MIT-ADT UNIVERSITY

PUNE, INDIA

A leap towards World Class Education

A PROJECT REPORT ON
"AI CAR SIMULATION"

SUBMITTED BY -

ABHISHEK TEKAVADE (2203003)

VINCE FRANCIS DSOUZA (2203221)

TANUJ SINHA (2203046)

AADITYA NAIR (2203391)

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MINI PROJECT III – SEM V

ACKNOWLEDGEMENT

Words fall short to express our deep sense of gratitude towards them all who have imparted their valuable time, energy and intellect towards the beautification of our Mini Project entitled as, **"AI CAR SIMULATION".**

It gives us great pleasure in presenting this report. Its justification will never sound good if we do not express our vote of thanks to **Prof. Abhishek Das** for her great help and guidance.

Last but not least, we are very thankful to all our colleagues for their immense encouragement for the successful completion of the project. We hope that the project will serve its purpose for which it is developed, thereby underlining the success of the process.

By: -

Abhishek Tekavade (2203003)

Vince Francis Dsouza (2203221)

Tanuj Sinha (2203046)

Aaditya Nair (2203391)

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CHAPTER 1

INTRODUCTION

1.1 Ai Car simulation

In today's era, we all are aware of our daily changing requirements and the need to be entertained as this world is full of tasks and jobs.
In new emerging games, we can share information and can be connected to more people like us.
Online Gaming via this interface makes us elevate from being digitally literate to digitally fluent, collaborate using appropriate virtual tools and systems that are cost-effective and environment friendly too.
As a result, putting our efforts into this application, we are going to create "Retro Games".
This project conceptually integrates the experience of nostalgia—defined as a predominantly positive, social, and past-oriented emotion—into the fold of video game research. We emphasize the role of nostalgia as an explanation for contemporary retro gaming trends, and suggest that nostalgia towards gaming events is a necessary area of research. The tools within our website can include –

- Login
- Playing Games

Retro Games were very popular in the early 2000's. However, a lot of these websites were discontinued. Our main goal is to provide a touch of nostalgia to the generation that grew up playing these games, and also to let the new generation experience retro games! These games do not require large memory space or graphic specifications, which make them ideal for all kinds of PC owners.

Benefits:

- Provides the quickest and most efficient path to complete the course
- Replace repetitive tasks and routine jobs

1.2 Motivation behind the idea

The current self-driving technology relies on sensors and makes decision in real time to drive a car based on millions of hours of statistical data provided by human drivers.

We aim to create an add on software to this technology by creating a program which identifies repeated routes in our day-to-day life for e.g. home to workplace and vice versa and create an efficient input sequence in a virtual environment so we can optimize self-driving in routes we take on a daily basis. As we hope for a future where automation proceeds to an unimaginable degree, we believe this program to be our contribution to the development of self-driving cars

CHAPTER 2

LITERATURE SURVEY

Sr No.	Paper Name	Author	Year of Publication	objective	Methodology	conclusion
1	ARTIFICIAL INTELLIGENCE IN AUTONOMOUS VEHICLES - A LITERATURE REVIEW	VINYAS D. SAGAR	27/03/2019	Give an holistic views of an artificially intelligent vehicle and the different methods adopted	The following components have been used in this research paper • Fuzzy-Neural Vehicle Systems Control • Neural-Network-Based Virtual Sensors • Cascaded Neural Networks in Order to Recognize Traffic Signs	Artificial intelligence, especially neural networks, machine learning, and deep learning have become an absolute necessity to make autonomous vehicles function properly and safely. All these make the vehicles more efficient and does not pose a threat to neither the pedestrians nor the travellers, with advanced sensors and technology autonomous vehicles can predict what might happen and hence gather information to perform the necessary tasks. Autonomous vehicles also reduce distracted driving accidents to a great extent.
2	Bilateral Deep Reinforcement Learning Approach for Better-than-human Car-following	Tianyu Shi1 , Yifei Ai2 , Omar ElSamadisy1 , Baher Abdulhai	–	Deep Reinforcement Learning (DRL) framework for car-following control by integrating bilateral information into both state and reward function based on the bilateral control model (BCM) for car-following control	The following components have been used in this research paper • Centralized and decentralized learning framework • Markov Decision Process	Designed the bilateral deep reinforcement learning framework for car-following control. Also found that the framework has better performance than human driving models. It is the most effective perturbation damper among these models. Also, it is in the top place in other metrics, i.e., safety, efficiency, comfort.
3	Review of the State-of-the-Art of Brain-Controlled Vehicles	Amin Hekmatm Anesh, Pedro H J Nardelli	18/06/2022	It focuses on the most relevant topics on brain-controlled vehicles, with a special reference	The following components have been used in this research paper • Bio-signal patterns	They provide a systematic presentation of the most significant literature in the topic of BCV and BCAV from the past ten years
				to the terrestrial BCV and the aerial BCV, also called BCAV controlled by using bio-signals, such as electroencephalogram (EEG), Electrooculogram (EOG), and Electromyogram (EMG)	• machine learning • artificial intelligence simulator, • aerial vehicle.	

CHAPTER 3

PROBLEM STATEMENT & OBJECTIVES

PROBLEM STATEMENT –

The Problem Statement is *"The project purpose is to train a neural network to drive an autonomous car agent on the tracks."*

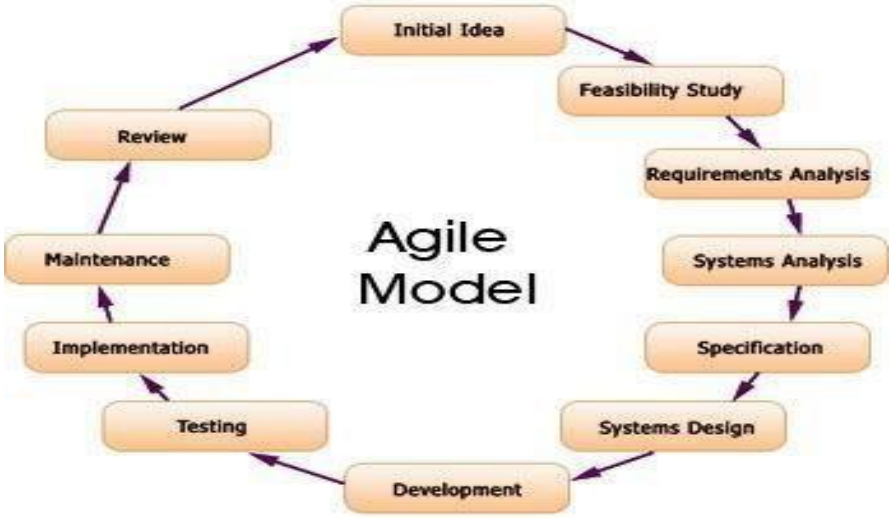
OBJECTIVES –

Self-driving cars have become a trending subject with a significant improvement in the technologies in the last decade. Ai will learn to control a racecar using NEAT -Neuro evolution of augmenting topologies and find the best possible inputs to finish the race in the shortest amount of time. NeuroEvolution of Augmenting Topologies (NEAT) is a genetic algorithm (GA) for the generation of evolving artificial neural networks (a neuro evolution technique)

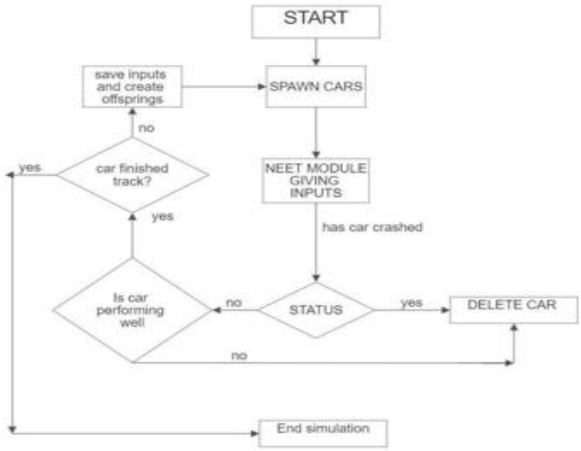
4.1 AGILE MODEL

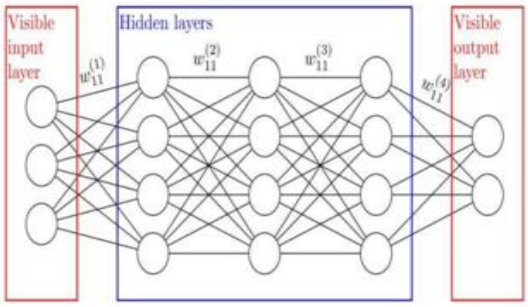
CHAPTER 4
SYSTEM ARCHITECTURE

Agile model is selected for the project. We are planning to implement the system with basic facilities only. So many future enhancements are possible with this model. Agile model can satisfy this requirement efficiently. Since it follows the plan-do-check-act for improvement, backtracking can be done easily in Agile model.



Agile modelling is a practice-based methodology for effective modelling and documentation of software-based systems. This can be applied on a software development project in an effective and light-weight manner. An Agile Model Driven Development (AMDD) approach enables high-level modelling at the beginning of a project to understand the scope and potential architecture of the system, and then during development iterations, it requires modelling as part of iteration planning activities and then requires just in time (JIT) model storming approach.


START
save inputs and create offsprings
SPAWN CARS
no
yes
car finished track?
NEET MODULE GIVING INPUTS
yes
has car crashed
Is car performing well
no
STATUS
yes
DELETE CAR
no
End simulation


Visible input layer
Hidden layers
Visible output layer

4.2 HARDWARE AND SOFTWARE REQUIREMENTS –

- **Hardware requirements-**

  Dual 2GHz+ CPU

  2GB+ RAM

  80MB database space

  1GB disk space.

- **Software requirements-**

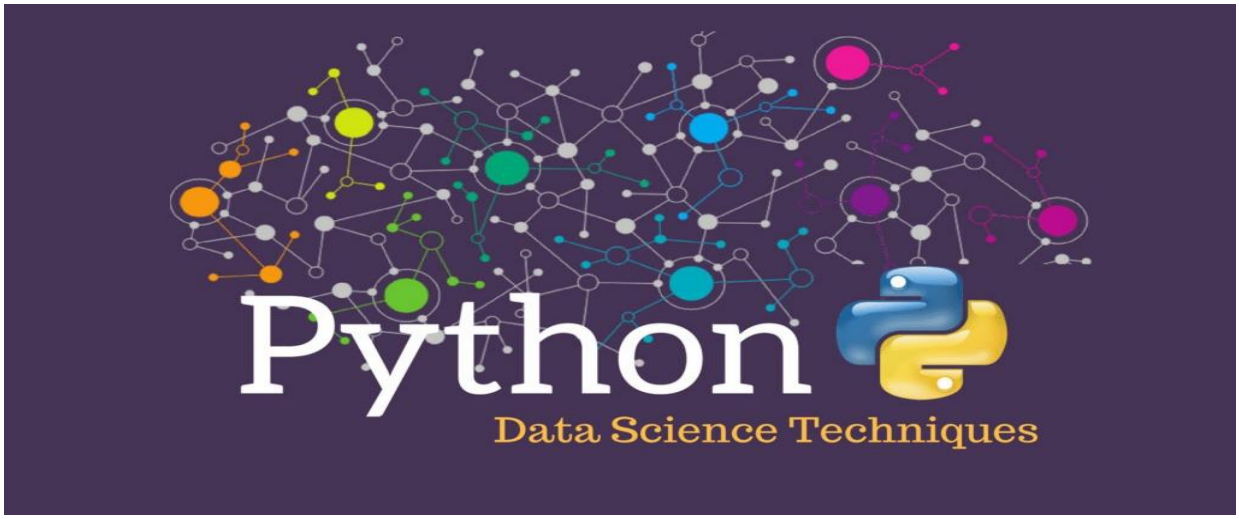
  Visual studio code/PyCharm

  Python idle

CHAPTER 5

TECHNOLOGIES USED

PYTHON, NEAT, AI



5.1 PYTHON

PYTHON is a high-level, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation

Python is dynamically-typed and garbage-collected. It supports multiple programming paradigms, including structured (particularly procedural), object-oriented and functional programing. It is often described as “batteries included” language due to its comprehensive standard library

Guido van Rossum began working on Python in the late 1980s as a successor to the ABC programming language and first released it in 1991 as Python 0.9.0. Python 2.0 was released in 2000 and introduced new features such as list comprehensions, cycle-detecting garbage collection, reference counting, and Unicode support. Python 3.0, released in 2008, was a major revision that is not completely backward-compatible with earlier versions. Python 2 was discontinued with version 2.7.18 in 2020.

Python consistently ranks as one of the most popular programming languages

5.2 NEAT

Neuroevolutionary of Augmenting Topologies (NEAT) is a genetic algorithm (GA) for the generation of evolving artificial neural networks (a neuroevolutionary technique) developed by Kenneth Stanley and Risto Miikkulainen in 2002 while at The University of Texas at Austin. It alters both the weighting parameters and structures of networks, attempting to find a balance between the fitness of evolved solutions and their diversity.

It is based on applying three key techniques: tracking genes with history markers to allow crossover among topologies, applying speciation (the evolution of species) to preserve innovations, and developing topologies incrementally from simple initial structures ("complexifying").

Traditionally a neural network topology is chosen by a human experimenter, and effective connection weight values are learned through a training procedure. This yields a situation whereby a trial-and-error process may be necessary in order to determine an appropriate topology. NEAT is an example of a topology and weight evolving artificial neural network (TWEANN) which attempts to simultaneously learn weight values and an appropriate topology for a neural network.

In order to encode the network into a phenotype for the GA, NEAT uses a direct encoding scheme which means every connection and neuron is explicitly represented. This is in contrast to indirect encoding schemes which define rules that allow the network to be constructed without explicitly representing every connection and neuron allowing for more compact representation.

The NEAT approach begins with a perceptron-like feed-forward network of only input neurons and output neurons. As evolution progresses through discrete steps, the complexity of the network's topology may grow, either by inserting a new neuron into a connection path, or by creating a new connection between (formerly unconnected) neurons.

5.3 AI

Artificial intelligence (AI) is intelligence—perceiving, synthesizing, and infering information—demonstrated by machines, as opposed to intelligence displayed by animals and humans. Example tasks in which this is done include speech recognition, computer vision, translation between (natural) languages, as well as other mappings of inputs.

Artificial intelligence was founded as an academic discipline in 1956, and in the years since has experienced several waves of optimism, followed by disappointment and the loss of funding (known as an "AI winter"), followed by new approaches, success and renewed funding. AI research has tried and discarded many different approaches since its founding, including simulating the brain, modeling human problem solving, formal logic, large databases of knowledge and imitating animal behavior. In the first decades of the 21st century, highly mathematical-statistical machine learning has dominated the field, and this technique has proved highly successful, helping to solve many challenging problems throughout industry and academia.

The various sub-fields of AI research are centered around particular goals and the use of particular tools. The traditional goals of AI research include reasoning, knowledge representation, planning, learning, natural language processing, perception, and the ability to move and manipulate objects. General intelligence (the ability to solve an arbitrary problem) is among the field's long-term goals. To solve these problems, AI researchers have adapted and integrated a wide range of problem-solving techniques – including search and mathematical optimization, formal logic, artificial neural networks, and methods based on statistics, probability and economics. AI also draws upon computer science, psychology, linguistics, philosophy, and many other fields

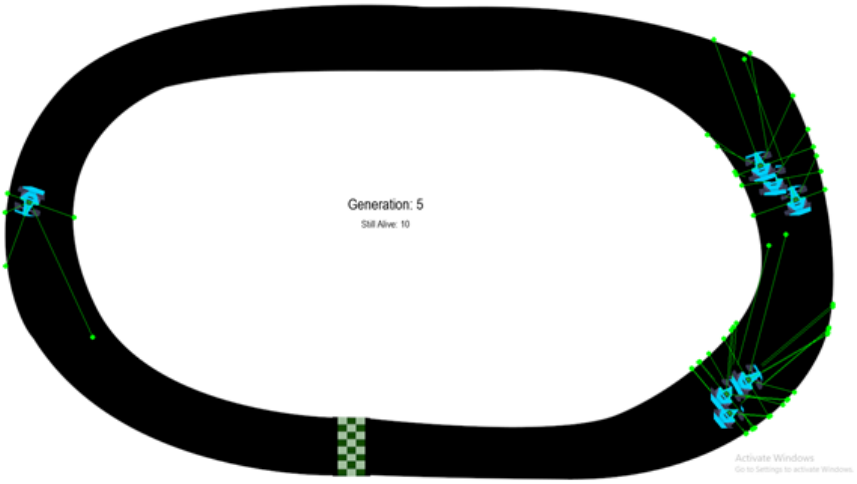
The field was founded on the assumption that human intelligence "can be so precisely described that a machine can be made to simulate it". This raised philosophical arguments about the mind and the ethical consequences of creating artificial beings endowed with human-like intelligence; these issues have previously been explored by myth, fiction and philosophy since antiquity. Computer scientists and philosophers have since suggested that AI may become an existential risk to humanity if its rational capacities are not steered towards beneficial goal.

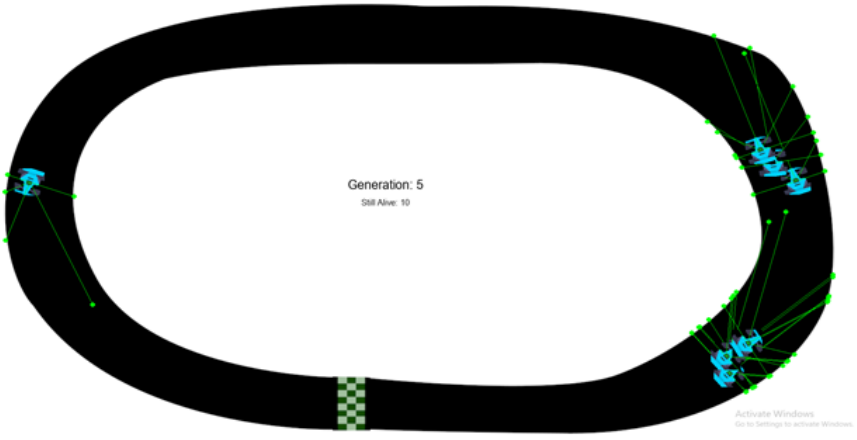
CHAPTER 6

PROJECT DETAILS

PROJECT IMAGES:

1-Race Course





2-Car details

```
****** Running generation 1 ******

Population's average fitness: 2233.49778 stdev: 10494.24698
Best fitness: 58660.00000 - size: (4, 20) - species 1 - id 17
Average adjusted fitness: 0.038
Mean genetic distance 1.138, standard deviation 0.207
Population of 30 members in 1 species:
   ID   age  size  fitness  adj fit  stag
  ====  ===  ====  =======  =======  ====
     1    1    30  58660.0    0.038     1
Total extinctions: 0
Generation time: 7.577 sec (7.844 average)
```

```
****** Running generation 9 ******

Population's average fitness: 218856.88000 stdev: 234475.43833
Best fitness: 480400.00000 - size: (4, 14) - species 2 - id 217
Average adjusted fitness: 0.456
Mean genetic distance 1.286, standard deviation 0.352
Population of 30 members in 2 species:
   ID   age  size  fitness  adj fit  stag
  ====  ===  ====  =======  =======  ====
     1    9    15  480400.0    0.508     5
     2    5    15  480400.0    0.403     4
Total extinctions: 0
Generation time: 24.845 sec (21.189 average)
```

7.1 FUTURE PROSPECTS

There are several future prospects to Ai Car Simulation. They are as listed below –

- The future prospect for our program builds upon the existing technology without replacing it like an add on which can identify repeated routes for eg. the route we take - home to workplace / workplace to home.
- Here our program can take control on the car once it has run its simulation and memorized the input sequence as long as the real time environment matches the limits of the virtual one.
- Once the limits are breached due to events like pedestrians, traffic etc. our program can hand control back to the existing real time software to prevent accidents.
- This way we can ensure a more efficient journey under close to ideal conditions
- Another application of our program is providing a visual Computer assisted driving presentation on the on-screen dashboard of the vehicle to guide the driver to use an efficient pathing based on the simulation data

CHAPTER 8

CONCLUSION

From the research conducted by us, several group discussions and our personal opinions, we would like to conclude our synopsis by saying that Self-driving cars aim to revolutionize car travel by making it safe and efficient some of the key components such as NEAT, cameras, and most importantly – the algorithms that make self-driving cars possible. While it's promising, there's still a lot of room for improvement. For example, current self-driving cars are at level-2 out of level-5 of advancement, which means that there still has to be a human ready to intervene if necessary.

THANK YOU!

REFERENCES

[1] M. Guo et al., "A decision-making method for unmanned cars based on drivable area cutting", 2012 IEEE 2nd International Conference on Cloud Computing and Intelligence Systems, pp. 1210-1215, 2012.

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Links –

- https://neat-python.readthedocs.io/en/latest/
- https://www.pygame.org/news