Robotics project 1st Term Writing report

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ABSTRACT Throughout this first installment was achieved the creation and implementation of the first prototype of our autonomous car, in which advances were made in the design of the structure for the optimization of space, movement and safety of it, in addition to that, the movement was achieved through wired control via arduino.

I. INTRODUCTION

Throughout this project we started to develop the prototype for the implementation of our autonomous car prototype, so in this first installment we mention the proposals that currently exist for this topic and comparing it with our ideas we have for our project, we list the materials that were used, in addition to the reason for this selection, the results we obtained when we made the first advance of the prototype and a brief conclusion on the analysis of what was achieved, what was not achieved and what we will seek to change or implement in a different way.

II. State of art

A. Why to choose this application?

A total of 38,824 people died in motor vehicle crashes in 2020. The U.S. Department of Transportation's most recent estimate of the annual economic cost of crashes is $242 billion.

Contributing to the death toll are alcohol, speeding, lack of seat belt use and other problematic behaviors. [1]

Pros and Cons of Autonomous Cars	
Pros	Cons
Accident reduction: Most accidents are caused by human errors. Mobility for all: People who can't drive for any reason (old age, sight problems, etc) would be able to transport. Less traffic: Efficient conduction would improve the overall mobility. Confort: The passengers in the vehicle won't have to do any effort in order to transport.	Insurance problems: When accidents do happen, who is to blame? Price: Since the technology will be more advance, these type of vehicles could have expensive prices Faculty loss: If we don't need to drive we will start losing those skills.

B. Current Implementations

FIGURE 1. **Tesla Model S.**

FIGURE 2. **Audi A8.**

This type of vehicles count with automatic pilot which allows them to:

- Controlling critical functions of driving on a freeway, overtaking a car or taking an exit.

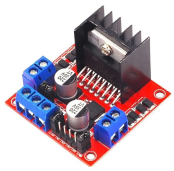
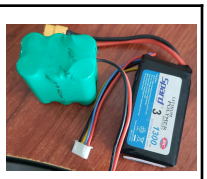
- Automatically activates safety settings when it detects certain traffic, road or environmental situations.
- The driver can stop supervising the car for extended periods of time.

C. Compare how these solutions differ from your own work and which ideas you are using from them.

The main difference between the solutions in the market and our solution is the reach of our solution, in this case, we're bringing a prototype that could be implemented within Tec campus Querétaro, in the electric train they have in the installations. The ideas we're using from them is mostly recognition of a specific set of images, in this case, the recognition of traffic lights and other signals found in the road such as stop signs, u-turns, right turns and left turns.

III. Materials and Methods

A. Materials

Material	What was used for?	Image
MDF	For the structure of the prototype	
4 Couplers for the wheels	To support the wheels to the motors	
4 motor supports	To support the motors to the structure	
2H Bridge L298	To allow the movement of the motors in both directions, both in forward and reverse.	
1 Arduino MEGA	To be able to control the movement of the motors.	
2 Li-Po rechargeable batteries (7.2V and 11.1V)	To supply energy to the motors.	
1 Sealed lead acid battery 12Vcc	Not used yet	
1 RPLIDAR: (with charger and serial connector)	Not used yet	
1 Nvidia Jetson Xavier Nx Ki	Currently, it is not implemented in the robot but is used to: save images collected using the camera, make the robot ready when it is powered, and host the ROS master.	
Camera web Logitech	To get images that we will use to train the AI, which will identify traffic signs.	
Joystick	To allow user input to determine the direction of the moment.	

B. Methods

a. The experimental setup you intend to use to test your project.

Given the budget, scale, and time limitations, the experimental setup to test our project will be conducted in a controlled, closed environment. We intend to test its efficacy in identifying and acting according to different traffic signals and obstacles while moving in a straight line.

b. The software you need or you use or you are planning to use for your project.

The project will be built with different software, programming languages, and libraries, which the main components are:

Arduino: It receives the movement instructions and sends them to drivers, so the motors move accordingly.
Python: It will be our primary High-level programing language because of its simplicity and the range of libraries we will use.
ROS: It will be used as the communication channel between the software.
XML: It will be used to define ROS launchers, which will be executed automatically when the robot is powered.
OpenCV: It will capture the images from the camera and, depending on the architecture used in the AI, may be used to deploy our model.
Pytorch: This library will be used to train a Yolo model to recognize multiple traffic signs simultaneously while having low latency.
TensorFlow: It will be used to build simpler models than Yolo so that the model will be faster, but with the downside, it will recognize only one signal in the picture.

IV. The theoretical tools, equations, algorithms, methodologies you are using or planning to use to solve your problem

A. Traffic signs recognition.

This section will have three approaches, depending on the test's time and observed behavior.
First, some Combolutiinal Neuronal Network will be trained using Kaggle datasets such as "GTSRB - German Traffic Sign Recognition Benchmark" and transfer learning. Different architectures will be tested, such as GoogLeNet, VGGNet, ResNet, and SENet.
Secondly, a RNN(Recurrent Neural Network) or GRU(Gated recurrent unit) will be implemented if in the test of the first approach, we identify a sporadic recognition of the traffic signs and it interferes with the desired behavior of the robot.
Thirdly, if required, we will implement a version of a Yolo to localize the position of the signs in the image and recognize multiple signals in the same picture.

B. Navigation while avoiding obstacles.

To evade obstacles SLAM(Simultaneous Localization And Mapping) will be implemented using lidars. And to secure the desired movent, a PID will be used to guarantee the correct control of the motors.
The commands coming from the SLAM and the signal recognition coming from the model will be sent to a control module which will act according to the input while giving priority to the signal recognition.

V. Annexes with source code, electronic diagrams and mechanics diagram

The ROS package, software (python and Arduino)and documentation of it can be found in our git https://github.com/AlexGarciaG/vistech that will be updated as new software is created and tested.

A. Mechanical diagram

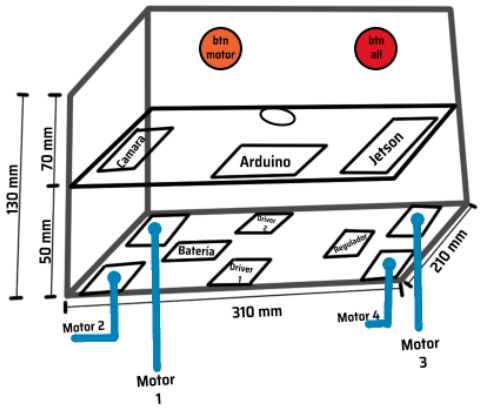


FIGURE 3. **Mechanical diagram of component distribution.**

B. Electric diagram

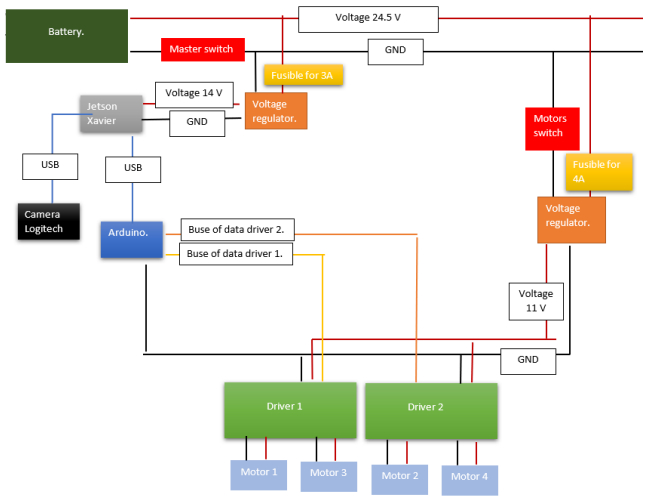


FIGURE 4. **Proposed electric diagram for the project.**

VI. CONCLUSION

Alexis García Gutiérrez

During the project's first phase, I learned the importance of having a backup of the project so that we could recover the code and recreate the working environment as soon as possible. Also, I comprehended the importance of having a solid structure and organized installation with diagrams and labels, so anyone can work with the robot or recognize and fix any failure it may have.

Furthermore, I identified some opportunities for the project: a better assembly between the motor and the robot

base, implementing the designed circuit diagram, implementing the port for the battery, and enhancing the aesthetics of the robot.

Laura Aylín Rivero López

During the development of this project we faced some challenges, and we learned the importance of having backup for your code, as well as an ordered work structure. We were able to test more than one approach to the requirements we needed to meet and we gained a deeper understanding of the technologies that we are using.

Rodrigo Gutiérrez Alvarez :

During the construction of this prototype we could see the importance of having a good notion of spacing within the structure. As well we were capable of using previous code thanks to a good documentation in order to understand the code and being able to adapt it to our needs. At the moment of showing our progress, we saw some areas of opportunities for changing within the structure to ensure a good mechanic operation.

Mónica Jimena Juárez Espinosa

During the construction of the prototype and the development of this first term, I was able to notice several things, as well as learn new ones. I learned that I have to let my colleagues help me even though I want to do everything myself, and that it is not wrong to ask for help from others. I also learned how to use other tools and get closer in the development of the structure. We learned that it is not always good to rely on familiar devices and to back up our projects, but we also learned how to handle together a problem quickly and efficiently.

Paul Ponce Pérez

Throughout the realization of this first prototype I realized the importance of having good documentation both at the time of wiring and at the time of programming, the structure and planning of the base are also of utmost importance and we realized that unexpected situations can occur, so having a backup is essential.

REFERENCES

[1] "Fatality Facts 2020: Yearly snapshot," IIHS-HLDI crash testing and highway safety, 2020. https://www.iihs.org/topics/fatality-statistics/detail/yearly-snapshot (accessed Sep. 18, 2022).

[2] "PRESENTA INEGI LA GEORREFERENCIACIÓN DE ACCIDENTES DE TRÁNSITO EN ZONAS URBANAS," INEGI.ORG, Nov. 22, 2021. https://www.inegi.org.mx/contenidos/saladeprensa/boletines/2021/accidentes/ACCIDENTES_2021.pdf (accessed Sep. 17, 2022).

[3] N. de, "Accidentes de tránsito," Inegi.org.mx, 2022. https://www.inegi.org.mx/temas/accidentes/#Informacion_general (accessed Sep. 18, 2022).

[4] "Comisión Nacional de Seguridad," Cns.gob.mx, 2013. http://www.cns.gob.mx/portalWebApp/appmanager/portal/desk?_nfpb=true&_pageLabel=portals_portal_page_m2p1p2&content_id=830068&folderNode=830052&folderNode1=810277 (accessed Sep. 18, 2022).

[5] "Conoce las diversas causas que provocan accidentes viales," Conductavialqualitas.com.mx, 2017. https://conductavialqualitas.com.mx/estadisticas.php (accessed Sep. 18, 2022).

[6] "ventajas-desventajas-coches-autonomos," Toyota ES, 2022. https://www.toyota.es/world-of-toyota/articles-news-events/ventajas-desventajas-coches-autonomos#:~:text=Cuando%20los%20coches%20aut%C3%B3nomos%20conquisten,la%20tasa%20de%20alcoholemia%2C%20etc (accessed Sep. 18, 2022).