WGU C951

Task 3

MACHINE LEARNING PROJECT PROPOSAL

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# A. Project Overview

My proposed solution is a smartphone app with machine learning AI that will assist in diagnosing issues with automobiles. The app will be downloadable to any up-to-date smart device that has a camera and a microphone. An optional diagnostics tool will be available for purchase and will read check engine light errors.

# A.1. Organizational Need

Our company spends much too much time trying to diagnose car issues without being there in person. Over 78% of our manhours goes to simply diagnosing problems. We need an automatic way to assist our customers issues so that more time can be spent actually helping the repair process.

# A.2. Context and Background

The only thing everybody here in the US seems to own is a car. The auto repair industry is huge, making more than $6.5 billion dollars in revenue each year. People have no choice but to continue to dish out more and more money to repair their car. That’s why our company, The DIY Fly Co., was created and is thriving. While the company is doing great with our automated chat bots, instant customer phone support, and step by step guides online – the demand for each car’s problem diagnosis and fix is overwhelming. More than 78% of our representatives’ time is used just to diagnose the problem. Even then, a misdiagnosis can be devastating to productivity and the process must be started over again.

# A.3. Outside Works Review

1. There is an app that can be downloaded on Android and Apple devices as of today that uses a combination of the phones microphone and GPS to identify birds based on the sounds they make. “This app lets you record a file using the internal microphone of your Android or iOS device and an artificial neural network will tell you the most probable bird species present in your recording.” (BirdNet.edu, 2021) The AI will use the phone’s location to limit the search to birds that inhabit the area, and then use the sound to identify which bird it may be. This will reinforce the AI’s learning algorithm if found or may teach the AI that a bird may be able to migrate somewhere new, or may just have a new entry for bird species.

This is important for the proposed AI app, because the sound that a car makes can sometimes completely diagnose the issue. If AI can be used to identify bird sounds that can sound very similar, then our app can be used to determine what the likely cause of a sound is.

2. “Here we share our approach to automatic Vehicle Identification Number (VIN) detection and recognition using Deep Neural Networks. Our solution is robust in many aspects such as accuracy, generalization, and speed, and can be integrated into many areas in the insurance and automotive sectors.” (Smoleń & Bulanda, 2021) GrapeUp.com reviews how software developers are finding new ways to read VIN codes. Their AI learns how to read the VIN number with more accuracy than other methods. While this app’s purpose is to validate reading text, it is obvious that DIY Fly Co. could benefit from this technology. Users could capture their VIN number, and the DOL’s database will let us know the exact make, model, and options this car originally came with.

3. An available resource that we could implement in this very project could of course include Google Lens. “Google Lens is an AI-powered technology that uses your smartphone camera and deep machine learning to not only detect an object in front of the camera lens, but understand it and offer actions such as scanning, translation, shopping, and more” (Hall, 2021)

Google Lens is a powerful tool that is available for free on current app markets. It uses deep machine learning to identify everyday objects or suggest a place to shop for related items. In our application, we would only be searching for cars and car parts.

# A.4. Solution Summary

The solution is an app that will recognize cars make, models, options, and parts. The app will use sound and image to get an instant idea of what type of car it is and what sounds coming from it could be potential issues. The AI will learn different parts and will eventually be able to know what a part looks like and if there are any observable issues.

# A.5. Machine Learning Benefits

Machine learning will deeply influence how the app is made and its effectiveness. The more cars that it observes, the more it will be able to recognize what the car is supposed to look like versus how the car currently is. It will use neural networks to eliminate unprovable issues. It will be able to learn what specific problems presented will lead to the current conditions.

# B. Machine Learning Project Design

# B.1. Scope

To be included in this project:

* Design an app downloadable by customers that will record videos and send it to an AI Machine server.
* Develop a method that will identify what the make and model of the user’s car.
* Establish a deep machine learning algorithm to identify visuals and sounds of car parts, and identify what is missing or unlike the other similar car parts.

Not included in this scope is an actual given solution or step-by-step guide of how to repair the vehicle. This app will only be designed to help diagnose the problems. This information will be sent to customer service where they can make a final call of what the problem may be and how to fix it.

# B.2. Goals, Objectives, and Deliverables

Goals

* Assist customer service by cutting down on diagnostic times.
* Relieve stress from the customer by eliminating the need for technical knowledge of automotive and describing symptoms.

Objectives

* Develop an app that will simplify diagnosis of car problems
* Create a machine learning algorithm that will learn parts from pictures and recordings.
* Only important information and probable causes are relayed to customer service.

Deliverables

* An app that will locally record video and stream the footage to an AI server.
* An AI server that will take the video and interpret what is being visualized.
* A database that will store general vehicle details and what parts it is built with.
* A large tree data structure that will contain all known issues possible at the leaf level.

# B.3. Standard Methodology

We will be using SEMMA methodology. SEMMA is very useful for business intelligence, but also for containing and organizing large amounts of data.

• Sample: This is the data gathering stage. This is where data is stored into partitions in an organized fashion. There is a lot of car types and issues, and initially there needs to be many entries for the AI to start off. The more data, the better – for as long as it is organized in the database effectively.

• Explore: The initial data has been inserted, now the AI will learn the relationships between issues and cars. The AI will try different combinations of issues with makes and models and see what makes sense and what doesn’t.

• Modify: Once the exploring stage is over, the AI will parse through what data is important and most relevant to the vehicles and their potential issues. It will take only what is necessary to identify the issue and remove all other information.

• Model: Now that the information has been simplified, it can be placed into the tree database structure. It will know if one problem starts, a string of leaflet issues could happen as well. It will be able to tell what the issue is with most vehicles at some node in this structure.

• Assess: The AI will start with the very basic issues that could take place, and from there it will use process of elimination to find the diagnosis. The AI will move in logical steps and iterate down branches of the tree. It will know when the problem could not possibly be under a certain branch, and so it will back up and start on the next branch.

# B.4. Projected Timeline

10/22/21 – The proposal is accepted, and design period begins. Database design begins. Contract for using Google Vision AI and API is made.

10/29/21 – The concept for the app is designed and begins development. Data begins being input into database. Developers begin incorporating image recognition into code to store data into database.

11/29/21 – The basic frameworks of the app are finished; the app is functional but with limited use. Debugging process begins. The designed AI is capable of parsing through data and using SEMMA to store information.

01/28/22 – The app is fully functional. The AI will recognize what is presented to it and identify it. If not recognized, the AI will learn more information about the part and store it into the database. The database is organized in such a way that searches are quick and have little redundancy. Advertising and beta testing begin.

02/15/22 – The app is complete. The app is uploaded to Google Play and Apple Store and is available for download for most modern Android and iOS devices.

**Sprint Schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sprint** | **Start** | **End** | **Tasks** |
| 1 | 10/22/21 | 10/29/21 | Contracting, Database design. |
| 2 | 10/29/21 | 11/29/21 | App design, API incorporated with AI. |
| 3 | 11/29/21 | 01/28/22 | App functionality, AI learning |
| 4 | 01/28/22 | 02/15/22 | Testing, Debugging, QA |

# B.5. Resources and Costs

|  |  |  |
| --- | --- | --- |
| **Resource** | **Description** | **Cost** |
| Google Vision, API, and Cloud Host | Backbone of the app, needed before any sort of AI integration can begin | $1800  $60-100/mo |
| Android Development | Predictive amount of man hours to be spent: 100 Hours | $4500 |
| Database Structure Design | Predictive amount of man hours to be spent: 30 hours | $1350 |
| Implementation of Database to API | Predictive amount of hours: 80 | $3200 |
| AI Development | Predictive amount of hours: 120 | $6000 |
| Maintenance and testing | Quality assurance, fixing bugs, database management | $500-2400/mo |
|  | **Total** | $16,850 upfront  $560-2500 monthly |

# B.6. Evaluation Criteria

|  |  |
| --- | --- |
| **Objective** | **Success Criteria in One Year / Two years** |
| Successful Identification of parts | 50% of all attempts / 75% of attempts. |
| Successful Diagnosis | 20% of attempts / 30% of attempts |
| Accurate learning and storage of new parts | 60% of new parts / 80% of new parts |
| Technician time used to diagnose customer issues | < 50% of work hours / < 30% of work hours. |

# C. Machine Learning Solution Design

## C.1. Hypothesis

DIY Fly Co. spends many hours trying to diagnose issues over the phone or over very uninformative photos. The company will benefit from a mobile app by implementing AI to identify parts of a car and what issues it may be experiencing. This will result in a reduction of technician time to diagnose a problem, more time to guide a solution/fix to the problem, thus allowing for a larger flow of customers.

# C.2. Selected Algorithm

Classification/Regression trees will be used as a data structure that will allow the AI to access information quickly. This will separate parts into different categories so that it will be easier to identify what part is being presented to the AI.

# C.2.a Algorithm Justification

When searching the database, all data will be partitioned into classifications. Since each car is made from parts, it is possible to piece together a vehicle by selecting the appropriate parts to make a certain make and model. If all of parts are sorted into their classifications, this will allow the AI to find parts quickly. It will also benefit humans when they need to view or alter a part.

# C.2.a.i. Algorithm Advantage

This algorithm works well because there are many ways to search for parts. SQL can be used to quickly search for parts within a table. If the list of parts is large, then there are linear, binary, regressive, sublist, and many other kind of searches for the algorithm to use. The type of search will be based on how many variants of the same parts there are.

E.g. motors are shared amongst many different vehicles, so a linear or binary search may be all that is needed to identify the engine. However with parts such as exhaust systems, these will vary not only on each vehicle model but also what trim the model is. This type of search would greatly benefit from a regressive search.

# C.2.a.ii. Algorithm Limitation

A large setback of the Classification/regression tree approach is the potential redundancy in parts. Since many different makes and models of cars share the same parts, it is possible that a new entry for the part would be added as a new part under that car rather than selecting the part from the parts classification partition.

The chosen algorithm may be limited by speed of identification as the database grows. If parts are not able to be classified even further this will drastically increase the search time. For example, an alternator can be identified easily – but there are dozens of parts that make up an alternator that are not common with other alternators. This will add data very quickly to the database.

A potentially more effective algorithm may be clustering algorithm. The AI would learn to guess what a part is by identifying what it is around. This would take significantly more programming and database storage, but the speed of identification would be much greater than that of the classification/regression tree algorithm.

# C.3. Tools and Environment

We will be using Google Vision – a image identification service. Though Vision is used for much more than just auto parts, this decision was made because the monthly charges are very low compared to the cost of developing an image identification for auto parts only. The API for Vision will also be licensed, and finally for simplicity’s sake and for ease of use, we will also be using Google’s Cloud services. If there are any bugs or errors, we will have direct customer service all from one place. Google’s API is guaranteed to work with Vision and its Cloud service.

The app will be built for Android and iOS. Java/Kotlin will be used to develop the app, along with all the necessary libraries that will be supplied by google. The app and database structure will entirely be built by our developers.

# C.4. Performance Measurement

Performance will be evaluated by how quickly and accurately the AI is able to identify the auto part. It will also be measured on how accurately a new part is added. All new parts added to the database will be checked for accuracy by a technician, but this will allow us to see how well the AI is identifying parts. This learning algorithm can be tweaked as needed to get it to the correct evaluation criteria in Section B.6.

# D. Description of Data Sets

# D.1. Data Source

The data will be extracted from the pictures and videos that are taken via the designed app. The data will then be sent to the AI servers where it will then undergo data transformation and the AI will be able to identify the parts that it sees.

# D.2. Data Collection Method

The users will aim their camera at whatever parts they think are relevant. These images will be sent to the AI server for processing and identification by using Google Vision. Once the type of parts is identified by Vision, then the AI will use the database to determine what exact part is used based on how it looks, sounds, and what the car make, and model is. If there is no match, a new part will be entered into the database. O

# D.2.a.i. Data Collection Method Advantage

This approach will allow the AI to effectively identify what parts are being shown and can confirm with the database or add a new entry into the database. The AI has the ability to identify parts and learn from images and sounds.

# D.2.a.ii. Data Collection Method Limitation

If Google Vision is unable to interpret what it is seeing, then the AI will be completely unable to function. The AI needs to be able to know at what category it should search to find the correct part. Another issue is if Vision is also unable to accurately identify what it is looking at. The AI could become confused and try to insert a new part into the database where it does not belong. This is why the technician verification of each newly added part is important and may cost some time.

# D.3. Quality and Completeness of Data

Once Google Vision has given the AI server what type of part it being shown, then the AI will search for the parts from the category/regression tree database. Once found, the AI will build what parts the car is supposed to be made of. Once the diagnosis process is finished, the user’s car will be saved as a single entity in the database under a “Client’s Vehicles” classification. If the AI has identified a new part, the new part will have its shape, sound, and location saved to the database along with what make and model of car it came from. From there, the technicians can confirm the part and add information if needed about its specifications.

# D.4. Precautions for Sensitive Data

Describe behaviors when working with communicating about sensitive data.

Google Vision can identify much more than vehicle parts, but the AI will be programmed to only extract information if the image reveals a car part. No data will be acknowledged or saved to preserve privacy.

The user will have to agree to the EULA that will allow DIY Fly Co. to save the car’s make, model, and parts data for further assistance and machine learning. Information such as license plate, VIN number, or owner details will not be recorded.

# References

Doshi, K. (2021, May 21). Audio Deep Learning Made Simple: Sound Classification, step-by-step. Retrieved October 3, 2021, from <https://towardsdatascience.com/audio-deep-learning-made-simple-sound-classification-step-by-step-cebc936bbe5>

Industry Market Research, Reports, and Statistics. (2021, September 27). Retrieved October 3, 2021, from https://www.ibisworld.com/industry-statistics/market-size/auto-mechanics-united-states/#:~:text=The market size, measured by,is $65.8bn in 2021.

Smoleń, D., & Bulanda, D. (2021, January 12). Leveraging AI To Improve VIN Recognition. Retrieved October 3, 2021, from <https://grapeup.com/blog/leveraging-ai-to-improve-vin-recognition/>

Hall, C. (2021, April 01). What is Google Lens and how does it work? - Pocket-lint. Retrieved October 3, 2021, from https://www.pocket-lint.com/apps/news/google/141075-what-is-google-lens-and-how-does-it-work-and-which-devices-have-it