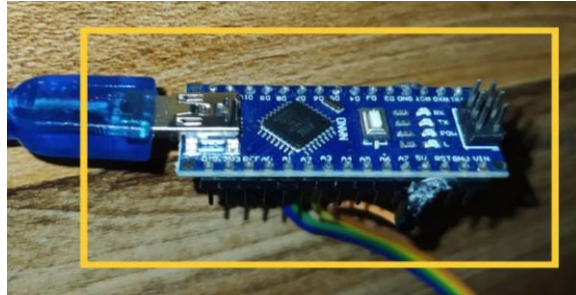
Figure 3. Ardunio nano

Figure 4. HC-12 wireless transceiver module

- Arduino UNO: The Arduino-UNO is a micro-controller board that utilizes the ATmega328P microcontroller (datasheet). There are 14 digital input/output pins (six of which can be used as pulse-width modulation (PWM) outputs), six analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an In-circuit serial programming (ICSP) header, and a reset button on the board [21]. It shown in Figure 5.
- L298N motor driver module: The L298N motor driver module is a "DC and stepper motor" high-speed driver. This module is made up of an (L298N motor driver IC) and (a 78M05 5 V regulator). The L298N module may control up to "4-DC" motors, or "2-DC" motors with direction and speed control [22]. It shown in Figure 6.
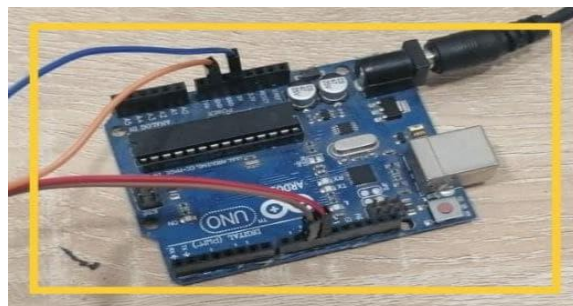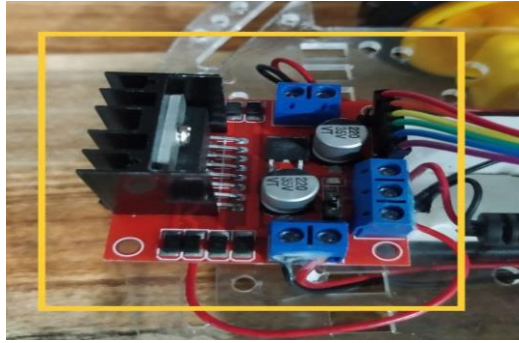

Figure 5. Arduino Uno

Figure 6. L298N motor driver module

- Robot car chassis: The car used in this project has a tachometer encoder and a mechanical structure. The robot car is easy to install and can be utilized for the measurement of distance and velocity. The robot car can be used with other devices to recognize the function of tracing; distance testing; obstacle avoidance; wireless remote control and speed testing. The size of it is (22cm x 14.7 cm), while the size of wheel (7 cm x 7 cm x 2.6 cm) [23]. It shown in Figure 7.
- Gear motor: In electronics and robotics, these motors are one of the most extensively used components. These motors transfer electrical energy from direct current to mechanical energy. The stator of these motors is powered by an external source. As a result of the current flowing through the stator, a uniform field is created beneath the poles [24]. It shown in Figure 8.
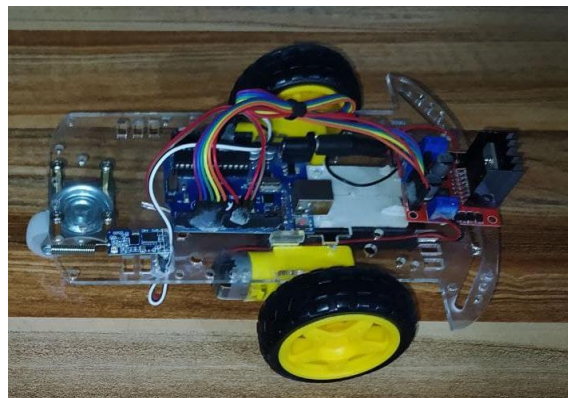
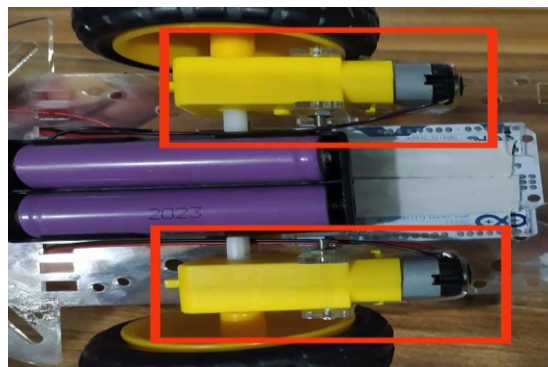

Figure 7. Robot car chassis

Figure 8. Gear motor

- Lithium battery x2: Lithium battery in Figure 9 is used as a primary battery and has a metallic lithium anode. This type of battery is also known as "lithium-metal battery". It distinguishes out from other batteries because of its high charge density and high cost per unit. Depending on the design and chemical compounds utilized, lithium cells can create voltages ranging from (1.5 V) to approximately (3.7 V) [25].

Figure 9. Lithium battery x2

4.   RESULTS

When a car with two engines is running, the engines run at a maximum rotational speed of 255 and when the sensor is triggered, it enters the car into the restricted area. The radio frequency transmitter sends out a radio frequency signal that contains information that indicates how fast the vehicle can be driven. Then the HC-12 receiver received the information and gave it to the Arduino controller which is used to control the speed of the motors. The analog signals will be converted to digital so that only the microcontroller will be able to process the signal. The transmitter signal is compared and based on the programming of the Arduino controller, it controls the motor speed and reduces it to 100 rotational speed. The relation between distance and speed of motors demonsterated in Figure 10.
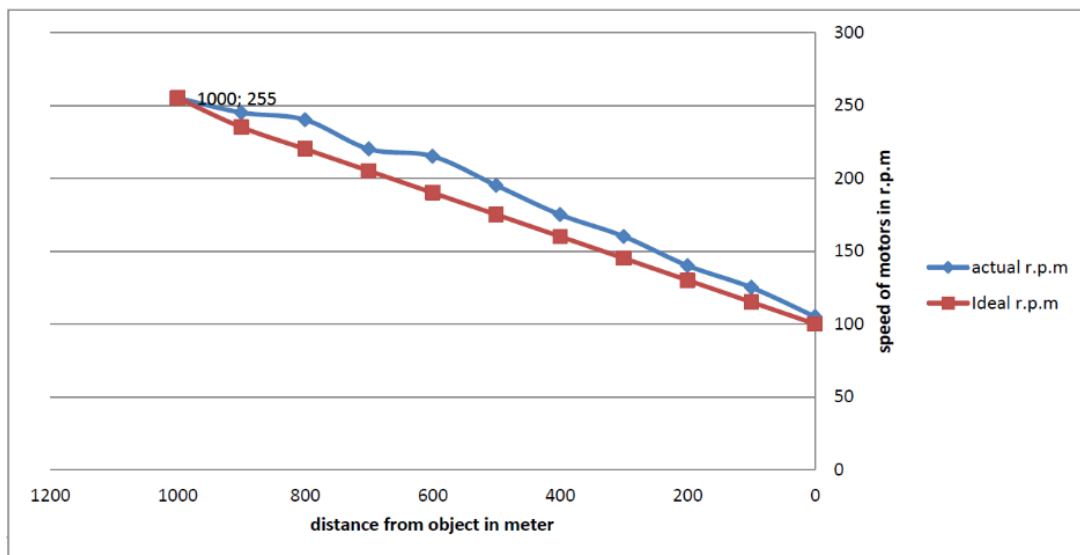

Figure 10. The relation between distance and speed of motors

5.   CONCLUSION

This study demonstrates the importance of automatically reducing vehicle speed and its advantages to pedestrian and road user safety. It has been discovered that using a vehicle speed control system helps to reduce the number of accidents that occur as a result of a driver's failure to respect roadside signboards in special

areas. Considering the automatic system is implemented near schools and hospitals regions, which allows the car to respond independently to slow down when the vehicle reaches a high speed, which actively and effectively reduces accidents caused by driver negligence. For the future, we suggest adding a timer with the power supply to the transmitter sensor and using an ultrasonic sensor so that the vehicle is stopped when people cross (a sensor that reduces the speed of the vehicle with the parking sensor).

REFERENCES

[1] Q. Chen, W. Zhao, L. Li, C. Wang, and F. Chen, "ES-DQN: A learning method for vehicle intelligent speed control strategy under uncertain cut-in scenario," *IEEE Transactions on Vehicular Technology*, vol. 71, no. 3, pp. 2472–2484, Mar. 2022, doi: 10.1109/TVT.2022.3143840.

[2] Z. Chen, X. Wang, Q. Guo, and A. Tarko, "Towards human-like speed control in autonomous vehicles: A mountainous freeway case," *Accident Analysis and Prevention*, vol. 166, 2022, doi: 10.1016/j.aap.2022.106566.

[3] L. A. Barbosa, D. C. Costa, and H. C. de Oliveira, "Evaluation of low-cost GNSS receivers for speed monitoring," *Case Studies on Transport Policy*, vol. 10, no. 1, pp. 239–247, Mar. 2022, doi: 10.1016/j.cstp.2021.12.005.

[4] S. A. Prakash, R. A. Mohan, R. M. Warrier, R. A. Krishna, A. S. Bhaskar, and A. K. Nair, "Real time automatic speed control unit for vehicles," in *Proceedings of the International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)*, I-SMAC 2018, Aug. 2019, pp. 157–161, doi: 10.1109/I-SMAC.2018.8653721.

[5] A. Vengadesh and K. Sekar, "Automatic speed control of vehicle in restricted areas using RF and GSM*," International Research Journal of Engineering and Technology*, vol. 2, no. 9, pp. 875–877, 2015, [Online]. Available: www.irjet.net.

[6] J. Tsuchiya, M. Hayashi, and R. Kohno, "Platoon characteristics of automatic vehicle speed control for vehicles equipped with DS-UWB radar," in *2010 IEEE 11th International Symposium on Spread Spectrum Techniques and Applications*, Oct. 2010, pp. 125–130, doi: 10.1109/ISSSTA.2010.5653334.

[7] Y. H. Lee, "Automatic speed control system for vehicle approaching and driving on a curve," in *Volume 17: Transportation Systems*, Jan. 2008, vol. 17, pp. 345–353, doi: 10.1115/IMECE2008-68343.

[8] A. Sathyapriya, K. Sathiya, T. M. Sneha, D. R. Raja, and T. Manikandan, "Automatic speed control system in vehicles using VANET," in *Advances in Intelligent Systems and Computing*, vol. 1163, 2021, pp. 719–726.

[9] C. Lin, X. Yu, M. Zhao, J. Yi, and R. Zhang, "Collaborative control of novel uninterrupted propulsion system for all-climate electric vehicles," *Automotive Innovation*, vol. 5, no. 1, pp. 18–28, Feb. 2022, doi: 10.1007/s42154-021-00170-0.

[10] Y. Wu, S. Li, Q. Zhang, K. Sun-Woo, and L. Yan, "Route planning and tracking control of an intelligent automatic unmanned transportation system based on dynamic nonlinear model predictive control," *IEEE Transactions on Intelligent Transportation Systems*, vol. 23, no. 9, pp. 16576–16589, Sep. 2022, doi: 10.1109/TITS.2022.3141214.

[11] M. Lungu, "Backstepping and dynamic inversion control techniques for automatic landing of fixed wing unmanned aerial vehicles," *Aerospace Science and Technology*, vol. 120, p. 107261, Jan. 2022, doi: 10.1016/j.ast.2021.107261.

[12] R. S. Ganesh, S. A. Sivakumar, V. Nagaraj, G. K. J. Hussain, M. Ashok, and G. T. Selvi, "Internet of things-based design of smart speed control system for highway transportation vehicles," in *Lecture Notes in Networks and Systems*, vol. 213, 2022, pp. 257–272, doi: 10.1007/978-981-16-2422-3_22.

[13] R. Senthilkumar, T. D. Prakash, A. Kannan, S. Selvaprasath, and P. T. Karthikrajan, "Embedded system for automatic vehicle speed control and data analysis using python software," *Journal of Control System and Control Instrumentation*, vol. 5, no. 2, pp. 14–20, 2019, doi: 10.5281/zenodo.3048906.

[14] G. Sattibabu, B. V. V Satyanarayan, and V. V. S. Kona, "Automatic vehicle speed control with wireless in-vehicle road sign delivery system using ARM 7," *International Journal of Technology Enhancements and Emerging Engineering Research*, vol. 2, no. 8, pp. 32–34, 2014.

[15] S. Sathiskumar, G. V. Navean, R. H. Prakash, and S. V. Praveen, "Automatic vehicle speed control system in a restricted zone," *International Journal of Scientific and Technology Research*, vol. 9, no. 2, pp. 2207–2210, 2020.

[16] A. M. Amulya, "Intelligent speed control system," *Volume*, vol. 5, no. 4, pp. 2537–2540, 2018.

[17] V. Niranjane and P. Mandavgade, "Automatic vehicle speed control system using zigbee technology," *Mandavgade International Journal of Electronics, Electrical and Computational System IJEECS ISSN 2348-117X*, vol. 6, no. 3, 2017.

[18] Amarnarayan, C. Saikumar, C. Mohan, Ajaykumar, and N. Sridhar, "Automatic over speed controlling of vehicle," *International Journal of Combined Research & Development (IJCRD)*, vol. 5, no. 5, pp. 706–709, 2016.

[19] M. K. Rout, *et al.* "PID controller design for cruise control system using genetic algorithm." 2016 international conference on electrical, electronics, and optimization techniques (ICEEOT). IEEE, 2016.

[20] M. Zaihidee, Fardila, S. Mekhilef, and M. Mubin. "Robust speed control of PMSM using sliding mode control (SMC)—A review." Energies vol.12 no.9. 2019.

[21] S. Gavhale, S. R. Kewate, S. V Karmare, and N. Sayankar, "Automatic speed control system by the color sensor for automobiles-an innovative model-based approach," *International Journal of Advanced Mechanical Engineering*, vol. 4, no. 2, pp. 223–230, 2014, [Online]. Available: http://www.ripublication.com/ijame.htm.

[22] Wang, Ziran, G. Wu, and M. J. Barth. "A review on cooperative adaptive cruise control (CACC) systems: Architectures, controls, and applications." 2018 21st International Conference on Intelligent Transportation Systems (ITSC). IEEE, 2018.

[23] Makridis, *et al.* "Empirical study on the properties of adaptive cruise control systems and their impact on traffic flow and string stability." Transportation research record 2674.4 (2020): 471-484.

[24] S. L. Comte, *Response to automatic speed control in urban areas: A simulator study*. Institute of Transport Studies, 1996.

[25] H. Takahashi, "Automatic speed control device using self-tuning fuzzy logic," in *1988., IEEE Workshop on Automotive Applications of Electronics*, 1988, pp. 65–71, doi: 10.1109/aae.1988.47596, doi: 10.1109/aae.1988.47596.

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