SCRUTINIZING MANIFOLD STIPULATIONS BY LINEAR KERNEL

A PROJECT REPORT

Submitted by

AKSHITHA RAVI [211418104015]

ANUSHIYA V [211418104022]

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

MAY 2022

PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

BONAFIDE CERTIFICATE

Certified that this project report **"SCRUTINIZING MANIFOLD STIPULATIONS BY LINEAR KERNEL"** is the bonafide work of "**AKSHITHA RAVI [211418104015] AND ANUSHIYA V [211418104022]"** who carried out the project work under my supervision.

SIGNATURE

Dr.S.MURUGAVALLI,M.E.,Ph.D.,
HEAD OF THE DEPARTMENT

DEPARTMENT OF CSE,
PANIMALAR ENGINEERING
COLLEGE,
NASARATHPETTAI,
POONAMALLEE,
CHENNAI-600 123.

SIGNATURE

Mrs.S.T.SANTHANALAKSHMI
SUPERVISOR
ASSISTANT PROFESSOR
(GRADE I)

DEPARTMENT OF CSE,
PANIMALAR ENGINEERING
COLLEGE,
NASARATHPETTAI,
POONAMALLEE,
CHENNAI-600 123.

Certified that the above mentioned students were examined in End Semester project viva-voice held on_____.

INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION BY THE STUDENT

We **AKSHITHA RAVI [211418104015]** AND **ANUSHIYA V [211418104022]** hereby declare that this project report titled "**SCRUTINIZING MANIFOLD STIPULATIONS BY LINEAR KERNEL**" , under the guidance of **Mrs. S.T.SANTHANALAKSHMI, ASSISTANT PROFESSOR (GRADE I)** is the original work done by us and we have not plagiarized or submitted to any other degree in any university by us.

1. AKSHITHA RAVI

2. ANUSHIYA V

ACKNOWLEDGEMENT

We would like to express our deep gratitude to our respected Secretary and Correspondent **Dr.P.CHINNADURAI, M.A., Ph.D.** for his kind words and enthusiastic motivation, which inspired us a lot in completing this project.

We express our sincere thanks to our Directors **Tmt.C.VIJAYARAJESWARI**, **Dr.C.SAKTHIKUMAR,M.E.,Ph.D** and **Dr.SARANYASREE SAKTHI KUMAR B.E.,M.B.A.,Ph.D.,** for providing us with the necessary facilities to undertake this project.

We also express our gratitude to our Principal **Dr.K.Mani, M.E., Ph.D.** who facilitated us in completing the project.

We thank the Head of the CSE Department, **Dr. S.MURUGAVALLI , M.E.,Ph.D.,**for the support extended throughout the project.

We would like to thank our **Project Guide Mrs. S.T.SANTHANALAKSHMI**, **ASSISTANT PROFESSOR (GRADE I)** and all the faculty members of the Department of CSE for their advice and encouragement for the successful completion of the project.

AKSHITHA RAVI

ANUSHIYA V

ABSTRACT

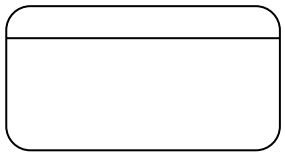
In the car manufacturing industry, the manufacturing and design of engines cannot be achieved successfully due to the different kinds of specifications which cannot be fulfilled by an engine designer. Despite, to accomplish a fitting engine configuration, it is crucial to get the right businessperson to suffice the needs of correct stipulations. We are proposing an algorithm describing linear svc to systematize the multiobjective obstacle of car stipulations using some classification model, then we analytically investigate the most suitable design for the engine through the specifications in various aspirations. We generated a recommendation platform to illustrate and understand the real-time high dimensional data of a car engine in the car manufacturing Industry. Our result betokens the multiple intentions of achieving the intended design by the car manufacturing firm. After obtaining the designs, then it assists to improve the manufacturing of cars fastly and achieving the vendor design correctly. The designs are shown in the state of the most gratifying specifications of the company design and even if the one design is dropped then with the help of linear svc we can achieve the second-best design and proceed with the process without a pause. It aids in settling the commitment at the right point. By employing this technology we can classify out the discontinuation of the manufacturing and as well as enhancing the performance of the classification of the designs rendered by the several kinds of the vendor.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

Symbols	Description
	A process that transforms the data flow
	Source or Destination of data
	Data flow

LIST OF ABBREVIATIONS

MOEA - Multi Objective Evolutionary Algorithms

ERD - Entity RelationshipDiagram

DFD - Data Flow Diagram

CSS - Cascading Style Sheets

JS - Java Script

MYSQL - Structured Query Language

DDR - Dynamic decomposition

PF - Pareto Front

PBI - Penalty boundary intersection

EMO - Evolutionary Multi Objective Optimization

DM - Decision Making

FR - Favourite Region

HSDC - Hyper Space Diagonal Counting

SD - State diagram

SVC - Support Vector Classifier

SVM - Support Vector Machine

CHAPTER 1
INTRODUCTION

1.1 OVERVIEW

Nowadays, the car manufacturing industry faces more demands delivering more cars within a short span and with good condition, so for a genuine car performance we must provide the best engine. The reliability of the manufacturing sector is to present the best engine for the car and also for a smooth-running engine the specifications must be fulfilled. The engineer presents the engine performance features and the manufacturing team provides the layout of the engine.So the design will have many specifications which need to be filled for the best performance. The vendor can upload the individual engine designs. Once the design is uploaded, the engineer inspects the designs of the various vendors and decides the best design by working on the multiobjective obstacle. But fitting the best design by succeeding the multiple specifications is challenging, as the specifications vary. To sort out this issue we implemented the linear SVC algorithm. We can acknowledge the best design and can assemble the specific engine from the selected vendor. This is not only for achieving the best design but is to visualize the whole process of car manufacturing where we can enhance efficiency for the completion. The purpose of this system includes finding the best design with in an efficient time, multi objective is achieved easily with numerous parameters,improving both sides is apparent and to retain the best design by overcoming pareto optimal fronts.

1.2 PROBLEM DEFINITION:

At present, the automobile industry is under more pressure to provide more automobiles in a shorter period of time and in good condition, therefore we must give the greatest engine for true car performance. The manufacturing sector's dependability is to deliver the best engine for the car, and requirements must be met for a smooth-running engine. The engine performance features are presented by the engineer, and the engine layout is provided by the manufacturing team. As a result, the design will include a number of specifications that must be filled in for the greatest results. Individual engine designs can be uploaded by the vendor. After the design is uploaded, the engineer examines the designs of the various vendors and selects the best design by utilizing the multiobjective obstacle. However, fitting the best design by meeting various standards is difficult because the specifications differ.The designs are displayed in the state of the most pleasing specifications of the corporate design, and even if one design is dropped, we may accomplish the second-best design using linear svc and continue the process without a halt. It assists in properly resolving the commitment.

CHAPTER 2
LITERATURE SURVEY

1. X. He, Y. Zhou, Z. Chen and Q. Zhang ”Evolutionary Many-Objective Optimization Based on Dynamical Decomposition”, 2019

Decomposition-based many-objective evolutionary algorithms generally decompose the objective space into multiple sub regions with the help of a set of reference vectors. The resulting sub regions are fixed since the reference vectors are usually predefined. When the optimization problem has a complicated Pareto front (PF), this decomposition may decrease the algorithm performance. To deal with this problem, this paper proposes a dynamical decomposition strategy. Instead of using predefined reference vectors, solution themselves are used as reference vectors. Thus, they are adapted to the shape of PF automatically. Besides, the subregions are produced one by one through successively bi-partitioning the objective space. The resulting subregions are not fixed but dynamically determined by the population solutions as well as the subregions produced previously. Based on this strategy, a solution ranking method, named dynamical-decomposition-based ranking method (DDR), is proposed which can be employed in the mating selection and environmental selection in commonly used algorithm frameworks.

2. Dong Han, Wenli Du, Wei Du, Yaochu Jin, Chunping Wu “An adaptive decomposition-based evolutionary algorithm for many-objective optimization,Information Sciences”,2019

Penalty boundary intersection (PBI) is one popular method in decomposition based evolutionary multi-objective algorithms, where the penalty factor is crucial for striking a balance between convergence and diversity in a high-dimensional objective space. Meanwhile, the distribution of the obtained solutions highly depends on the setting of

the weight vectors. This paper proposes an adaptive decomposition-based evolutionary algorithm for many-objective optimization, which introduces one adaptation mechanism for PBI-based decomposition and the other for adjusting the weight vector. The former assigns a specific penalty factor for each subproblem by using the distribution information of both population and the weight vectors, while the latter adjusts the weight vectors based on the objective ranges to handle problems with different scales on the objectives. We have compared the proposed algorithm with seven state-of-the-art many-objective evolutionary algorithms on a number of benchmark problems. The empirical results demonstrate the superiority of the proposed algorithm.

3. M. Jafari, L. Daryani and M. Feizi-Derakhshi, "A Prior Preference-Based Decision-Making Algorithm in Pareto Optimization", 2019

In the applications of real-life, the importance of having a flexible optimization algorithm is obvious. Commonly in these issues, Evolutionary Multi-Objective Optimization (EMO) algorithms and particularly Pareto optimization method as one of the most significant and useful classes have been used extensively. Often optimization algorithms that have used the EMO algorithm in their own as posteriori . In this paper, we propose a lightweight angle-based updating Pareto front (PF) algorithm which considers the preferences of desired objectives expressed using the Favorite Region (FR). Actually, the FR has been created in the objective space according to the prior-fixed angle of priority objectives. Thus, the solutions in PF will be able to tend towards FR during the evolutionary process. Consequently, other solutions that are not in the favorite region will not go away, but the Fronts levels of solutions via an update process will change rearwardly. The updating process in Pareto method, during the evolution process, causes that the solutions in the first and second fronts lead to the exploration and exploitation of appropriate solutions in the favorite regions with uniform

distribution for first Pareto Front, while the solutions' density in the undesirable region become impaired.

4. Y. Wan, H. Cui, Y. Liu and R. Cong, "A Visualization Framework of Pareto Optimization for Decision Making", 2020

Achieving the best tradeoffs is difficult when multicriteria involved. Pareto optimal is a common way to balance the multi-objective tradeoffs. However, when the number of criteria increases, it is difficult for users to make the decision since the balance is not that clear or intuitive. We propose a framework to visualize the Pareto optimization such that the tradeoffs are clearly seen and easily turned into decision. Since the number of criteria is large, we first divide the criteria into 2-pair groups. This could assist users to make better comparison. To obtain more broader view and make more correct decision, we divide the criteria into 3-pair groups and then visualize them with a 3D surface. Finally, with the case studies, it turns out our framework is useful for the multi-criteria decision making.

5. A. Brik, L. Labrak, L. Carrel, I. O'Connor and R. Iskander , "Fast extraction of predictive models for integrated circuits using n-performance Pareto fronts", 2019

Predictive models based on Pareto fronts are key tools to understand and leverage tradeoffs in electronic circuit and system design. However, their generation conventionally requires the extensive use of numerical simulation and multi-objective optimization methods, resulting in significant computational cost. This cost increases exponentially with the number of parameters, and visualization also becomes an issue as the number of performance metrics increases. In this paper, we present a method to extract predictive models efficiently for electronic subsystems based on Pareto fronts.

We use a very fast design and migration software called ID-Xplore™ to generate the performance space of sub-blocks in order to generate Pareto fronts for any block, thereby circumventing the traditional use of numerical optimization and thus accelerating the generation of Pareto-fronts for n-performance. We also combine the Pareto fronts in order to obtain one single Pareto front that represents all specifications, and use the Hyper-Space Diagonal Counting (HSDC) methodology to visualize n-performance Pareto fronts and combine the overall approach to help the designer in the final choice of optimal design points in the design of a state of the art OTA.

6. Xiao-Bing Hu; Hang Li; Jun Zhou; Ming-Kong Zhang; Jian-Qin Liao, "Finding all Pareto Optimal Paths for Dynamical Multi-Objective Path optimization Problems", 2019

Path optimization plays a fundamentally important role in computational intelligence and operational researches. Single-objective path optimization on static route network is often considered in theoretical research, but in reality, multiple objectives and dynamical routing environments make the problem much more complicated. In a multi-objective path optimization problem (MOPOP), there is usually not just one best path, but a set of Pareto optimal solutions, which together are important to decision-makers. Another challenge is dynamical routing environment, which makes it difficult even to find a single-objective best path. This paper puts multi-objective path optimization and dynamical routing environment together, and aims to develop an effective method to calculate the complete (not just a partial or approximated) Pareto front for MOPOP in dynamical routing environments. To this end, a novel nature-inspired method, so called ripple-spreading algorithm (RSA) is completely re-designed, in order to resolve the proposed problem with a theoretical optimality guarantee. Comprehensive experimental results clearly demonstrate the effectiveness and efficiency of the reported method.

7. Bejarano, Lilian A., Helbert E. Espitia, and Carlos E. Montenegro "Clustering Analysis for the Pareto Optimal Front in Multi-Objective Optimization", 2022

Bio-inspired algorithms are a suitable alternative for solving multi-objective optimization problems. Among different proposals, a widely used approach is based on the Pareto front. In this document, a proposal is made for the analysis of the optimal front for multi-objective optimization problems using clustering techniques. With this approach, an alternative is sought for further use and improvement of multi-objective optimization algorithms considering solutions and clusters found. To carry out the clustering, the methods k-means and fuzzy c-means are employed, in such a way that there are two alternatives to generate the possible clusters. Regarding the results, it is observed that both clustering algorithms perform an adequate separation of the optimal Pareto continuous fronts; for discontinuous fronts, k-means and fuzzy c-means obtain results that complement each other (there is no superior algorithm). In terms of processing time, k-means presents less execution time than fuzzy c-means.

8. Bin Wang, Xiong Han, Shijun Yang, Pan Zhao, Mingmin Li, Zongya Zhao, Na Wang, Huan Ma, Yue Zhang, Ting Zhao, Yanan Chen, Zhe Ren, Yang Hong & Qi Wang ,"An integrative prediction algorithm of drug-refractory epilepsy based on combined clinical-EEG functional connectivity features", 2021

Although the use of antiepileptic drugs (AEDs) is routine, 30–40% of patients with epilepsy (PWEs) experience drug resistance. Thus, early identification of AED resistance will help optimize treatment regimens and improve patients' prognoses. However, there have been few studies on this topic to date. Here, we try to establish an integrative prediction model of AED resistance for drug-naive PWEs, and to identify

the clinical and Electroencephalogram (EEG) factors that affect their outcomes. An integrative algorithm was modeled to predict AED resistance for drug-naive PWEs by SVM based on clinical characteristics and EEG functional connectivity values. The model had an accuracy of 94% [95% confidence interval (CI) 0.85–1.0], sensitivity of 95% [95% CI 0.82–1.0], specificity of 93% [95% CI 0.77–1.0], and an area under the curve (AUC) of 0.98 [95% CI 0.91–1.0]. The p values of accuracy, sensitivity specificity and AUC were calculated as 0.001, 0.001, 0.01 and 0.001, respectively. The δ band fromT4-FZ and T3-PZ, α band from T3-T6 and β band from F7-CZ and FP2-F3 were the top five EEG features that impacted the SVM classifier. We constructed an integrative prediction algorithm of AED resistance for drug-naive PWEs.

9. Boniphace Kutela, Subasish Das, Bahar Dadashova ,"Mining patterns of autonomous vehicle crashes involving vulnerable road users to understand the associated factors, Accident Analysis & Prevention", 2022

This study uses crash narratives from four-year (2017–2020) of AV crash data collected from California to explore the direct and indirect involvement of VRUs. The study applied text network and compared the text classification performance of four classifiers - Support Vector Machine (SVM), Naïve Bayes (NB), Random Forest (RF), and Neural Network (NN) and associated performance metrics to attain the objective. It was found that out of 252 crashes, VRUs were, directly and indirectly, involved in 23 and 12 crashes, respectively. Among VRUs, bicyclists and scooterists are more likely to be involved in the AV crashes directly, and bicyclists are likely to be at fault, while pedestrians appear more in the indirectly involvements. Further, crashes that involve VRUs indirectly are likely to occur when the AVs are in autonomous mode and are slightly involved minor damages on the rear bumper than the ones that directly involve VRUs. Additionally, feature importance from the best performing classifiers (RF and

NN) revealed that crosswalks, intersections, traffic signals, movements of AVs (turning, slowing down, stopping) are the key predictors of the VRUs-AV related crashes. These findings can be helpful to AV operators and city planners.

10. Dhruba Jyoti Kalita, Vibhav Prakash Singh & Vinay Kumar ,"Two-way threshold-based intelligent water drops feature selection algorithm for accurate detection of breast cancer ", 2022

This paper work proposes a novel 2-way threshold-based intelligent water drops IWD "algorithm for feature selection to design an effective and efficient CAD system that can detect breast cancer in early stage. This approach first extracts the local binary patterns in wavelet domain from mammograms and then applies our introduced 2-way threshold-based IWD algorithm to extract most important subset of features from the extracted features set. Two-way thresholding is a technique to find a lower bound and an upper bound on the number of features to be selected in the optimal subset. So, using these threshold values, IWD is capable of producing multiple optimal subsets of features rather than producing a single optimal subset of features. The best subset among the above subsets is then used to train and deploy support vector machine (SVM) to classify new mammograms. We have compared our introduced feature selection technique with other meta-heuristic features selection techniques such as ant colony optimization, particle swarm optimization, simulated annealing, genetic algorithm, gravitational search algorithm, inclined planes optimization and gray wolf optimization algorithm and found that it outperforms the other feature selection techniques. 96.4%, 94.8% and 96.2%.

CHAPTER 3
SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

In the car manufacturing industry of the past system, the designs are provided with a disintegration basis by using the weight vectors.As it becomes complex in determining the multi-objective obstacles because multiple specifications are provided for a car. These multiple specifications problems are first getting disintegrated into sub-problems by placing the upper bounds using weight vectors. In this, they calculate the providing design. But due to the finding of decomposed weight vectors is a much slower process for the multiple data it confronts a problem and the functioning of the algorithm is slow as it meets the requirements to reach both the Pareto fronts as well as the crossover and mutation. From the statistical view, we can surmise the engine design which is demanded to be fitted. And to obtain the most fitted one, the Decomposition-based multiobjective evolutionary algorithms (MOEAs) approach can perform best if the decomposition can be avoided and the Pareto optimal fronts are covered.

3.2 PROPOSED SYSTEM

The car engine design has the recommendation analysis which is for implementing the best design based on classification. This best design classification is done using the Linear support vector classification algorithm which provides the design most accurately according to the design implemented by the car manufacturing and engineering team because of the linear kernel method which sorts out the multi-objective problems by covering the Pareto front by enhancing both sides. After a vendor uploads the individual designs with multi parameters, the engineering team will predict the fittest design based on the classification of the multi stipulations. The classification for the most suitable design is investigated based on the specified points in the algorithm. Following the classification, the process for the procurement of the design

takes place. Once the vendor couldn't afford the engine at the assured time the sales team will request the second-best design for the purchase. The engineer again with the guidance of the algorithm determines the second-best design and updates for purchase.

3.3 FEASIBILITY STUDY

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

3.4 HARDWARE ENVIRONMENT

- Processor - i3, i5, i7
- Speed - 2.3 GHz
- RAM - 4 Gb
- Hard Disk - 260 GB

3.5 SOFTWARE ENVIRONMENT

- Front end : Core Python, CSS, JS
- Web application : Django, Flask
- Back end : MySQL

CHAPTER 4
SYSTEM DESIGN

4.1 E –R DIAGRAM

The relation upon the system is structured through a conceptual ER-Diagram, which not only specifics the existing entities, but also the standard relations through which the system exists and the cardinalities that are necessary for the system state to continue.The Entity Relationship Diagram (ERD) depicts the relationship between the data objects. The ERD is the notation that is used to conduct, the date modeling activity the attributes of each data object noted, is the ERD can be described resign a data object description.

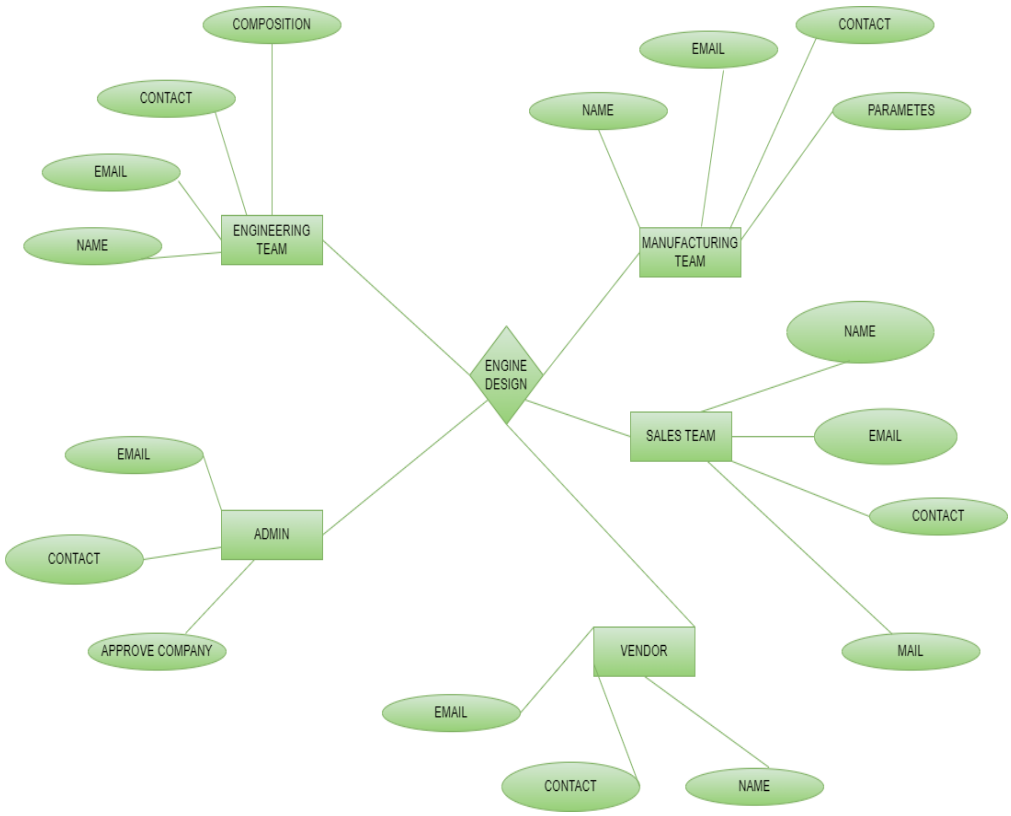
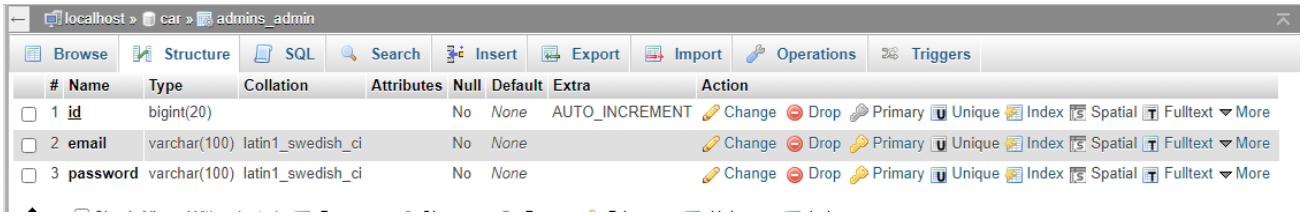


Figure 4.1 – Entity Diagram

4.2 DATA DICTIONARY

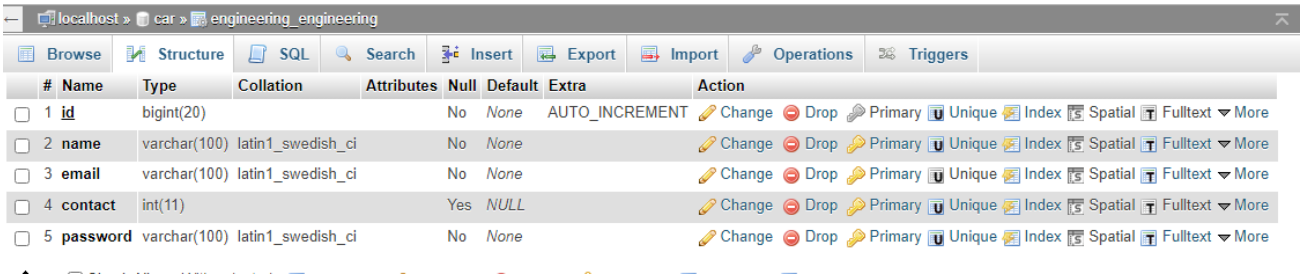
4.2.1 ADMIN LOGIN



#	Name	Type	Collation	Attributes	Null	Default	Extra	Action
1	id	bigint(20)			No	None	AUTO_INCREMENT	Change Drop Primary Unique Index Spatial Fulltext More
2	email	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index Spatial Fulltext More
3	password	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index Spatial Fulltext More

Table 4.1 Admin login

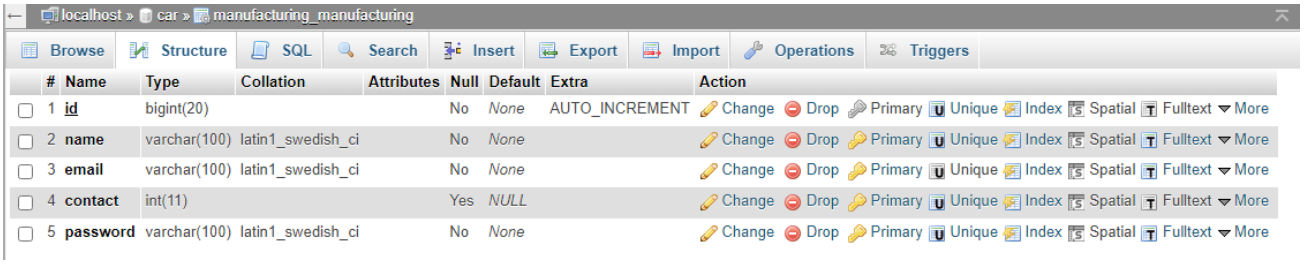
4.2.2 ENGINEERING TEAM LOGIN



#	Name	Type	Collation	Attributes	Null	Default	Extra	Action
1	id	bigint(20)			No	None	AUTO_INCREMENT	Change Drop Primary Unique Index Spatial Fulltext More
2	name	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index Spatial Fulltext More
3	email	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index Spatial Fulltext More
4	contact	int(11)			Yes	NULL		Change Drop Primary Unique Index Spatial Fulltext More
5	password	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index Spatial Fulltext More

Table 4.2 Engineering team login

4.2.3 MANUFACTURING TEAM LOGIN



#	Name	Type	Collation	Attributes	Null	Default	Extra	Action
1	id	bigint(20)			No	None	AUTO_INCREMENT	Change Drop Primary Unique Index Spatial Fulltext More
2	name	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index Spatial Fulltext More
3	email	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index Spatial Fulltext More
4	contact	int(11)			Yes	NULL		Change Drop Primary Unique Index Spatial Fulltext More
5	password	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index Spatial Fulltext More

Table 4.3 Manufacturing team login

4.2.4 SALES TEAM LOGIN

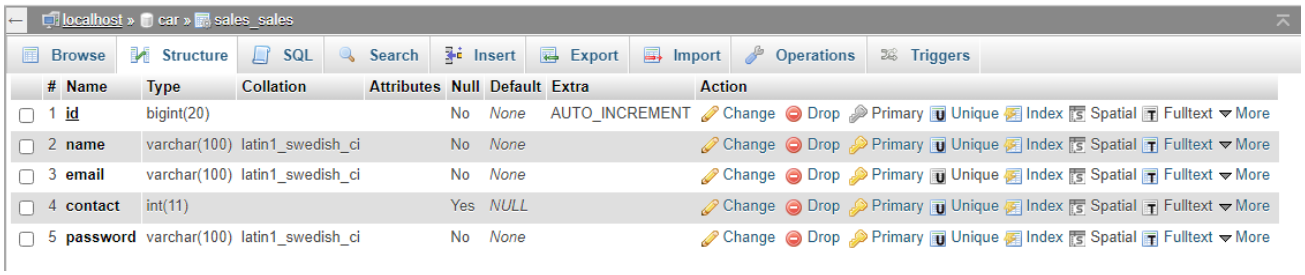


Table 4.4 Sales team login

4.2.5 VENDOR TEAM LOGIN

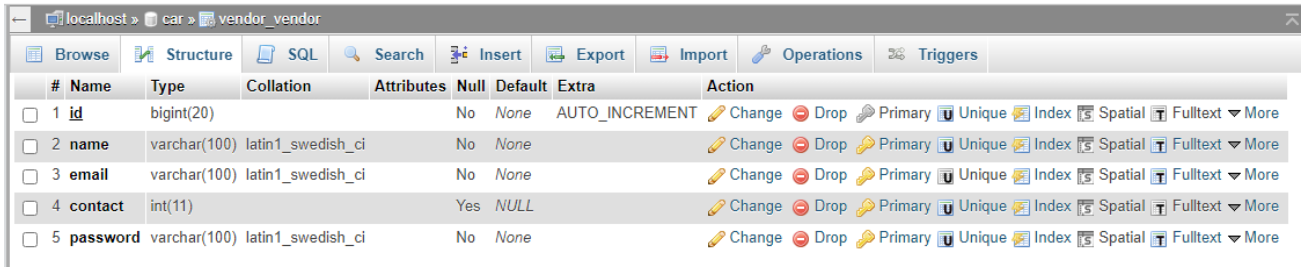


Table 4.5 Vendor team login

4.2.6 VENDOR DESIGN

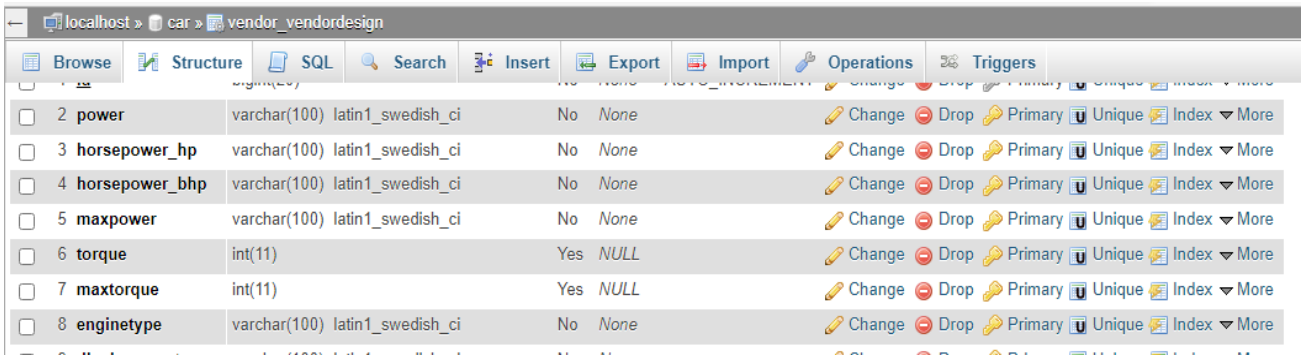
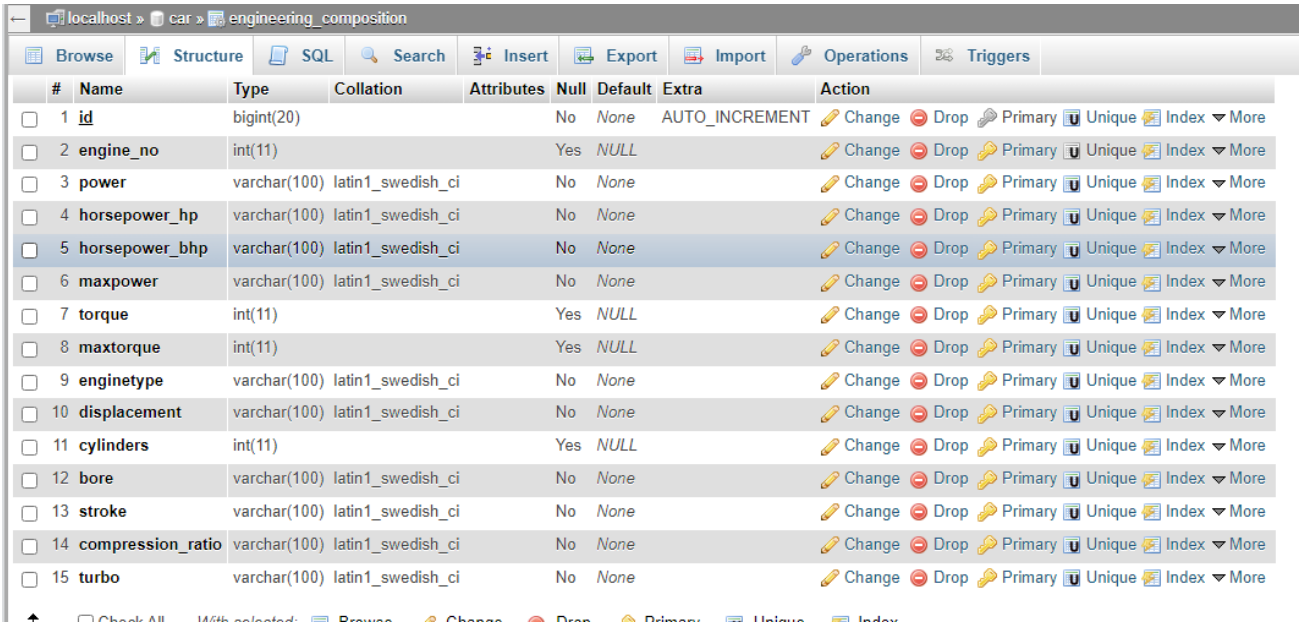


Table 4.6 Vendor design

4.2.7 ENGINEERING COMPOSITION



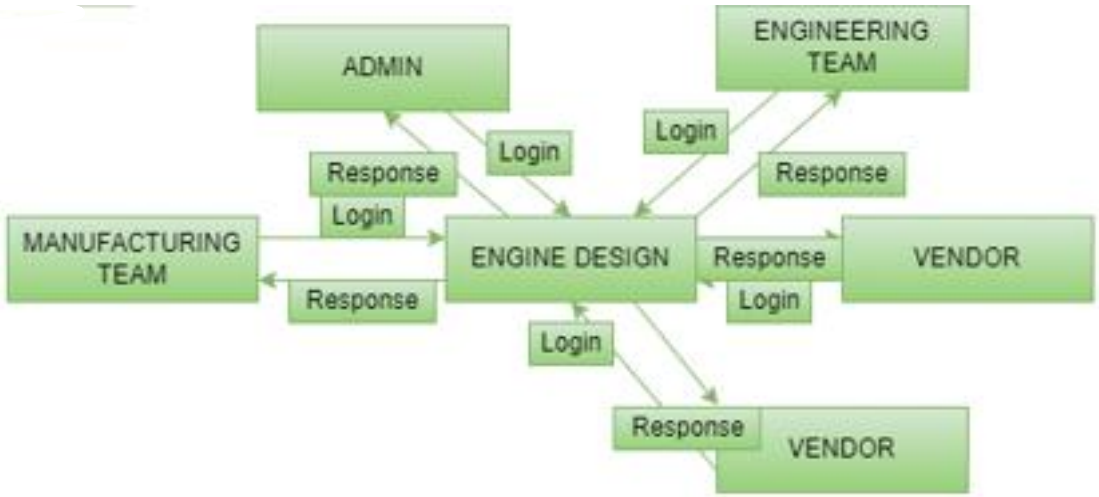
#	Name	Type	Collation	Attributes	Null	Default	Extra	Action
1	id	bigint(20)			No	None	AUTO_INCREMENT	Change Drop Primary Unique Index More
2	engine_no	int(11)			Yes	NULL		Change Drop Primary Unique Index More
3	power	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
4	horsepower_hp	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
5	horsepower_bhp	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
6	maxpower	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
7	torque	int(11)			Yes	NULL		Change Drop Primary Unique Index More
8	maxtorque	int(11)			Yes	NULL		Change Drop Primary Unique Index More
9	enginetype	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
10	displacement	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
11	cylinders	int(11)			Yes	NULL		Change Drop Primary Unique Index More
12	bore	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
13	stroke	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
14	compression_ratio	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More
15	turbo	varchar(100)	latin1_swedish_ci		No	None		Change Drop Primary Unique Index More

Table 4.7 Engineering composition

4.3 DATA FLOW DIAGRAM

A Data Flow has only one direction of flow between symbols. It may flow in both directions between a process and a data store to show a read before an update. Thelatter is usually indicated, however by two separate arrows since these happen at different type.A join in DFD means that exactly the same data comes from any of two or more different processes data store or sink to a common location.A data flow cannot go directly back to the same process it leads. There must be at least one other process that handles the data flow produce some other data flow returns the original data in the beginning process.

LEVEL 1



`Figure 4.2 – DFD- Engine Design Login

LEVEL 2

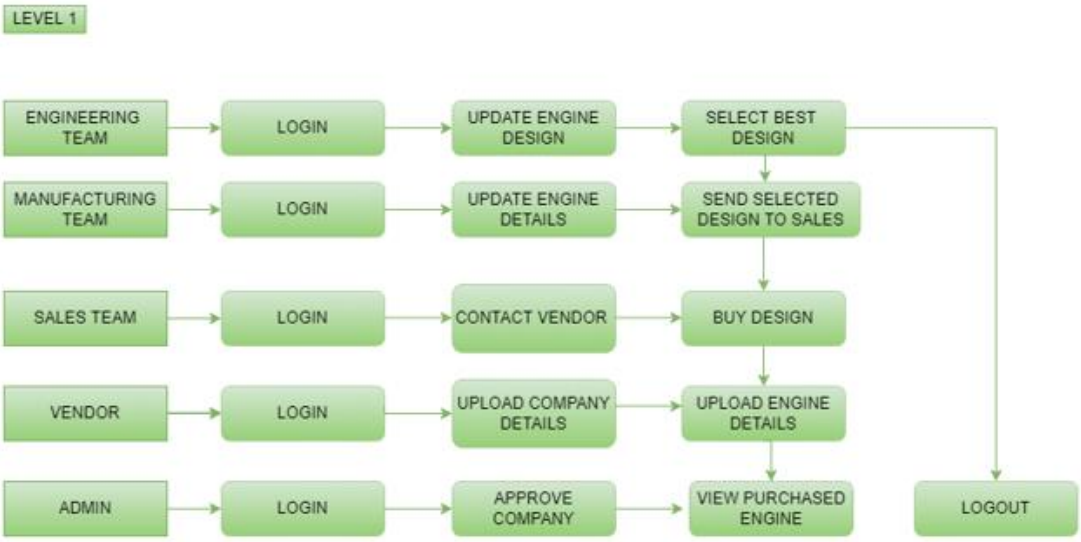


Figure 4.3 – DFD-User Login

A Data flow to a data store means update (delete or change).A data Flow from a data store means retrieve or use. A data flow has a noun phrase label more than one data flow noun phrase can appear on a single arrow as long as all of the flows on the same arrow move together as one package. The user login here lets the user login into every module to give and take the specificatios required as such.

LEVEL 3

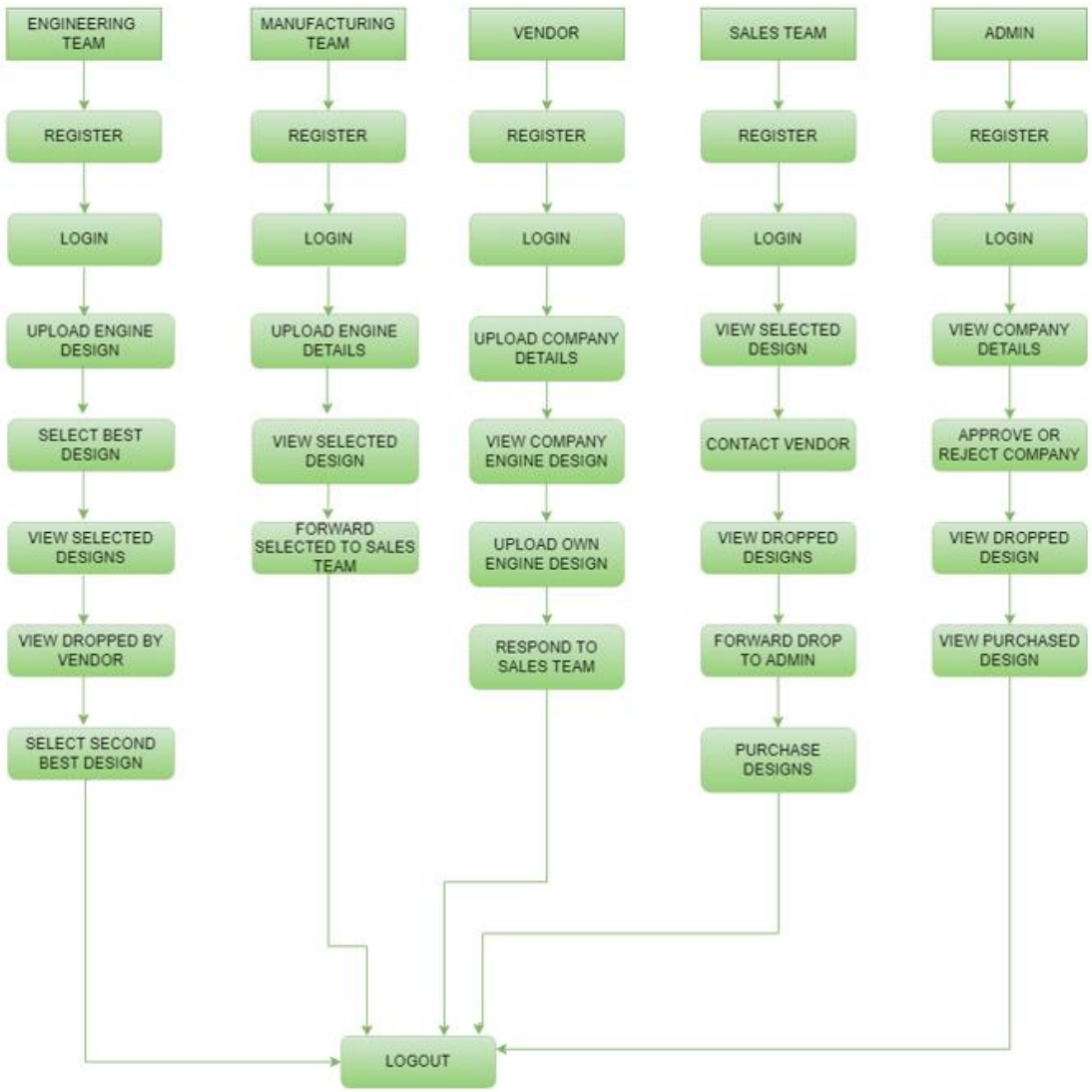


Figure 4.4 – DFD-Admin Login

4.4 UML DIAGRAMS

4.4.1. USE CASE DIAGRAM

Figure 4.5 – Use Case Diagram

1. CLASS DIAGRAM

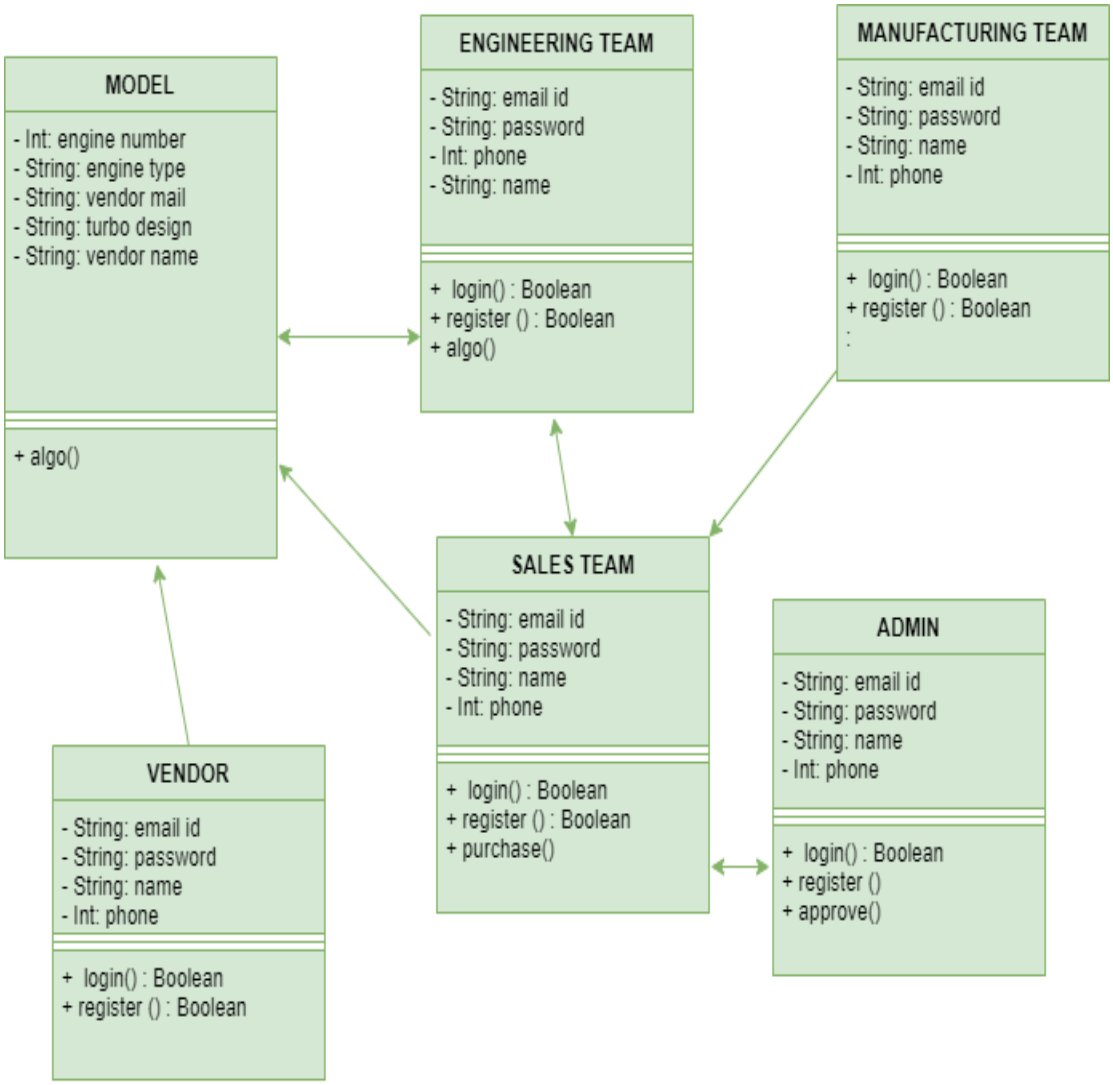


Figure 4.6 – Class Diagram

2. SEQUENCE DIAGRAM

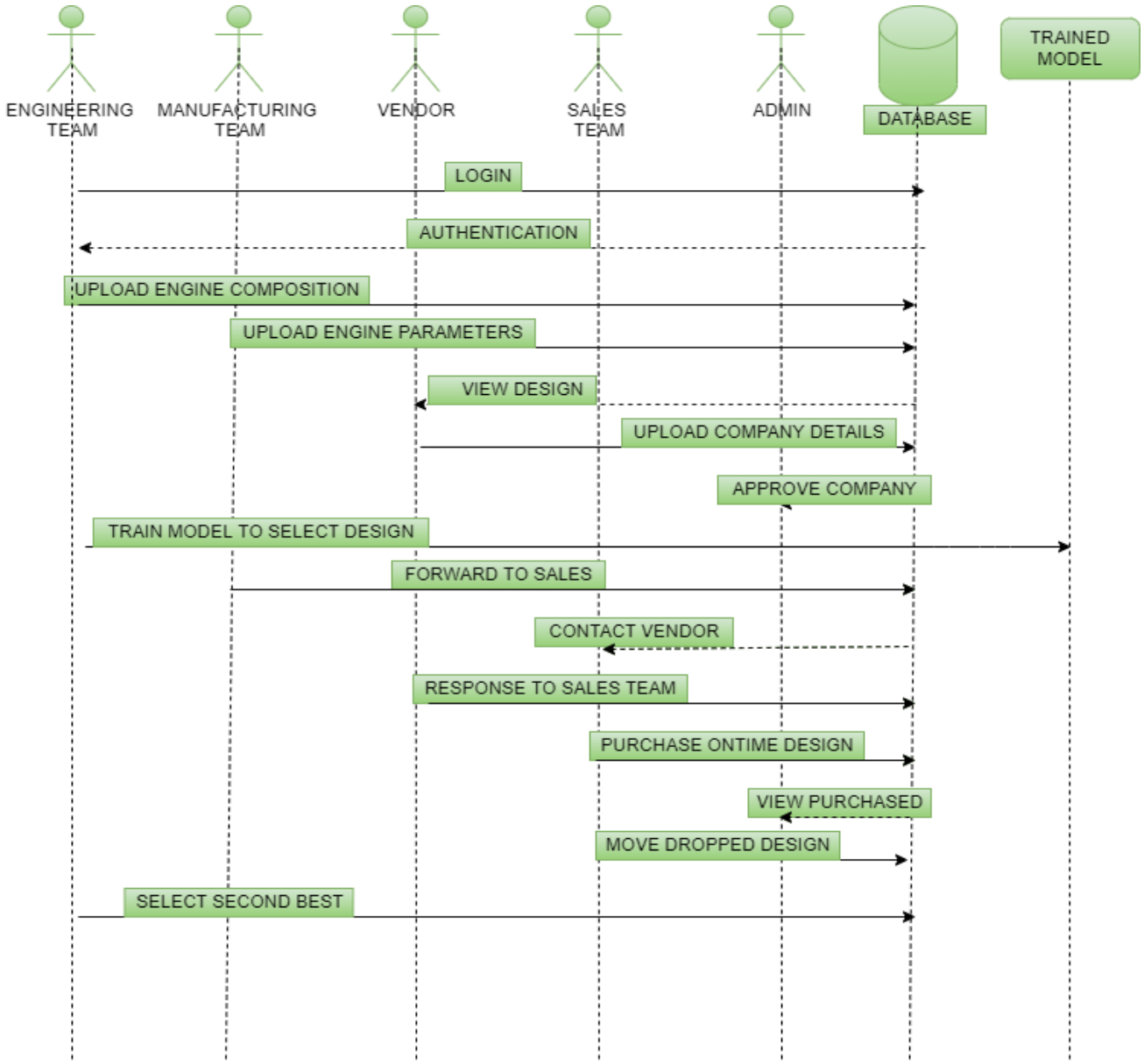


Figure 4.7 – Sequence Diagram

3. DEPLOYMENT DIAGRAM

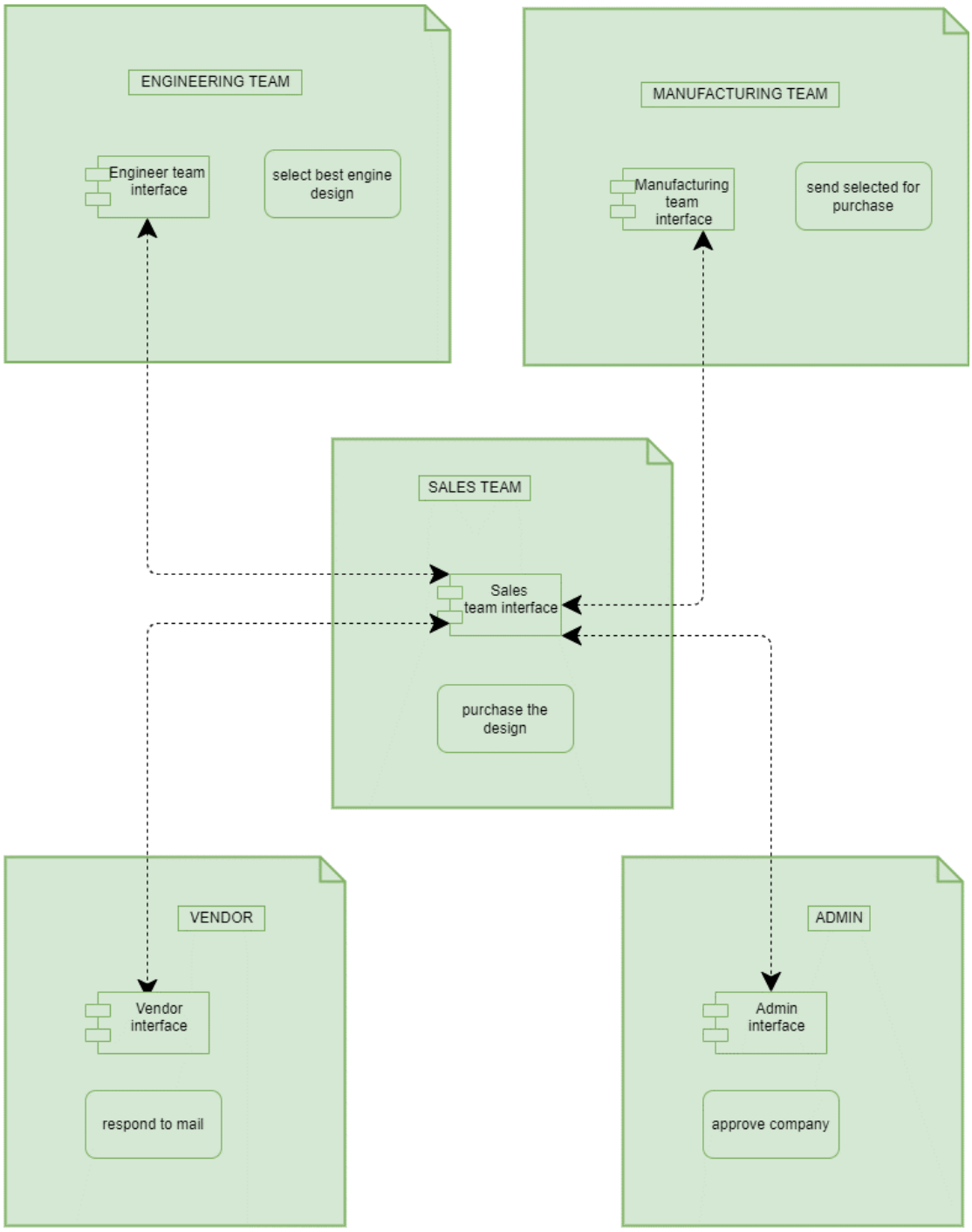


Figure 4.8 – Deployment Diagram

4. COLLABORATION DIAGRAM

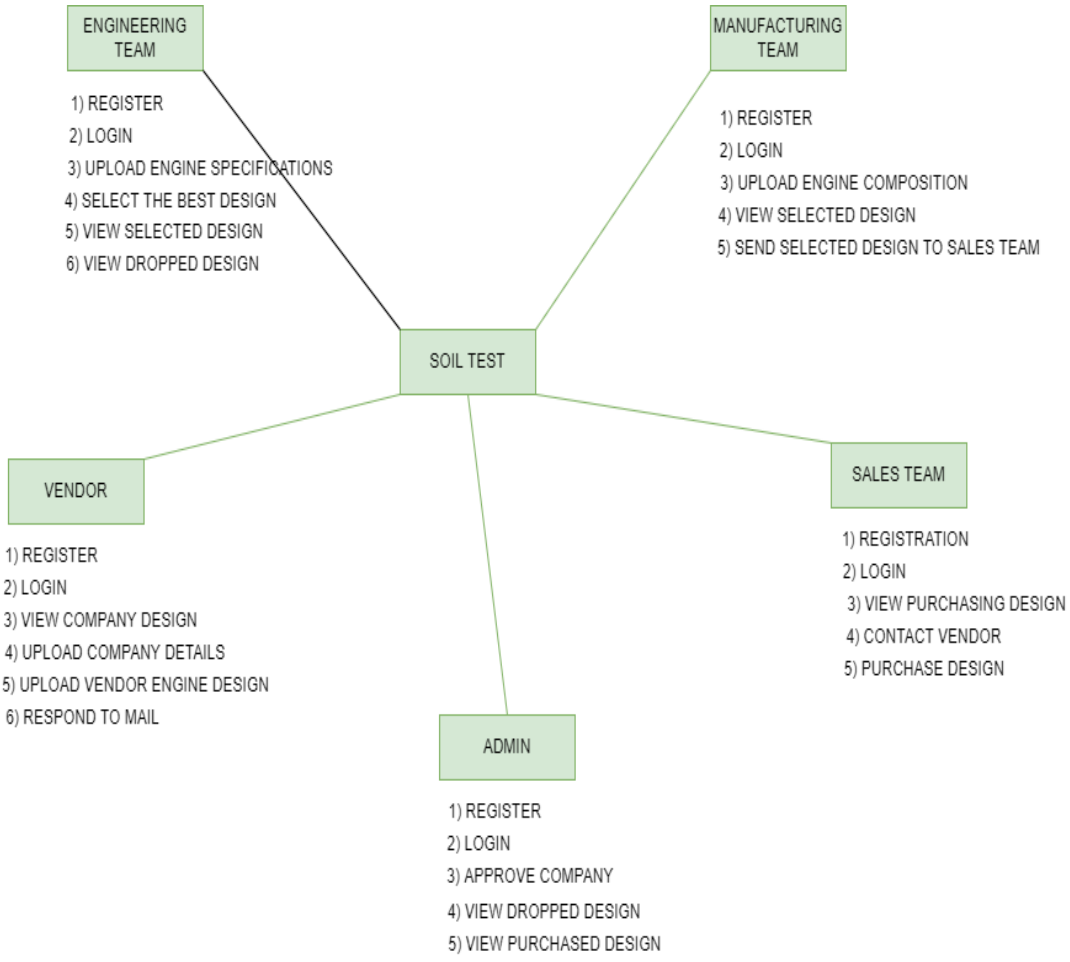


Figure 4.9 – Collaboration Diagram

5. COMPONENT DIAGRAM

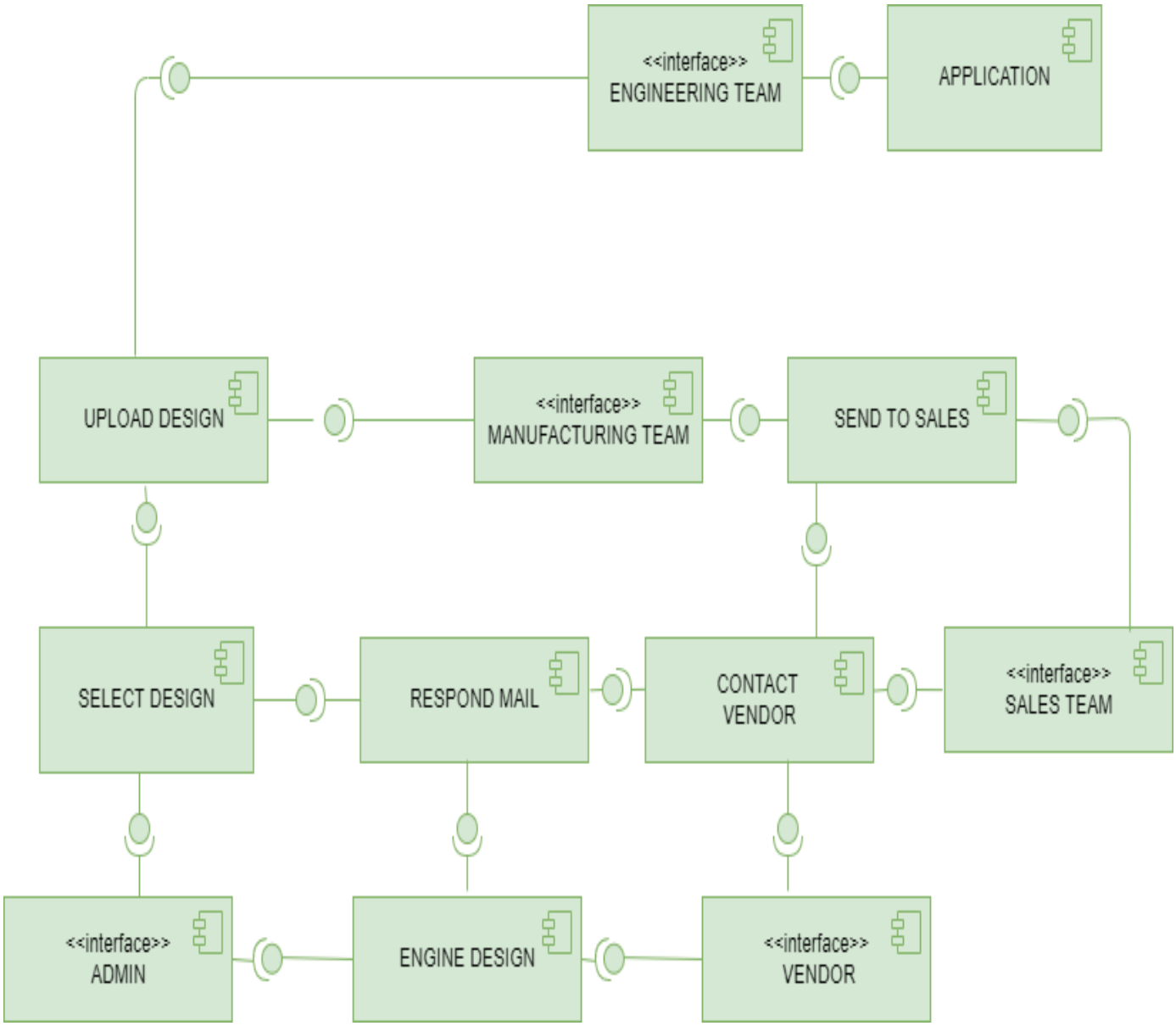


Figure 4.10 – Component Diagram

6. STATE DIAGRAM

LEVEL 0

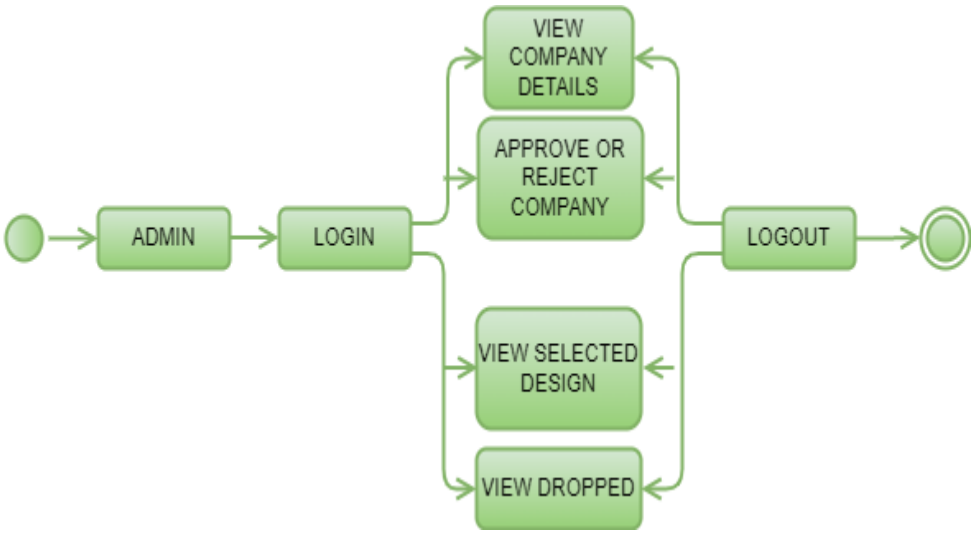


Figure 4.11 – SD Admin Login

LEVEL 1

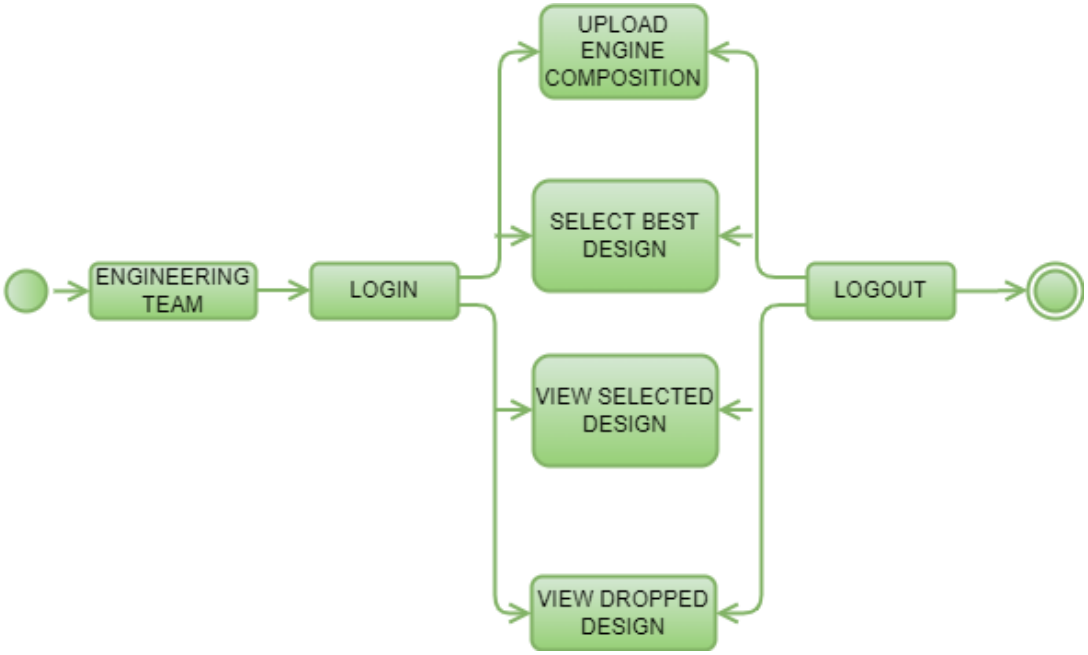


Figure 4.12 – SD-Engineering Team Login

LEVEL 2

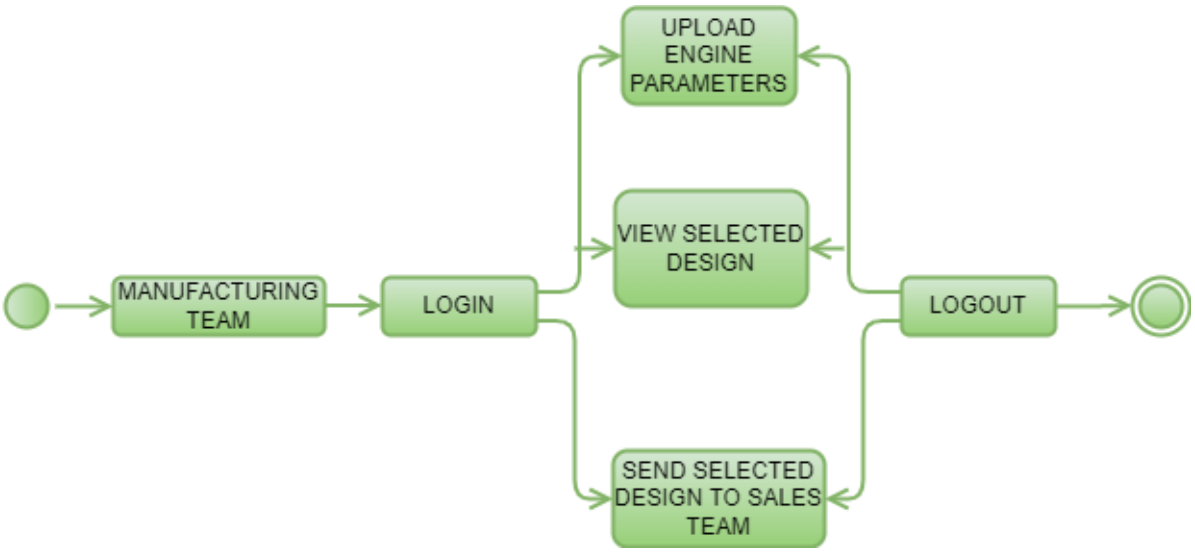


Figure 4.13 – SD-Manufacturing Team Login

LEVEL 3

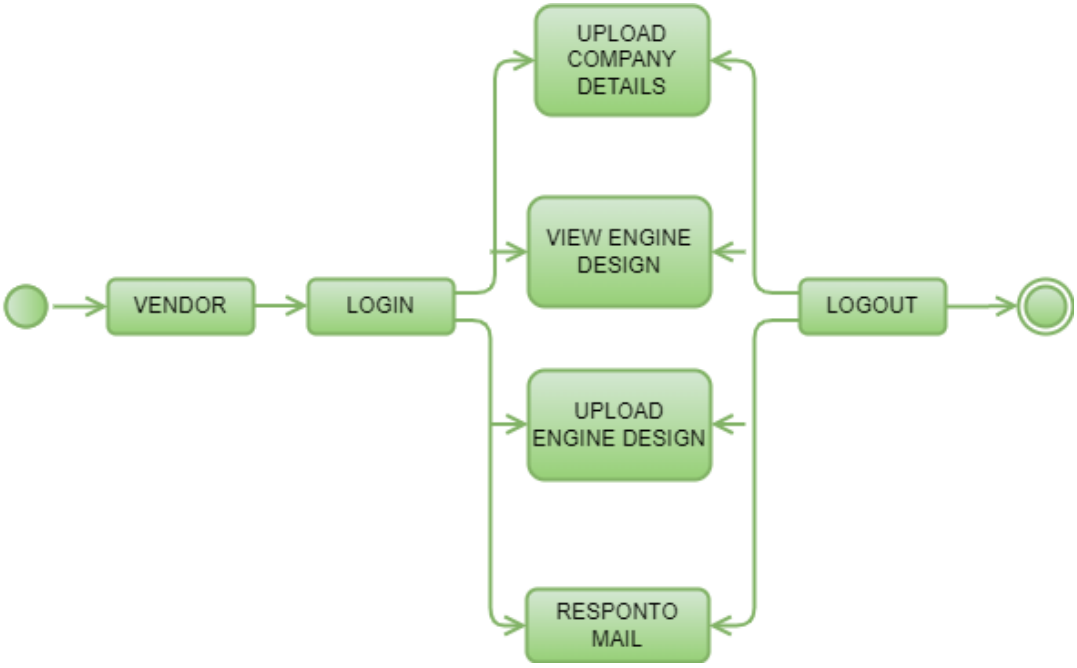


Figure 4.14-SD-Vendor Login

LEVEL 4

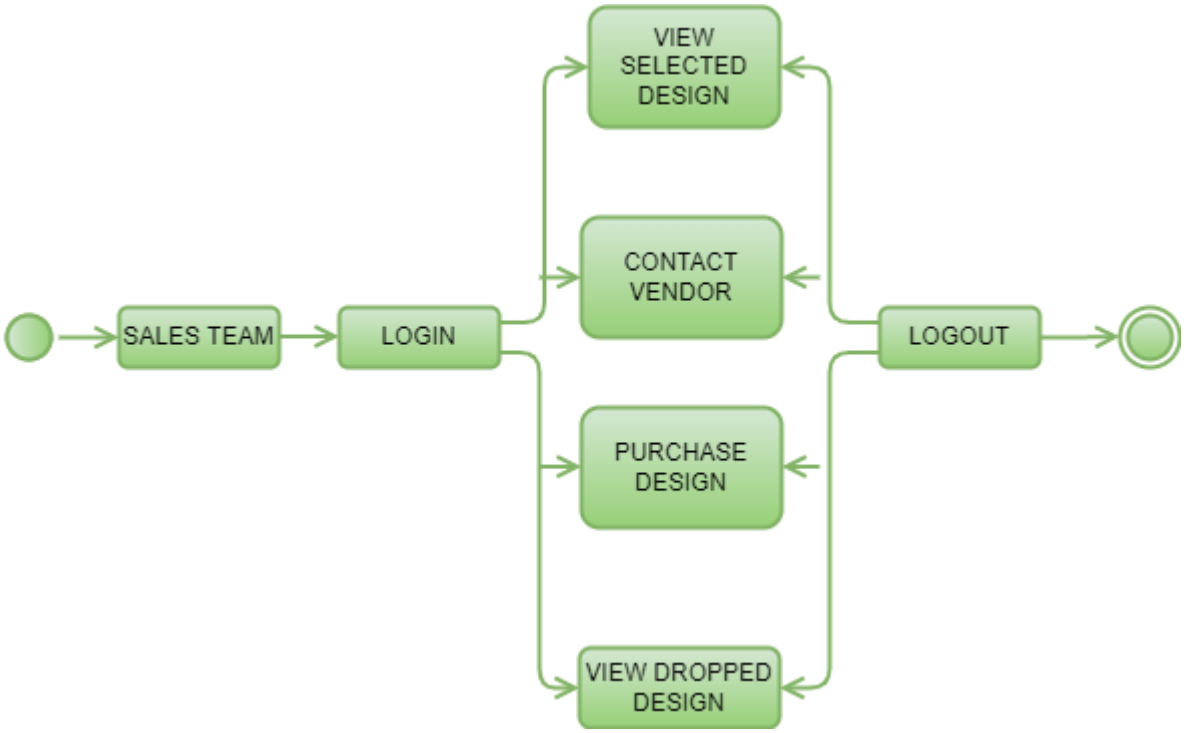


Figure 4.15– SD-Sales Team Login

A state diagram, also known as a state machine diagram or statechart diagram, is an illustration of the states an object can attain as well as the transitions between those states in the Unified Modeling Language (UML). This project has four levels such as the admin login, engineering team login, manufacturing team login and then the vendor login. This diagram allows to ensure the steps invloved and how the flow of the project works in chronological order. It models the dynamic nature of the system.

CHAPTER 5
SYSTEM ARCHITECTURE

ARCHITECTURE DIAGRAM

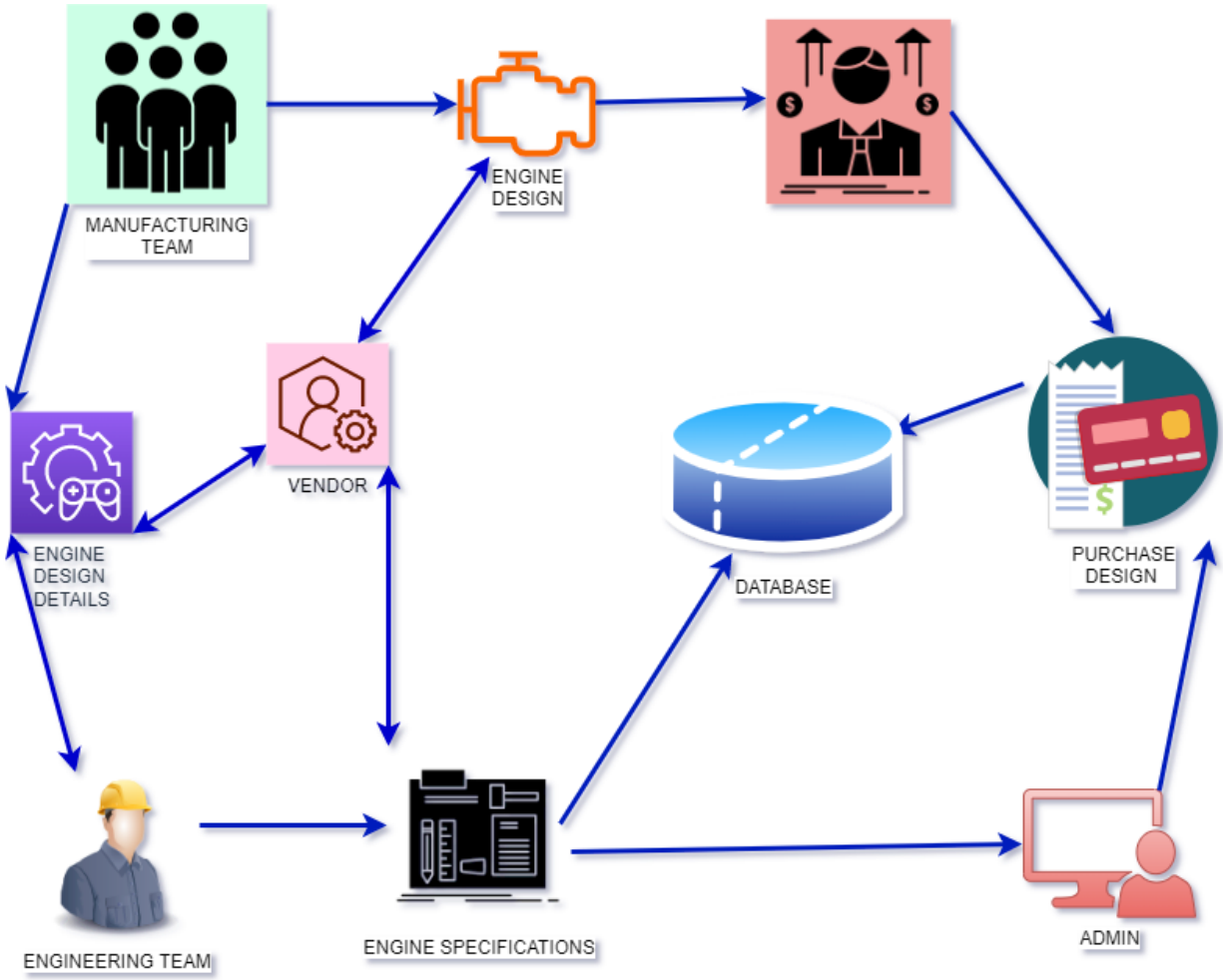


Figure 5.1 - System Architecture Diagram

5.1 MODULE DESIGN SPECIFICATION

MODULES:

- Engineering Team
- Manufacturing Team
- Sales Team
- Vendor
- Admin

ENGINEERING TEAM:

This module gives the registration process with the engineer details of name,email id, contact number, and password. With this, the engineer can log in to the engineering team page. Within the engineering team module, there is another module called upload composition, view vendor design, view selected to design, and view dropped. After the login process in the engineering team module engineer can upload the required composition for engine design like power, horsepower, maximum power, and torque. In the view vendor design, the engineering team can view the engine designs of the vendors and select the best design for the engine. In the view selected design, the engineering team views the selected best design for further process. In the view dropped design the engineering team will view the design not provided by the vendor at the time and in the module view vendor design module, the engineering team will view the second-best design and select the design of the vendor.

MANUFACTURING TEAM:

After registration, the manufacturing team can log in to the manufacturing team page. Within the manufacturing team module, there are sub-modules named upload composition, view selected and select design. In the sub-module named upload composition, the manufacturing team can upload the engine design details like engine type, displacement, cylinders, bore, stroke, compression ratio, and turbo details followed by the upload of the engineering team. In the module named view selected the manufacturing team see the vendor selected by the Engineering Team. In the module named selected design table, the manufacturing team can view the details of the engine design of the selected vendor with each specification of the engine by the engineering team and forward it to the sales team.

SALES TEAM:

This module gives the registration process with the sales team details of name, email id, contact number, and password. After registration, the sales team can log in to the respective page. Within the sales team module, there are sub-modules named design selected, contact vendor, buy design, and view dropped. In the table named view selected sub-module, the sales team can view the design selected by the engineer and forwarded by the manufacturing team. In the contact vendor module, the sales team will contact the vendor whose design is selected as the best and send the information regarding buying the engine through the mail. In the module, buy design the sales team can buy the engine once the response is received from the vendor side. In the view dropped module, the sales team can view the engine design which the vendor failed to deliver and forward it to the admin.

VENDOR:

This module gives the registration process with the vendor details of name, email id, contact number, and password. After registration, the vendor can log in to the respective page. Within the vendor module, there are sub-modules named view design, company details, upload design, and respond to mail. In the table named view to design the vendor can view the engine details uploaded by the engineering and manufacturing team of the company. In the module named company details the vendor can upload the company details and upload it to admin. In the module named upload design, each vendor can upload each individual and different designs designed by the vendor. In the module named to respond to mail, the vendor can respond to the mail sent by the sales team either by promising of delivering the product on time or by replying to the design that cannot be delivered.

ADMIN:

This module allows the admin to login into the admin page and views the overall work. In the admin module, there are sub-modules named select company, purchased design and dropped design. In the module named select company, the admin either selects or rejects the vendor's company. In the module, named purchased design in the form of a table, the admin can view the design which is selected by the engineering team and which is purchased from the selected vendor by the sales team. In the module named dropped design in the form of a table, the admin can view the design forwarded by the sales team which the vendor failed to deliver on time. And admin views the dropped design and forwards it to the engineering team to finish the process soon by selecting the second-best design.

5.2 ALGORITHMS

The most applicable machine learning algorithm for our problem is **Linear SVC.** Before hopping into Linear SVC with our data, we're going to show a very simple example that should help solidify your understanding of working with Linear SVC.

The objective of a Linear SVC (Support Vector Classifier) is to fit to the data you provide, returning a "best fit" hyperplane that divides, or categorizes, your data. From there, after getting the hyperplane, you can then feed some features to your classifier to see what the "predicted" class is. This makes this specific algorithm rather suitable for our uses, though you can use this for many situations. Let's get started.

First, we're going to need some basic dependencies:

```
importnumpy as np
importmatplotlib.pyplot as plt
frommatplotlib import style
style.use("ggplot")
fromsklearn import svm
```

Matplotlib here is not truly necessary for Linear SVC. The reason why we're using it here is for the eventual data visualization. Typically, you wont be able to visualize as many dimensions as you will have features, but, it's worth visualizing at least once to understand how linear svc works.

Other than the visualization packages we're using, you will just need to import svm from sklearn and numpy for array conversion.

Next, let's consider that we have two features to consider. These features will be visualized as axis on our graph. So something like:

```
x = [1, 5, 1.5, 8, 1, 9]
y = [2, 8, 1.8, 8, 0.6, 11]
```

Then we can graph this data using:

```
plt.scatter(x,y)
plt.show()
```

The result is:

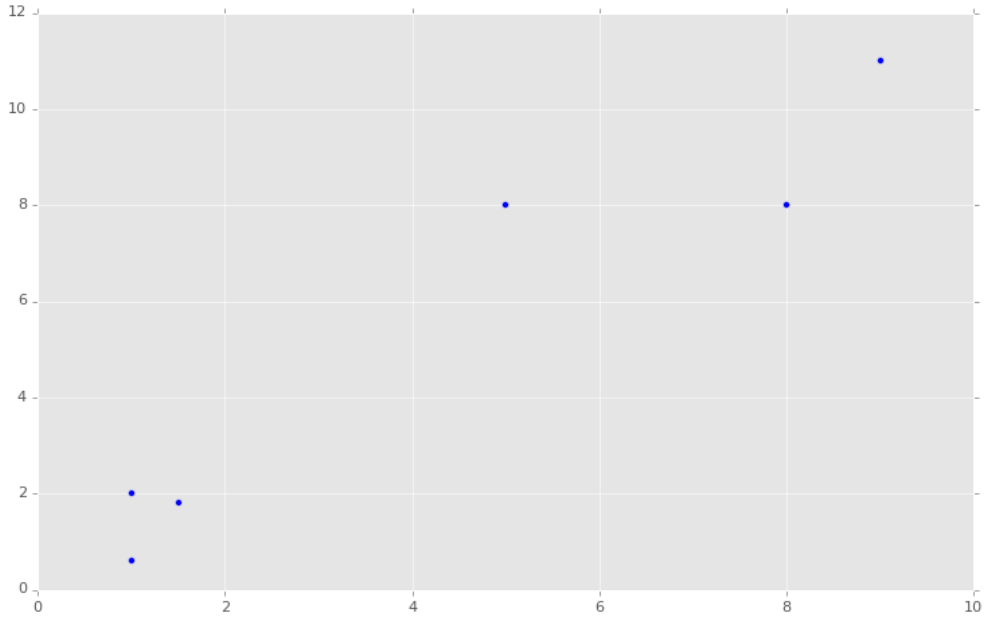


Figure 5.2 Graph-1

Now, of course, we can see with our own eyes how these groups should be divided, though exactly where we might draw the dividing line might be debated:

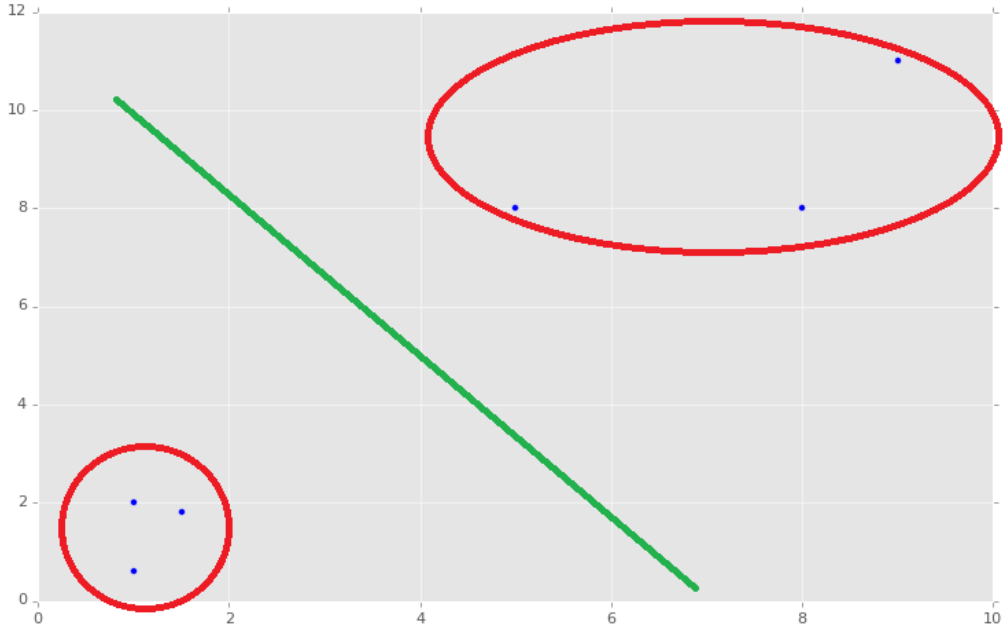


Figure 5.3 Graph-2

So this is with two features, and we see we have a 2D graph. If we had three features, we could have a 3D graph. The 3D graph would be a little more challenging for us to visually group and divide, but still do-able. The problem occurs when we have four features, or four-thousand features. Now you can start to understand the power of machine learning, seeing and analyzing a number of dimensions imperceptible to us.

With that in mind, we're going to go ahead and continue with our two-featured example. Now, in order to feed data into our machine learning algorithm, we first need to compile an array of the features, rather than having them as x and y coordinate values.

Generally, you will see the feature list being stored in a capital X variable. Let's translate our above x and y coordinates into an array that is compiled of the x and y coordinates, where x is a feature and y is a feature.

Refer the data below.

```
X = np.array([[1,2],
              [5,8],
              [1.5,1.8],
              [8,8],
              [1,0.6],
              [9,11]])
```

Now that we have this array, we need to label it for training purposes. There are forms of machine learning called "unsupervised learning," where data labeling isn't used, as is the case with clustering, though this example is a form of supervised learning.

For our labels, sometimes referred to as "targets," we're going to use 0 or 1.

```
y = [0,1,0,1,0,1]
```

Just by looking at our data set, we can see we have coordinate pairs that are "low" numbers and coordinate pairs that are "higher" numbers. We've then assigned 0 to the lower coordinate pairs and 1 to the higher feature pairs.

These are the labels. In the case of our project, we will wind up having a list of numerical features that are various statistics about stock companies, and then the "label" will be either a 0 or a 1, where 0 is under-perform the market and a 1 is out-perform the market.

Moving along, we are now going to define our classifier:

```
clf = svm.SVC(kernel='linear', C = 1.0)
```

We're going to be using the SVC (support vector classifier) SVM (support vector machine). Our kernel is going to be linear, and C is equal to 1.0. What is C you ask? Don't worry about it for now, but, if you must know, C is a valuation of "how badly" you want to properly classify, or fit, everything. The machine learning field is relatively new, and experimental. There exist many debates about the value of C, as well as how to calculate the value for C. We're going to just stick with 1.0 for now, which is a nice default parameter.

Next, we call:

```
clf.fit(X,y)
```

Note: this is an older tutorial, and Scikit-Learn has since deprecated this method. By version 0.19, this code will cause an error because it needs to be a numpy array, and re-shaped. You do not need to follow along with that series to mimic what is done there with the reshaping, and continue along with this series.

From here, the learning is done. It should be nearly-instant, since we have such a small data set.

Next, we can predict and test. Let's print a prediction:

```
print(clf.predict([0.58,0.76]))
```

We're hoping this predicts a 0, since this is a "lower" coordinate pair.

Sure enough, the prediction is a classification of 0. Next, what if we do:

```
print(clf.predict([10.58,10.76]))
```

And again, we have a theoretically correct answer of 1 as the classification. This was a blind prediction, though it was really a test as well, since we knew what the hopeful target was. Congratulations, you have 100% accuracy!

Now, to visualize your data:

```
w = clf.coef_[0]
print(w)

a = -w[0] / w[1]

xx = np.linspace(0,12)
yy = a * xx - clf.intercept_[0] / w[1]

h0 = plt.plot(xx, yy, 'k-', label="non weighted div")

plt.scatter(X[:, 0], X[:, 1], c = y)
plt.legend()
plt.show()
```

The result:

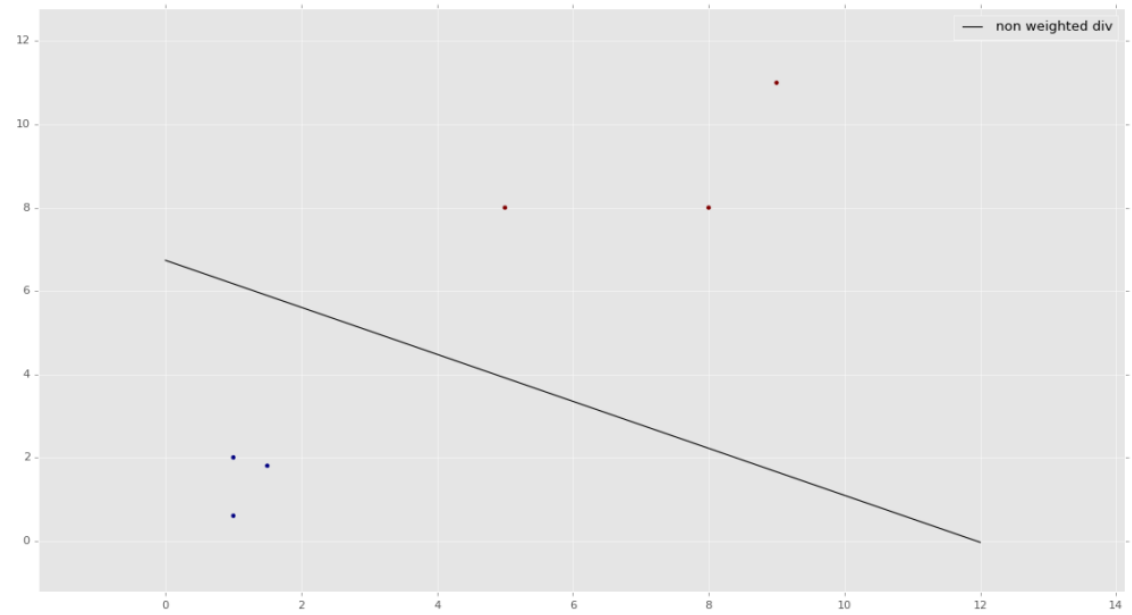


Figure 5.4 Graph-3

Visualizing the data is somewhat useful to see what the program is doing in the background, but is not really necessary to understand how to visualize it specifically at this point. You will likely find that the problems you are trying to solve simply cannot be visualized due to having too many features and thus too many dimensions to graph.

CHAPTER 6
SYSTEM IMPLEMENTATION

6.1 CLIENT SIDE CODING

```
<!--
Author: W3layouts
Author URL: http://w3layouts.com
-->
<!doctype html>
<html lang="en">
<head> {% load static %}
<!-- Required meta tags -->
<meta charset="utf-8">
<meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-
fit=no">

<title>Companies a Industrial Category Bootstrap Responsive Website Template |
Home :: W3layouts</title>
<!-- web fonts -->
<link
href="//fonts.googleapis.com/css?family=Poppins:300,400,500,600,700,800,900&dis
play=swap" rel="stylesheet">
```

```
<link href="//fonts.googleapis.com/css?family=Hind&display=swap"
rel="stylesheet">
<!-- //web fonts -->
<!-- Template CSS -->
<link rel="stylesheet" href="{% static 'assets/css/style-starter.css'%}">
<link rel="stylesheet" href="{% static 'f/css/style.css'%}">
</head>
<body  style="background-image:url({% static 'assets\images\sa.jpg' %});
background-size:cover ">
  {% if messages %}
    {% for message in messages%}
<script>
        alert("{{message}}")
</script>
    {% endfor %}
    {% endif %}

<section class="w3l-bootstrap-header">
<nav class="navbar navbar-expand-lg navbar-light py-lg-3 py-2"
style="background:black">
<div class="container">
```

```
<a class="navbar-brand" href="#"><span class="fafa-
cog"></span>AUTOMOBILES</a>
<!-- if logo is image enable this
<a class="navbar-brand" href="#index.html">
<imgsrc="image-path" alt="Your logo" title="Your logo" style="height:35px;" />
</a> -->
<button class="navbar-toggler" type="button" data-toggle="collapse" data-
target="#navbarSupportedContent"
      aria-controls="navbarSupportedContent" aria-expanded="false" aria-
label="Toggle navigation">
<span class="navbar-toggler-icon fafa-bars"></span>
</button>


<div class="collapse navbar-collapse" id="navbarSupportedContent">
<ul class="navbar-nav mx-auto">

<li class="nav-item">
<a class="nav-link" href="/eng/show">ENGINEERING TEAM</a>
</li>
<li class="nav-item">
```

```
<a class="nav-link active" href="/eng/upload">UPLOAD COMPOSITION</a>
</li>
<li class="nav-item">
<a class="nav-link" href="/eng/design">VIEW VENDOR DESIGN</a>
</li>

<li class="nav-item">
<a class="nav-link" href="/eng/selected">VIEW SELECTED DESIGN</a>
</li>
<li class="nav-item">
<a class="nav-link" href="/eng/dropped">VIEW DROPPED </a>
</li>
<li class="nav-item">
<a class="nav-link" href="/eng/logout">LOGOUT</a>
</li>




</ul>
</div>
</div>
```

```
</nav>
</section>
<section class="w3l-main-slider" id="home">
<br><br><br>
<!-- contact1 -->
<br><br><br>
<section class="w3l-simple-contact-form1" >
<div class=""><center><h3 style="color:black">UPLOAD ENGINE
COMPOSITION </h3><br><br><br></center>
<div class="wrapper">
<div class="contact-form" style="max-width: 450px; margin: 0 auto;">
<div class="form-mid">
<form action="/eng/upload/" method="post">
{% csrf_token %}
<div class="field">
<input type="text" class="form-control" name="engine_no" id="w3lName"
placeholder="ENGINE NO" required="">
</div>
<div class="field">
<input type="text" class="form-control" name="power" id="w3lSender"
placeholder="POWER"
```

```
required="">
</div>
<div class="field">
<input type="text" class="form-control" name="horsepower_hp" id="w3lSubject"
placeholder="HORSEPOWER IN hp"
required="">
</div>
<div class="field">
<input type="text" class="form-control" name="horsepower_bhp"
placeholder="HORSEPOWER IN bhp" required="">
</div>
<div class="field">
<input type="text" class="form-control" name="maxpower"
placeholder="MAXIMUM POWER"
required="">
</div>
<div class="field">
<input type="text" class="form-control" name="torque"  placeholder="TORQUE"
            required="">
</div>
<div class="field">
```

```
<input type="text" class="form-control" name="maxtorque"
placeholder="MAXIMUM TORQUE"
                required="">
</div>

<button type="submit" class="btnbtn-contact">UPLOAD</button>
<!--
Author: W3layouts
Author URL: http://w3layouts.com
-->
<!doctype html>
<html lang="en">
<head>
   {% load static %}
<!-- Required meta tags -->
<meta charset="utf-8">
<meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-
fit=no">

<title>Companies a Industrial Category Bootstrap Responsive Website Template |
Home :: W3layouts</title>
```

```
<!-- web fonts -->
<link
href="//fonts.googleapis.com/css?family=Poppins:300,400,500,600,700,800,900&dis
play=swap" rel="stylesheet">
<link href="//fonts.googleapis.com/css?family=Hind&display=swap"
rel="stylesheet">
<!-- //web fonts -->
<!-- Template CSS -->
<link rel="stylesheet" href="{% static 'assets/css/style-starter.css'%}">
</head>
<body  style="background-image:url({% static 'assets\images\ser-1.jpg' %});
background-size:cover ">
  {% if messages %}
   {% for message in messages%}
<script>
      alert("{{message}}")
</script>
   {% endfor %}
   {% endif %}
```

```
<section class="w3l-bootstrap-header">
<nav class="navbar navbar-expand-lg navbar-light py-lg-3 py-2">
<div class="container">
<a class="navbar-brand" href="#"><span class="fafa-
cog"></span>AUTOMOBILES</a>
<!-- if logo is image enable this
<a class="navbar-brand" href="#index.html">
<imgsrc="image-path" alt="Your logo" title="Your logo" style="height:35px;" />
</a> -->
<button class="navbar-toggler" type="button" data-toggle="collapse" data-
target="#navbarSupportedContent"
                aria-controls="navbarSupportedContent" aria-expanded="false" aria-
label="Toggle navigation">
<span class="navbar-toggler-icon fa fa-bars"></span>
</button>
<div class="collapse navbar-collapse" id="navbarSupportedContent">
<ul class="navbar-nav mx-auto">
<li class="nav-item">
<li class="nav-item">
<a class="nav-link" href="/eng/show">ENGINEERING TEAM</a></li>
```

6.2 SERVER SIDE CODING

```
fromdjango.shortcuts import render,redirect
from . models import *
from django.db import IntegrityError
from django.contrib import messages
from vendor.models import *


from django.core.mail import send_mail
from django.conf import settings
def index(request):
    return render(request,'index.html')



def login(request):
    if request.method=='POST':
        email=request.POST['email']
        password=request.POST['password']
        try:
r=admin.objects.get(email=email,password=password)
request.session['ad']=r.email
            if r is not None:
```

```
            messages.info(request,'welcome')
            return redirect('/show')
        except admin.DoesNotExist as e:
            messages.info(request,'name does not exists')
            return redirect('/login')

    else:
        return render(request,'admins/login.html')


def show(request):
    return render(request, 'admins/showadmin.html')


defselectcompany(request):
    a=company.objects.filter(approval='waiting')
    return render(request, 'admins/selectvendor.html',{'a':a})


def approve(request,id):
    a=company.objects.get(id=id)
```

```
a.approval='approved'
a.save()
    messages.info(request,'Approved company')
    return redirect('/selectcompany/')


def reject(request, id):
    a = company.objects.get(id=id)
a.approval = 'rejected'
a.save()
    messages.info(request, 'Rejected company')
    return redirect('/selectcompany/')


def purchased(request):
    a = vendordesign.objects.filter(mailsent=True,buy=True,ontime=True)
    return render(request, 'admins/bought.html', {'a': a})


def dropped(request):
    a = vendordesign.objects.filter(mailsent=True, buy=True,
```

```
delay=True,drop='waiting')
    return render(request, 'admins/dropped.html', {'a': a})



defsendtoeng(request,username):
    messages.info(request,'details forwarded to engineer')
    vendordesign.objects.filter(username=username).update(drop='dropped')
    return redirect('/dropped')



def logout(request):

fromdjango.shortcuts import render,redirect
from . models import *
from django.db import IntegrityError
from django.contrib import messages
from vendor.models import *

from django.core.mail import send_mail
from django.conf import settings
def index(request):
```

```
    return render(request,'index.html')



def login(request):
    if request.method=='POST':
        email=request.POST['email']
        password=request.POST['password']
        try:
            r=admin.objects.get(email=email,password=password)
request.session['ad']=r.email
            if r is not None:
                messages.info(request,'welcome')
                return redirect('/show')
        except admin.DoesNotExist as e:
            messages.info(request,'name does not exists')
            return redirect('/login')


else:
        return render(request,'admins/login.html')
```

```
def show(request):
    return render(request, 'admins/showadmin.html')


defselectcompany(request):
    a=company.objects.filter(approval='waiting')
    return render(request, 'admins/selectvendor.html',{'a':a})



def approve(request,id):
    a=company.objects.get(id=id)
a.approval='approved'
a.save()
    messages.info(request,'Approved company')
    return redirect('/selectcompany/')


def reject(request, id):
    a = company.objects.get(id=id)
a.approval = 'rejected'
a.save()
messages.info(request, 'Rejected company')
    return redirect('/selectcompany/')
```

```
def purchased(request):
    a = vendordesign.objects.filter(mailsent=True,buy=True,ontime=True)
    return render(request, 'admins/bought.html', {'a': a})
def dropped(request):
    a = vendordesign.objects.filter(mailsent=True, buy=True,
delay=True,drop='waiting')
    return render(request, 'admins/dropped.html', {'a': a})
defsendtoeng(request,username):
    messages.info(request,'details forwarded to engineer')
    vendordesign.objects.filter(username=username).update(drop='dropped')
    return redirect('/dropped')
defsendtoeng(request,username):
    messages.info(request,'details forwarded to engineer')
    vendordesign.objects.filter(username=username).update(drop='dropped')
    return redirect('/dropped')
```

CHAPTER 7

PERFORMANCE ANALYSIS

7.1 TEST CASE AND REPORTS:

TEST CASES

No	Test Scenario	Expected Result	Test Result	Pass /Fail
1	Username is correct. Password is incorrect.	Username and Password is incorrect.	Username and Password is incorrect.	Pass
2	Username is incorrect. Password is correct.	Username and Password is incorrect.	Username and Password is incorrect.	Pass
3	Username is empty. Password is correct.	Username is required.	Username is required.	Pass
4	Username is correct. Password is empty.	Password is required.	Password is required	Pass
5	Both Username and Password is incorrect.	Username and Password is incorrect.	Username and Password is incorrect.	Pass

6	Both Username and Password is empty.	Username and Password is required.	Username and Password is required.	Pass
7	Both Username and Password is correct.	Login Successful.	Login Successful.	Pass

REPORTS

All the test cases have passed and the proof of the actual output is added below in the appendices column(Fig A.1)

CHAPTER 8
CONCLUSION

8.1 RESULTS & DISCUSSION

This paper proposes a strategy for arriving at the best design possible which aligns with the interests of the user who wants to buy a car with the best engine design. In this, information is moved among prevalent and delegates utilizing a solid convention.

8.2 CONCLUSION AND FUTURE ENHANCEMENTS

CONCLUSION:

In this project, the best design selection for the car manufacturing industry has an outstanding role. So the first best design of the vendor is achieved by applying the Linear Support Vector Classification algorithm and though when the vendor fails to supply the needs. Then the recommendation for the second best is chosen for the completion of the project based on the classification process by using the linear kernel. In this approach, we can choose the outstanding design by covering all the multiple specifications.

FUTURE ENHANCEMENTS:

In future enhancements, the proposal for the engine design for the different kinds of vehicles can be applied in a wide range by using the algorithm. So that in every way, the request for the best design can be fulfilled to which enhances the efficiency of the vehicle and improving the industry sector needs efficiently.

APPENDICES

A.1 SAMPLE SCREENS

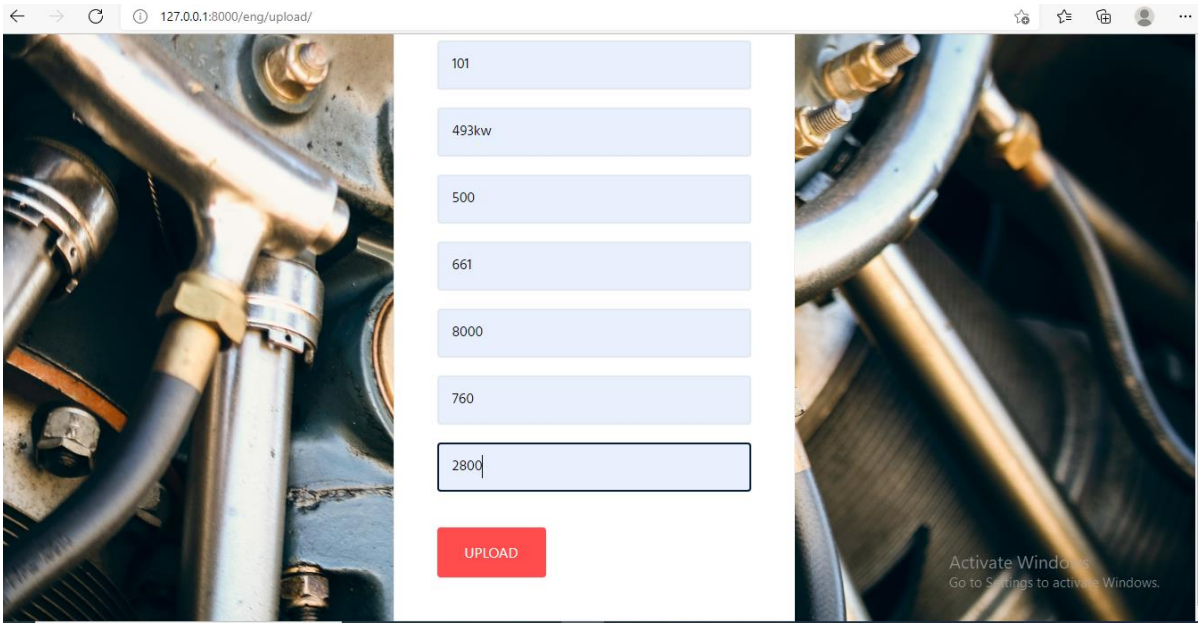


Figure A1: Engine design login page

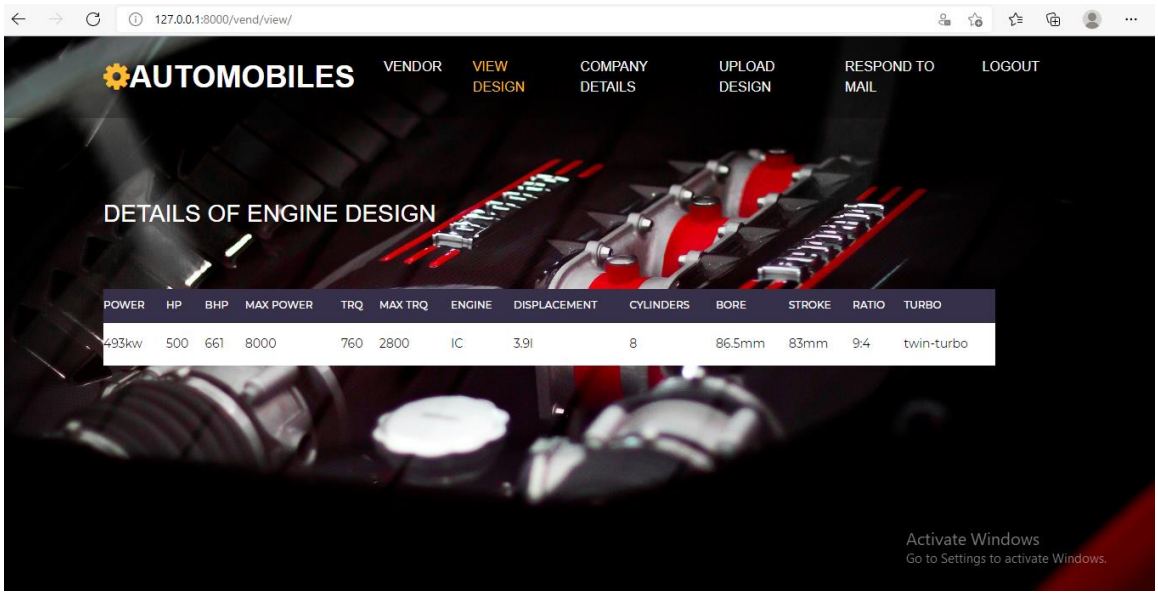


Figure A2: View Design page

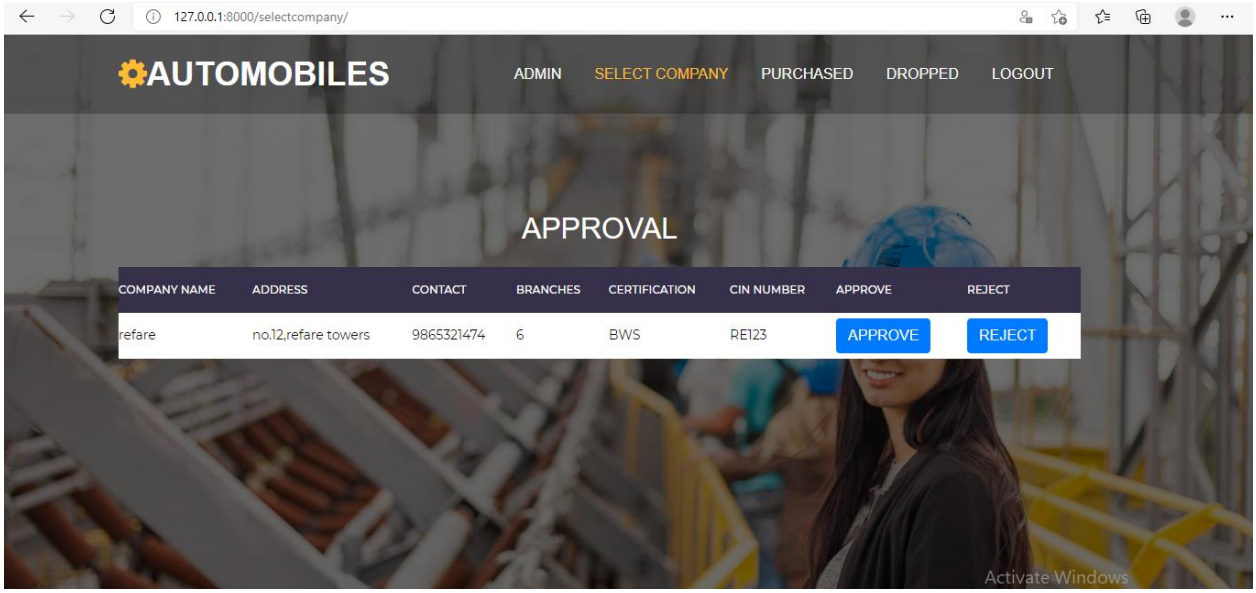


Figure A3: Select Company page

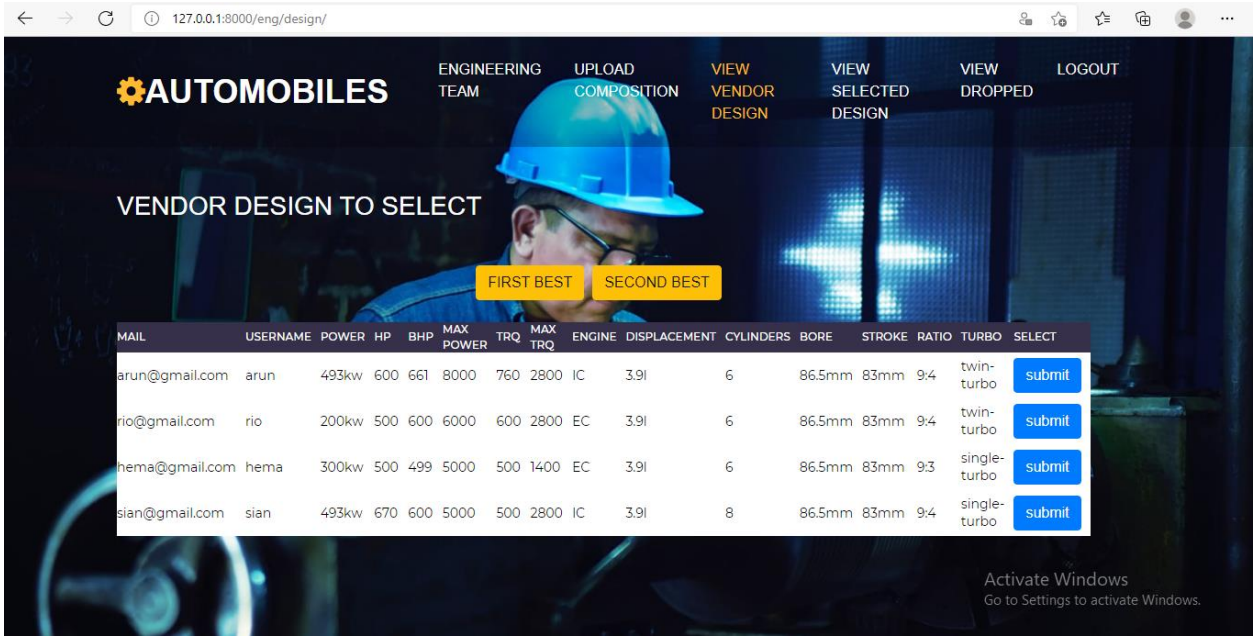


Figure A4: View vendor design page

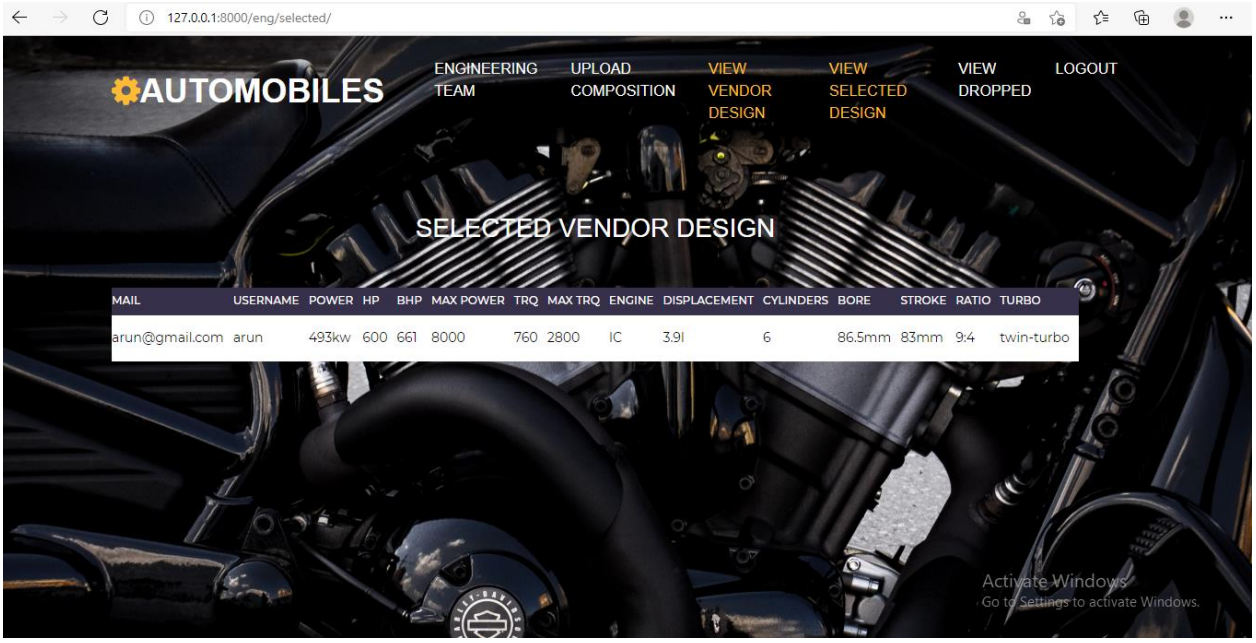


Figure A5: Selected vendor design page

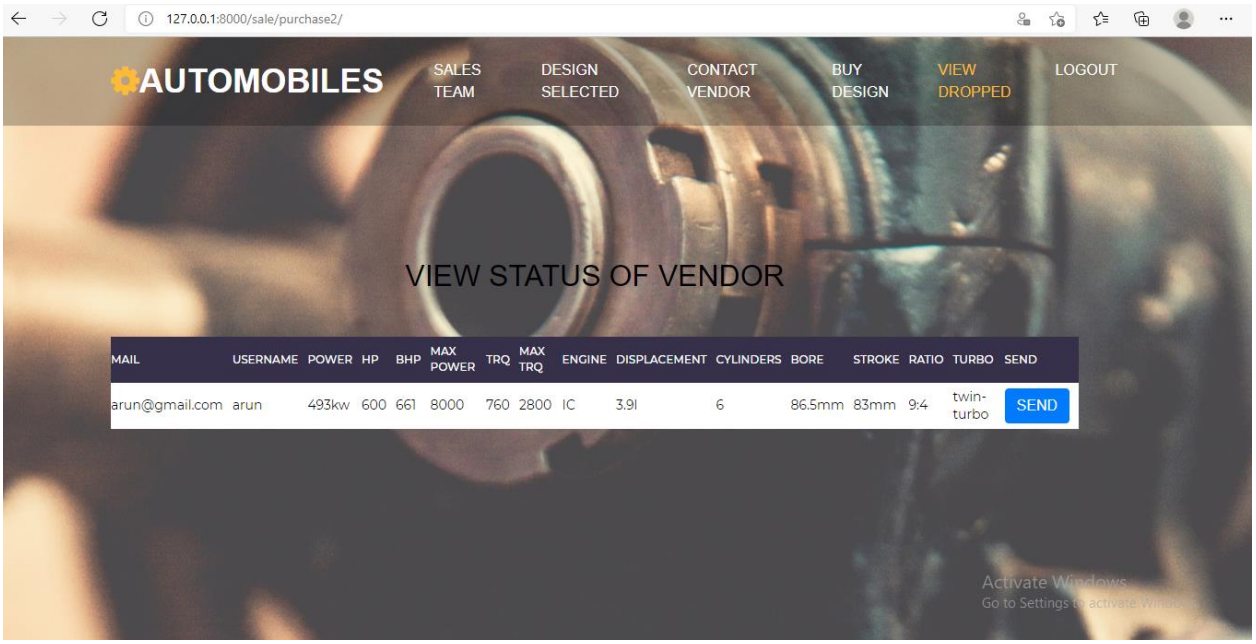


Figure A6: Status of vendor page

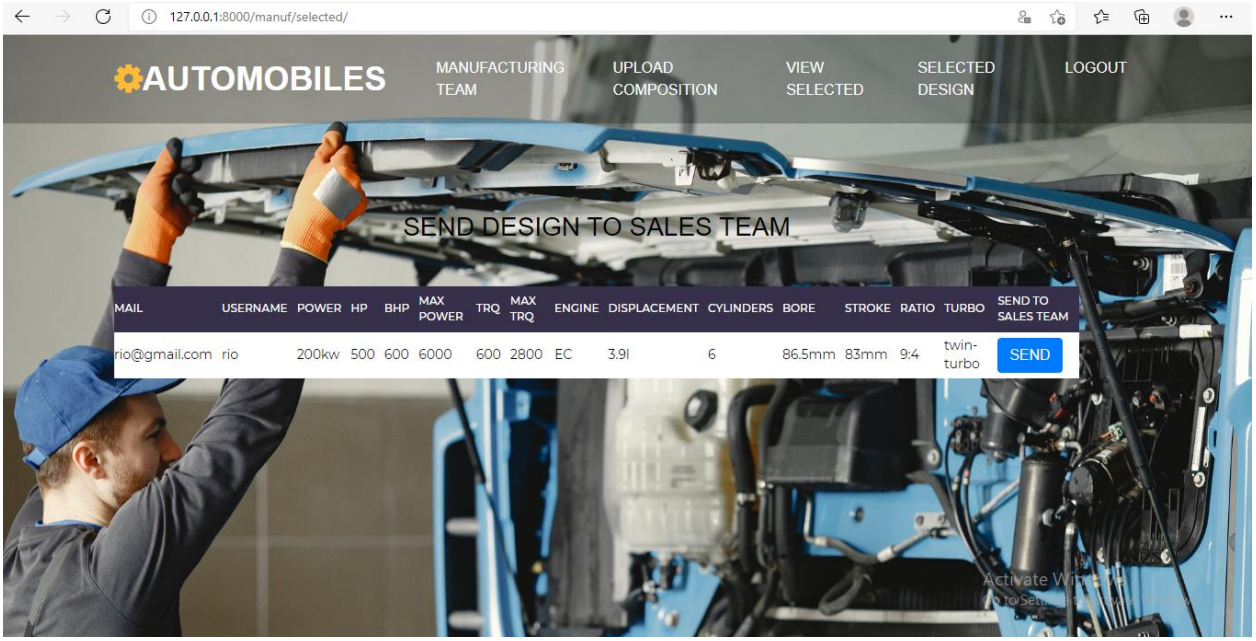


Figure A7: Design sending page

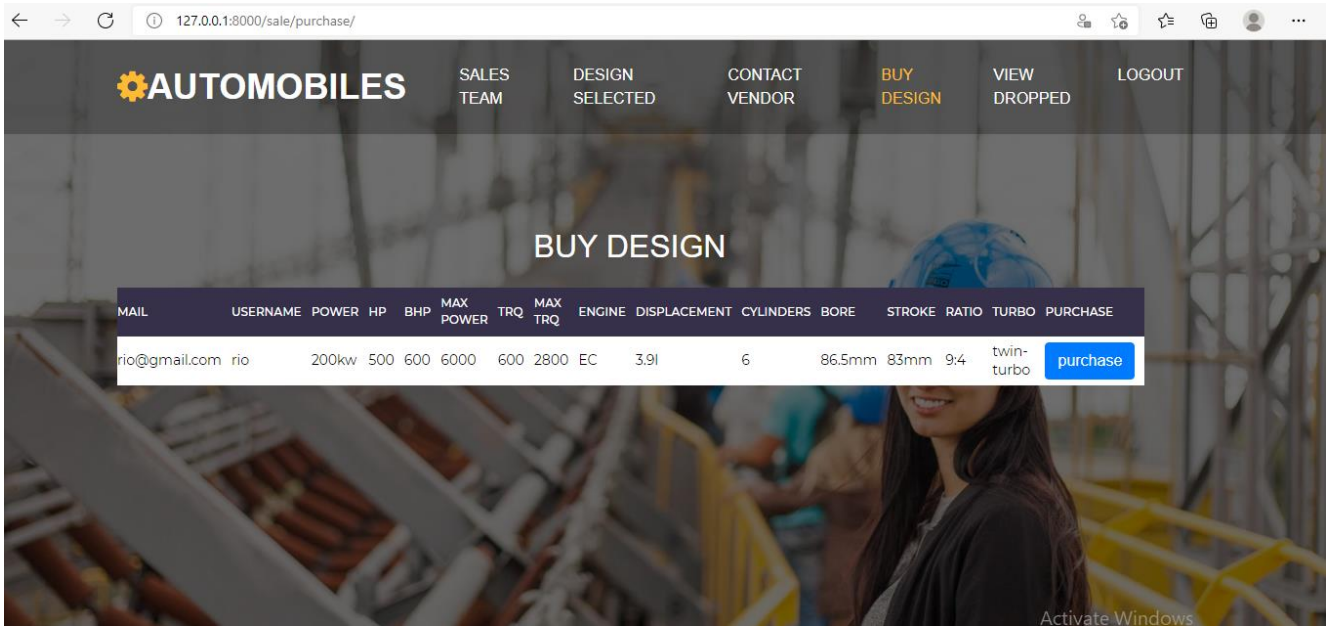


Figure A8: Buy design page

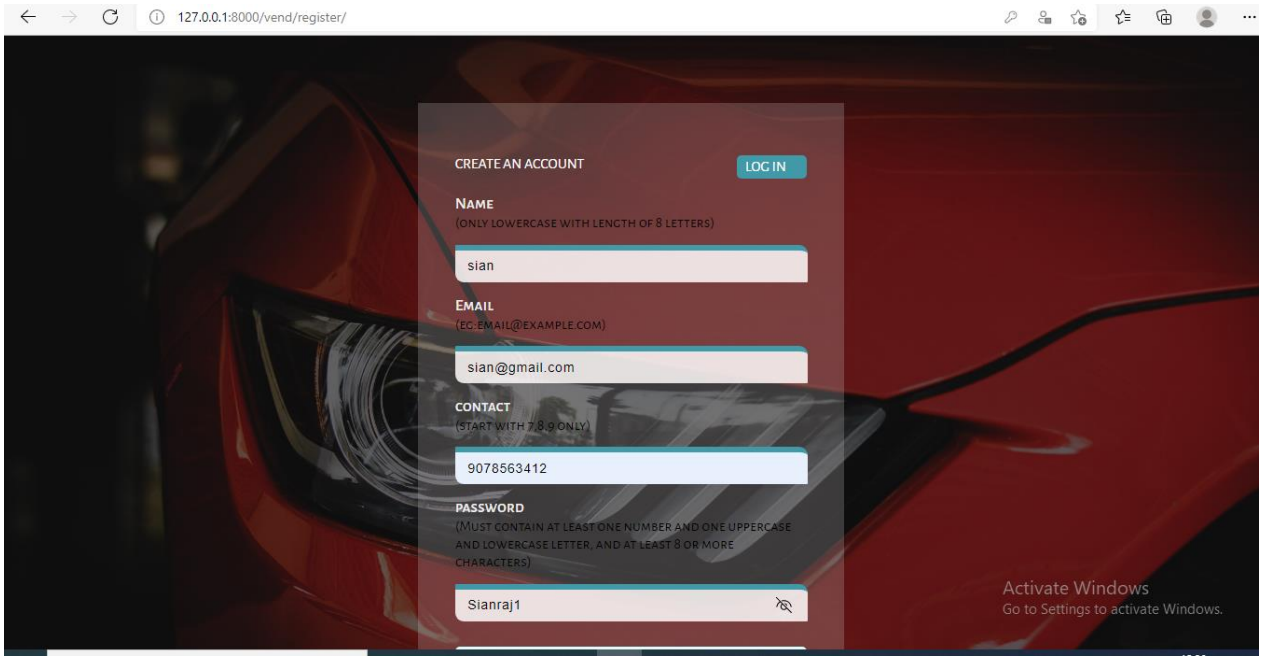


Figure A9: Vendor login form

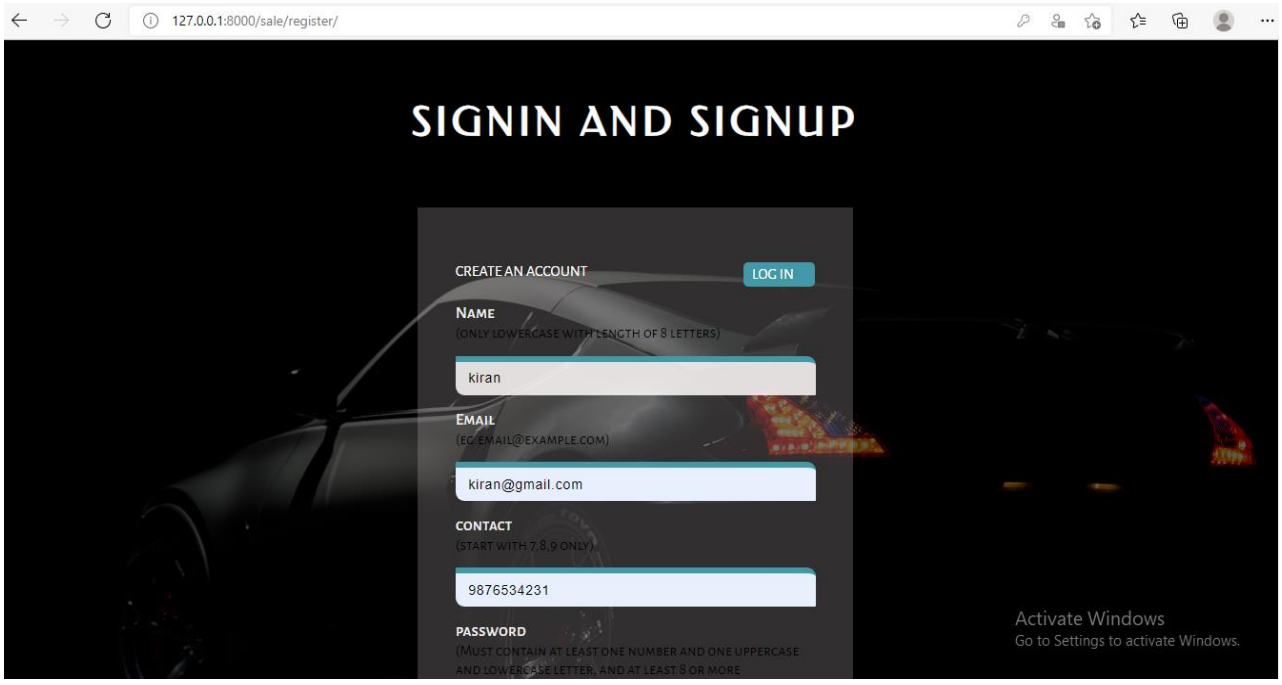


Figure A10: Sales register form

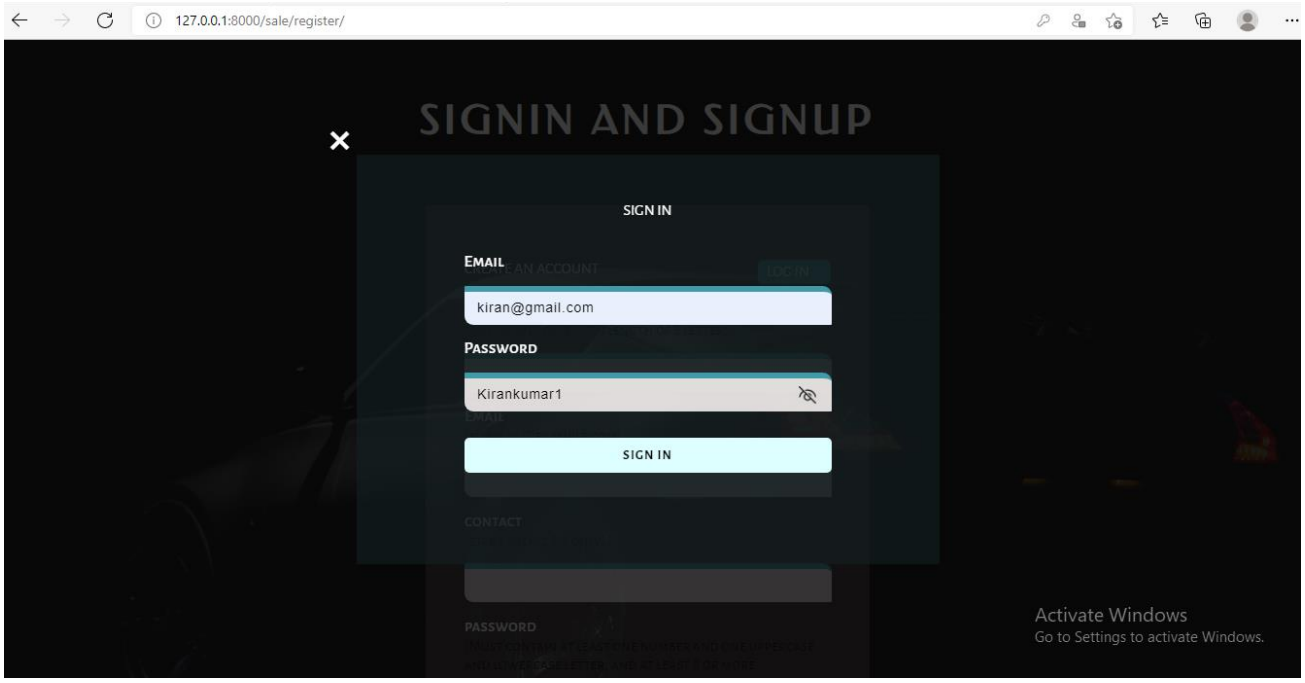


Figure A11: Sales login form

REFERENCES

1. D. Han, W. Du, W. Du, Y. Jin, and C. Wu, “An adaptive decompositionbased evolutionary algorithm for many-objective optimization,” Inf. Sci., vol. 491, pp. 204–222, Jul. 2019.

2. D. Sudholt, “How crossover speeds up building-block assembly ingenetic algorithms,” Evol. Comput., vol. 25, no. 2, pp. 237–274, 2017.

3. F. Daolio, A. Liefooghe, S. Verel, H. Aguirre, and K. Tanaka, “Problem features versus algorithm performance on rugged multiobjective combinatorial fitness landscapes,” Evol. Comput., vol. 25, no. 4, pp. 555–585, 2017.

4. H. Ishibuchi, Y. Setoguchi, H. Masuda, and Y. Nojima, “Performance of decomposition-based many-objective algorithms strongly dependson Pareto front shapes,” IEEE Trans. Evol. Comput., vol. 21, no. 2,pp. 169–190, Apr. 2017.

5. R. Tanabe and H. Ishibuchi, “An analysis of control parameters of MOEA/D under two different optimization scenarios,” Appl. Soft Comput., vol. 70, pp. 22–40, Sep. 2018

6. R. Wang, J. Xiong, H. Ishibuchi, G. Wu, and T. Zhang, “On the effectof reference point in MOEA/D for multi-objective optimization,” Appl.Soft Comput., vol. 58, pp. 25–34, Sep. 2017.

7. R. Wang, Q. Zhang, and T. Zhang, “Decomposition-based algorithmsusing Pareto adaptive scalarizing methods,” IEEE Trans. Evol. Comput.,vol. 20, no. 6, pp. 821–837, Dec. 2016.

8. X. He, Y. Zhou, Z. Chen, and Q. Zhang, “Evolutionary many-objectiveoptimization based on dynamical decomposition,” IEEE Trans. Evol.Comput., vol. 23, no. 3, pp. 361–375, Jun. 2019.

9. X. Ma, Q. Zhang, G. Tian, J. Yang, and Z. Zhu, “On Tchebycheff decomposition approaches for multiobjective evolutionary optimization,” IEEE

Trans. Evol. Comput., vol. 22, no. 2, pp. 226–244, Apr. 2018

10. Y. Xiang, Y. Zhou, M. Li, and Z. Chen, “A vector angle-based evolutionary algorithm for unconstrained many-objective optimization,” IEEETrans. Evol. Comput., vol. 21, no. 1, pp. 131–152, Feb. 2017.

11. Dong Han, Wenli Du, Wei Du, Yaochu Jin, Chunping Wu, An adaptive decomposition-based evolutionary algorithm for many-objective optimization,Information Sciences,Volume 491,2019,Pages 204-222,ISSN 0020-0255.

12. M. Jafari, L. Daryani and M. Feizi-Derakhshi, "A Prior Preference-Based Decision-Making Algorithm in Pareto Optimization," 2019 9th International Conference on Computer and Knowledge Engineering (ICCKE), 2019, pp. 98-103, doi: 10.1109/ICCKE48569.2019.8964943.

13. Y. Wan, H. Cui, Y. Liu and R. Cong, "A Visualization Framework of Pareto Optimization for Decision Making," 2020 International Conference on Artificial Intelligence and Computer Engineering (ICAICE), 2020, pp. 501-505, doi: 10.1109/ICAICE51518.2020.00103.

14. A. Brik, L. Labrak, L. Carrel, I. O’Connor and R. Iskander, "Fast extraction of predictive models for integrated circuits using n-performance Pareto fronts," 2019 IFIP/IEEE 27th International Conference on Very Large Scale Integration (VLSI-SoC), 2019, pp. 281-286, doi: 10.1109/VLSI-SoC.2019.8920305.

15. Bejarano, Lilian A., Helbert E. Espitia, and Carlos E. Montenegro. 2022. "Clustering Analysis for the Pareto Optimal Front in Multi-Objective Optimization" Computation 10, no. 3: 37.

16. A. Toro-Frias et al., "Generation of Lifetime-Aware Pareto-Optimal Fronts Using a Stochastic Reliability Simulator," 2019 Design, Automation & Test in Europe Conference & Exhibition (DATE), 2019, pp. 78-83, doi: 10.23919/DATE.2019.8714784.

17. Zhang, Chunhua & Shao, Xiaojian & Li, Dewei. (2013). Knowledge-based Support Vector Classification Based on C-SVC. Procedia Computer Science. 17. 1083-1090. 10.1016/j.procs.2013.05.137.

18. J. Wang, H. Liu, X. Cao, Q. Deng and T. Pei, "Multi-objective Optimization of Resource Allocation for Uplink Transmission in Two-Tier Heterogeneous Cellular Networks," 2019 IEEE International Conference on Smart Internet of Things (SmartIoT), 2019, pp. 275-282, doi: 10.1109/SmartIoT.2019.00049.

19. X. -B. Hu, H. Li, J. Zhou, M. -K. Zhang and J. -Q. Liao, "Finding all Pareto Optimal Paths for Dynamical Multi-Objective Path optimization Problems," 2019 IEEE Symposium Series on Computational Intelligence (SSCI), 2019, pp. 965-972, doi: 10.1109/SSCI.2018.8628753.

20. Geng, Zhiqiang & Zhu, Qunxiong & Han, Yongming. (2017). Review: Multi-objective optimization methods and application in energy saving. Energy. 125. 10.1016/j.energy.2017.02.174.