ANTI THEFT DESIGN OF CAR SEAT

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We certify that the project entitled *Anti Theft Design of Car Seat (Mechanicals)* is written by *Nurul Husna binti Mohamad Shariff* . We have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. We herewith recommend that it be accepted in partial fulfilments of the requirements for the degree of Bachelor of Mechanical Engineering with Automotive Engineering.

Dr. Maisara Mohyeldin

Examiner Signature

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Report submitted in fulfillment of the requirements
for the award of the degree of
Bachelor of Mechanical Engineering with Automotive Engineering

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Automotive Engineering.

Signature	:	
Name of Supervisor	:	Mr. Zamri bin Mohamed.
Position	:	Lecturer
Date	:	20 November 2009

STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurently submitted for award of other degree.

Signature :

Name : Nurul Husna bt. Mohamad Shariff

ID Number: MH07069

Date : 20 NOVEMBER 2009

Dedicated to my beloved mak and ayah

ACKNOWLEDGEMENTS

Throughout two semesters, I met numbers of lecturers and professionals who have assisted me in many ways towards completing my research. Firstly, I would like to express my sincere appreciation to my supervisor, Mr. Zamri b. Mohamed, who generously shared his insights and suggestions, for his critics, trust, encouragement, and attention. Without their continued support and interest, this project report would not have been the same as presented here.

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ABSTRACT

This report is an outcome of the work I have carried out in doing and completing my final year project, the Anti Theft Design of Car Seat. This report presents a new anti theft design of car seat prototype designed for the automatic car locking system, with attention on user's safety and surrounding impact. The overall task is analyzed and proper suggestions are developed to organize the operation of new type car lock system which will use a car seat as a locking medium. The report starts off with an introduction on car anti theft system and car lock system. Then a further introduction describe on the important of the car lock and its advantages towards car safety. Based on the information, a design of new seat model is made. Several sketches have been made and only a few have been selected based on the suitability of the system. Besides, material needed in this project will be listed and the system used will be selected. Next all the sketches will be draw into CATIA software .Each part of the new model are tested using finite element method to make sure that the strength and stiffness of the seat unit are suitable for everyday usage. The seat are design to be fully automated seat, thus the control system of the seat movement are made. This project is successfully completed when final model has proved to be fulfilling nearly every factor that needed in anti theft system and car seat system.

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ABSTRAK

Laporan ini adalah hasil dari kajian saya dalam menyiapkan Projek Sarjana Muda saya yakni bertajuk Rekaan Kerusi Kereta Anti Pencuri (Mekanikal).Secara keseluruhannya,laporan ini akan memaparkan prototype baru kerusi kereta anti pencuri yang direka khas untuk sistem penguncian kereta dengan mengambil kira keselamatan pengguna dan kesannya kepada keadaan sekeliling.Keseluruhan tugas adalah untuk manganalisis dan memberikan cadangan yang terbaik dalam merekabentuk kekunci terbaru yang mana menggunakan kerusi kereta sebagai medium kekunci.Laporan ini dimulakan dengan pengenalan kepada sistem anti pencuri dan sistem kekunci kereta.Lanjutan pengenalan menyentuh tentang kepentingan kekunci kereta dan kepentingannya kepada keselamatan kereta.Rekabentuk akan dibuat berdasarkan dokumen yang dikumpulkan dan dipilih bersesuaian dengan projek ini sendiri.Beberapa lakaran akan dibuat dan berdasarkan lakaran ini,bahan yang akan duguna akan disenaraikan.Lakaran ini kemudiannya akan dilakukan semuala dalam perisian CATIA.Semua komponen akan diuji menggunakan perisian ALGOR bagi memastikan ketahanan dan keutuhan model baru ini adalah bersesuaian untuk kegunaan harian.Secara keseluruhannya,kerusi ini direka sepenuhnya kepada kerusi automatik,oleh itu litar pengawal kepada unit ini juga disiapkan.Projek ini dibuktikan berjaya apabila model baru Kerusi Kereta Anti Pencuri ini memenuhi semua aspek yang diperlukan dalam sistem kawalan anti pencuri dan system kerusi ketera itu sendiri.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURES

LIST OF SYMBOLS

a_c	Acceleration
r	Radial Position
$\dot{r}$	Radial Displacement Speed
S	Displacement
So	Initial Displacement
t	Time
V	Velocity
Vo	Initial Velocity
θ	Angle
$\dot{\theta}$	Angular Displacement Speed

LIST OF ABBREVIATIONS

2-D	Two Dimensional
3-D	Three Dimensional
AC	Automatic Control
CFD	Computational Fluid Dynamics
CAD	Computational Aided Design
CATIA	Conception Assistée Tridimensionnelle Interactive, ench for Interactive Aided Three Dimensional Design
DC	Direct Current
FEA	Finite Element Analysis
RPM	Rotational Per Minutes
SPICE	Simulation Program for Integrated Circuits Emphasis.

CHAPTER 1

INTRODUCTION

1.0 PROJECT BACKGROUND

The project purpose of this project is to designing and analyze an Anti Theft Car Seat model. This car seat design would be entirely different from other existing car anti theft devices. In this study, the main target is to design the whole new anti theft car seat and to ensure that it is suitable and match various kind of seat model.

The project covers the analysis of car seat structure with focusing to the mechanism and cost. Electronic devices will also be added to supplement the design. Overall, this project involves most of the mechanical engineering aspect.

1.1 PROJECT SYNOPSIS

Anti theft device are widely use today due to increasing of car stolen case. Many car users realize that they need some extra devices to ensure their car safety. Mechanical devices such as steering wheel bars and pedal locks are only a minor inconvenience for the car thieves. They can easily break it and steal the car easily. Auto theft is common criminal causing loss not only in terms of money and time, but also ones life. This project will come out with one of innovative way to improve car security is by designing an anti-theft car seat.

Anti Theft Car Seat help user to lock the car at non drivable position. One of the main objective is to design and install lock so that the seat stay put in non drivable position, thus prevent the car prom be driven and stole. This car seat locking system would be entirely different from other existing car anti theft devices. In this study, the main target is to design an anti theft car seat and make sure it is suitable and match various kind of seat model.

1.2 STATEMENT OF PROBLEM

Anti theft devices that are available today are separable from car part. It is usually bulky and appears to be more visible to the car thieves. Considering these factors, anti theft devices are more efficiently if it's less visible and pack with available car part such as car seat. This project explains and focuses detail on how to design and implement anti theft system on car seat.

1.3 PROJECT OBJECTIVES AND SCOPES OF WORK

The main objectives of this project are:

- Design of anti theft car seat mechanism
- Analyze the new seat mechanism
- Modification of standard seat rail mechanism/structure.
- Fabrication of the new modified seat mechanism with anti theft car seat lock.

The scope involve will be:

- Literature review :To practice the knowledge and skill that have been gathered before solving problem process .This project also important to train and increase the capability to get know, research, data gathering, analysis making and then solve a problem by research or scientific research.
- Design: Design a new modification on car seat mechanism using CATIA and PSPICE software.
- Analysis : Analyze car seat mechanism using CAE,CAD and FMEA table
- Fabrication: Apply the design and fabricate into whole new car seat lock.

1.4 SIGNIFICANT OF PROJECT

This present invention is to overcome the disadvantages of anti theft system by providing an anti theft system using components that are already attached is a car such as car seat. The anti theft component are attach together in a new and useful way to provide a much low cost and ergonomics anti theft seat system for automobile vehicle.

1.5 EXPECTED OUTCOMES

The expected outcomes for this project is to come out with the new anti theft design of car seat that come together with the car anti theft system This new invention are design and analyze concerning on vehicle user's needs and everyday usage of the seat unit.

1.6 PROJECT ORGANIZATION

Chapter 1 is an overall introduction of this project which will be started with a project background. The rational of these project then will be discusses in problem statement followed by the purpose of the project. This chapter ended with the research question.

Chapter 2 is a review on the literature. An introduction to the design software used which is the CATIA.Computer software application can be utilized to perform computational analysis of the vehicle body shape based on the established theory. The body that had been developed this far was analyzed and optimized through the use of two computer software applications.

Solid model of the vehicle body shapes were created using CATIA software. CATIA is a computer aided drawing software packages that are used to create two and three dimensional model of various shape such as vehicle body shapes. Then, the CATIA model will be tested. CATIA software is widely used in study of mechanical and flow behaviors around moving bodies.

Furthermore it discusses on the important of car anti theft system and lead screw system which will be used in the new Anti Theft Design of Car Seat.

Chapter 3 is discussing on the overall planning for this project which include the flow chart and Gantt chart. All of the software that has been used in this project will be basically introduce in this chapter. These chapters are important as an overall review of the project structure.

Chapter 4 is focus on the analysis of the result and discussion. Some of the important factor in designing new seat such as material selection, gearing system and anti theft seat system whole calculations also been focused. Comparison of the commercial seat and new seat are made in order to highlight the different of both model. At the end there are the discussion and analysis are made refers to the both model.

Chapter 5 will summarize the entire project. It represents the recommendation, the future work and lastly the conclusion of the whole project.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

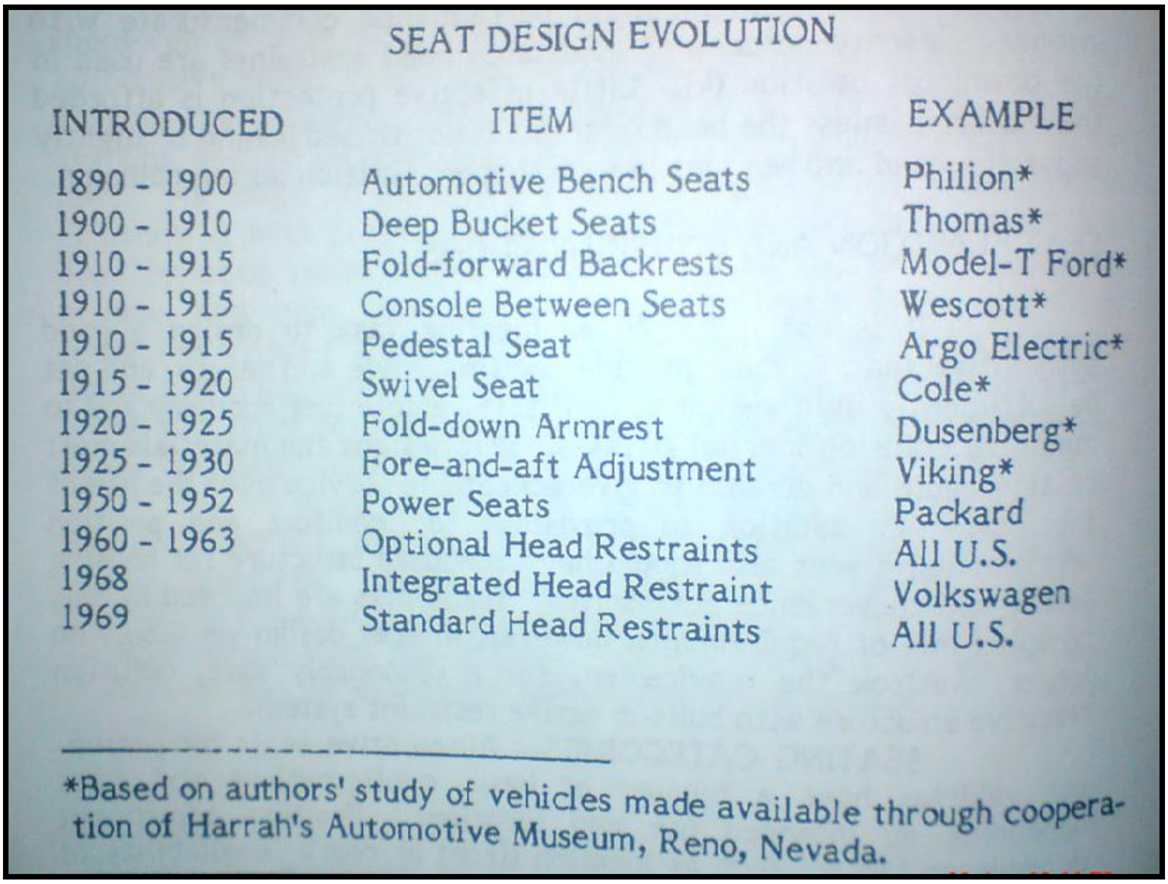
This chapter is an introduction to car seat system. Starts with the history of car seat development, this section will elaborate more on the improvement of car seat design. Next is seat function and configuration where seat part will be defined one by one. This section end with a description an car anti theft system and devises and its important toward vehicle users.

2.1 CAR SEAT HISTORY

Like the first automobile, the first automotive seat was adaptation from the horse draw carriage. Using spring to absorb road shock and effective padding was none yet exists and seat adjustability had not yet been considered. Around 1900, deep contoured seat were created for motorist safety while travelling over rough road to rescue the likelihood of motorist ejection as they pitch and rolled. (Kerkhoff J.F.,,2006).

Front seat adjustment was only available until about 1929 and became features of higher prices automobiles. Improvements in seat design continued by the mid 1930's,seats tracks and runners closely resembled those of the mid 1960's.During in between of these period, the only significant innovation in seat design was the introduction of power seats and adjustable reclining backrest during early 1950's. (Kerkhoff J.F.,,2006)

Seatback height reached reasonable reason levels in 1960's but by the mid 70's the height of backrest on many model had declined to less effective then thirty years ago. Seatback strength has not increased significantly over 30 yeas and remains inadequate to resist even moderate collision forces.(David C.Viano(2003)),(Severy D.M.,Blaisdale M.,Kerkhoff J.F(2006,)).



SEAT DESIGN EVOLUTION

INTRODUCED	ITEM	EXAMPLE
1890 - 1900	Automotive Bench Seats	Philion*
1900 - 1910	Deep Bucket Seats	Thomas*
1910 - 1915	Fold-forward Backrests	Model-T Ford*
1910 - 1915	Console Between Seats	Wescott*
1910 - 1915	Pedestal Seat	Argo Electric*
1915 - 1920	Swivel Seat	Cole*
1920 - 1925	Fold-down Armrest	Dusenberg*
1925 - 1930	Fore-and-aft Adjustment	Viking*
1950 - 1952	Power Seats	Packard
1960 - 1963	Optional Head Restraints	All U.S.
1968	Integrated Head Restraint	Volkswagen
1969	Standard Head Restraints	All U.S.

*Based on authors' study of vehicles made available through cooperation of Harrah's Automotive Museum, Reno, Nevada.

Figure 1.1: Seat Design Evolution

2.2 SEAT FUNCTION AND CONFIGURATIONS

It’s not a simple engineering task to design automotive seat. It must provide comfort, style, safety and sufficiently light weight to facilitate vehicle fuel economics. In addition to provisions for comfort and position adjustment, a seat should also have adequate structure for housing safety and convenience accessories. The seat design should no longer overlook the requirement for a reasonable safe, collision resistive structure with build in active restrain system.(David C.Viano(2003)), (Kerkhoff J.F.,,2006).

2.2.1 SEATING CATEGORIES

An automotive seat for passenger vehicles have different number of configurations and sized depends on used and locations. Position adjustment depends on factors such as locations (front or rear); availability of comfort features, including centre armrests, depends on vehicles price, type purpose and even country of origin. (David C.Viano(2003))

Table 2.1: Seating Categories

Bench Seat-Solid Back	• Standard for 4 door sedan • Front seat has a single adjustment mechanism and entire seat is usually adjusted according to driver needs. • Bench seat ad equated design for 3 occupants.
Bench Seat-Split Back	• Fold-forward backrests provide access to the rear seat of 2 vehicle • Only upper portion of seat divided, the fore and aft adjustment can accommodate only one person. • Backrest angle can be made adjusted according to the individual needs of driver and passenger.

Bucket Seat	• Contours seat for individual occupancy. • Adjustable backrest angle is commonly available and provides improved comfort and reduce muscle fatigue.
Folding Seat	• Required special design consideration to allow them to be folded flat when hauling cargo. • Seatback strength and height as well as provision for isolating cargo are collision safety factors to be considered.
Pedestal Bucket Seats	• Common to bus, van and trucks. Variable backrest angle and swiveling position mechanism are sometimes provided
Fixed, Bus type Bench Seats	• Similar to rear seat of passenger sedans, but these seats are elevated and generally provide open space beneath • Structural limitations and remoteness of seats from floor increase the difficulty of direct restrain attachment.

Source: Severy D.M.,Blaisdale M.,Kerkhoff J.F.(2006)

2.2.2 SEATING COMPONENTS

A brief description of seats component to allow better understanding of basic seats requirement and the special seat structure.

Table 2.2 : Seating Component

Structural Frame Member	• The seat framework • Usually constructed of steel that has been formed into tubular configurations or of stamped or rolled sheet metal.

	• New design and strengthening of the seat framework in conjunction with its anchorages can provide the force resistance necessary for occupants' restraint during moderate and severe front and rear-end collision.
Non-Structural Seat Material	• Cushions, spring and upholstery provide the necessary means of loads distributions between occupant and seat frame • An improved designed integral seat would include energy absorption padding at the sides, top and back to provide additional force moderation and load distribution.
Seat Adjustment Mechanism	• Seat Adjustment Mechanism should be strengthened to withstand collision force as well as the rigors of everyday usage. • Desired seat positions may be accomplished by means of longitudinal, vertical and tilt adjustments. • Other adjustment include backrest angle, head restrain position and lumbar support stiffness.
Seat Anchorages	• Generally interposed between the seat adjustment mechanism and the vehicle floor pan or lower structure. • Under static condition, the seats anchorage transmitted compressions, tension and shear forces from the seats to the floor or side structure. • Beside the usual floor, sill and tunnel anchorages, other potential anchorage location for strengthened seat system include side and roof attachment.

Source: Severy D.M.,Blaisdale M.,Kerkhoff J.F.(200)

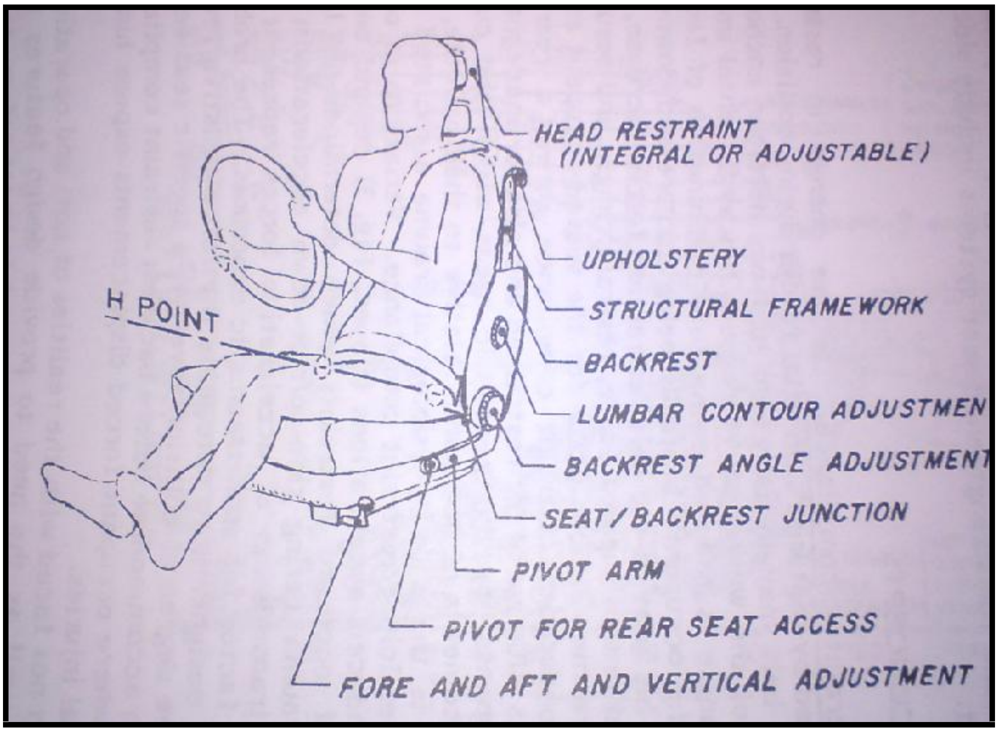


Figure 2.1: Seat Nomenclature

2.3 CAR ANTI THEFT DEVICES

Nine-out-of-ten cars are hot-wired and driven away. Mechanical devices such as steering wheel bars and pedal locks are only a minor inconvenience for the professional. Although they may work as a deterrent, car alarms can be "hot wired" around. The professional thief simply cuts or jumps the alarm wires and he is gone. Tracking devices used by police to locate stolen cars do not stop the vehicle from being hot-wired and driven away. They depend on early notification of authorities by the owner. A car that is taken at 2 a.m. can be dismantled miles away before the owner even realizes it is gone. (Kerkhoff J.F.,,2006), (David C.Viano(2003)).

Some models are more popular than others, but any vehicle is a target for car thieves. A dismantled vehicle is worth two to four times its showroom value in parts.

Anti-theft devices Car thieves target vehicles that present the least amount of hassle. A vehicle equipped with an anti-theft device is more of a hassle than one without. This part of Auto Crime and Fraud helps you choose a good anti-theft device and rates the effectiveness of most models available on the market today. It also shows how crime-savvy customers can save money on a policy or a claim. (Kerkhoff J.F.,,2006), (David C.Viano(2003)).

Anti-theft devices can deter thieves three ways:

- Physically — no thief wants to waste precious time exerting a lot of physical effort.
- Visually — just the sight of an anti-theft device inside a car will put off many thieves.
- Audibly — thieves never want to draw attention to them.

To help protect the vehicle, it's worth investing in the best anti-theft system that can be afforded. But no anti-theft device is foolproof.

While not foolproof, anti-theft devices can stop the amateur thief and slow down the professional. The longer it takes to steal a car, the more attention the thief attracts, and the more likely the thief will look elsewhere. (Crouse, Anglin (2001)).

2.4 GEAR SYSTEM

Gears are machine elements used to transmit rotary motion between two shafts, normally with a constant ratio. Gear design has evolved to such a level that throughout the motion of each contacting pair of teeth the velocity ratio of the gears is maintained fixed and the velocity ratio is still fixed as each subsequent pair of teeth come into contact. This project involved 3 different types of gear which is rack and pinion, internal gear and spur gear. All of the gear are used as seat locking devices in the anti theft car seat system. (Norton,2006), (Johnson.,2003).

The first gear system which is the rack and pinion is used to convert between rotary and linear motion. The rack is the flat, toothed part, the pinion is the gear. Rack and pinion can convert from rotary to linear of from linear to rotary. (Norton,2006).

The speed that the rack moves as the pinion turns determines by the diameter of the gear. Rack and pinion gears give a positive motion especially compared to the friction drive of a wheel in tarmac. In the rack and pinion railway a central rack between the two rails engages with a pinion on the engine allowing the train to be pulled up very steep slopes. (Norton,2006)

The spur gear is a simplest type of gear manufactured and is generally used for transmission of rotary motion between parallel shafts. The spur gear is the first choice option for gears except when high speeds, loads, and ratios direct towards other options. A gear pair should be selected to have the highest number of teeth consistent with a suitable safety margin in strength and wear. In this project, internal contact spur gear and normal spur gear have been use. (Norton,2006), (Johnson.,2003).

CHAPTER 3

METHODOLOGY

3.1 PROJECT FLOW CHART

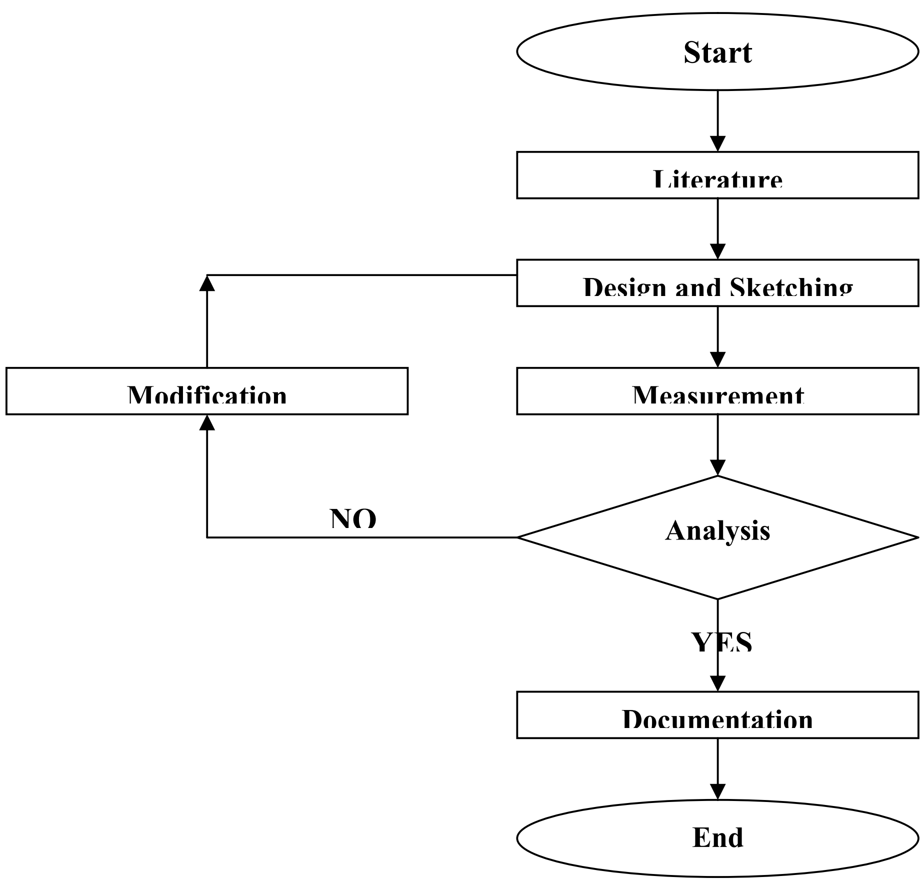


Figure 3.1: Project Flow Chart

Refers to the Figure 3.1, the project starts with the literature review and research on these project topics which is the Anti Theft Design of Car Seat. It consist the review on the study case background and simulation of car lock system and software used for the study which is CATIA and Solid Work. These tasks have been done through research on the internet, books and other relevant sources.

After gathering all the relevant information, the project undergoes design process. In this steps, from the knowledge gathered before is use to make a design refers to case data that suitable for the project. Several sketches have been made and only a few have been selected based on the suitability of the system. Based on the sketches, material needed in this project will be listed and the system used will be selected. Next all the sketches will be draw into Solid Work and CATIA software.

In the analysis step, all the relevant parts that have been completed will be analyze by using Finite Element Analysis software which is ALGOR to make sure the strength and stiffness for the unit are relevant. Gear properties are analyzed by GearTrax software. Beside using computer based analysis, all the data and properties are calculated manually using mechanical design analysis formula.

At the end, when all the process mentioned above is done, the material for report writing is gathered. The report writing process will be guided by the University Malaysia Pahang final year report writing guide. This process also included the presentation slide making for the final presentation of the project. The project ended after the submission of the report and the presentation slide has been presented.

	Task Name	Duration	Start	Finish
1	Project Development	12 days?	Tue 1/13/09	Wed 1/28/09
2	Study The Problem	6 days	Tue 1/13/09	Tue 1/20/09
3	Identify Project requirement	5 days?	Wed 1/21/09	Tue 1/27/09
4	Submitted	1 day?	Wed 1/28/09	Wed 1/28/09
5				
6	Literature Review	32 days?	Tue 2/3/09	Wed 3/18/09
7	Analyse Project Requirement	16 days?	Tue 2/3/09	Tue 2/24/09
8	Technique	11 days?	Tue 2/3/09	Tue 2/17/09
9	Software	5 days?	Wed 2/18/09	Tue 2/24/09
10	Analyse System Requirement	17 days?	Tue 2/24/09	Wed 3/18/09
11	System	6 days?	Tue 2/24/09	Tue 3/3/09
12	Parts/ Material	11 days?	Wed 3/4/09	Wed 3/18/09
13				
14	Design Phase	27 days?	Tue 2/24/09	Wed 4/1/09
15	Preliminary Design	11 days?	Tue 2/24/09	Tue 3/10/09
16	Discuss and Choose The Best Design	1 day?	Wed 3/11/09	Wed 3/11/09
17	Design Using Solid Work	10 days?	Thu 3/12/09	Wed 3/25/09
18	Design Usig Catia	5 days?	Thu 3/26/09	Wed 4/1/09
19				
20	Presentation	5 days?	Mon 4/6/09	Fri 4/10/09

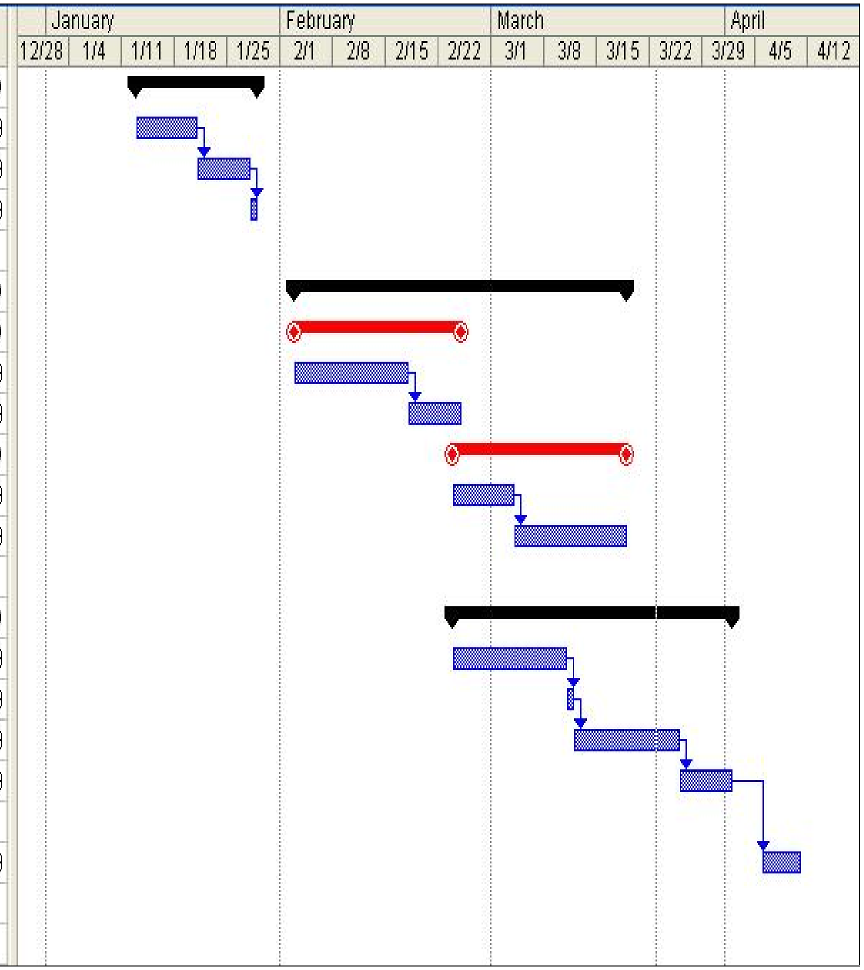


Figure 3.2: Project Gantt chart 1

	Task Name	Duration	Start	Finish
1	**Anti Theft Design of Car Seat**	**61 days**	**Mon 5/4/09**	**Mon 7/27/09**
2	**Analysis**	**13 days**	**Mon 5/4/09**	**Wed 5/20/09**
3	Analysis Material Requirement	11 days	Mon 5/4/09	Mon 5/18/09
4	Analysis Completed	1 day	Wed 5/20/09	Wed 5/20/09
5	**Design Phase**	**25 days**	**Thu 5/21/09**	**Wed 6/24/09**
6	Final design	15 days	Thu 5/21/09	Wed 6/10/09
7	Discuss and get the design approval	2 days	Thu 6/11/09	Fri 6/12/09
8	Develop System	8 days	Mon 6/15/09	Wed 6/24/09
9	**Measurement**	**30 days**	**Mon 6/1/09**	**Fri 7/10/09**
10	Measure seat mechanism	6 days	Mon 6/1/09	Mon 6/8/09
11	Construct an measurement testing	24 days	Tue 6/9/09	Fri 7/10/09
12	**Fabrication**	**26 days**	**Mon 6/22/09**	**Mon 7/27/09**
13	Remove the original seat adjuster	6 days	Mon 6/22/09	Mon 6/29/09
14	Install Lead Srew System to seat mech	20 days	Tue 6/30/09	Mon 7/27/09
15				
16	**Modification**	6 days	Tue 7/7/09	Tue 7/14/09
17				
18	**Report Writing Process**	**398 days?**	**Mon 4/21/08**	**Wed 10/28/09**
19		93 days?	Mon 4/21/08	Wed 8/27/08
20	**Final Presentation**	1 day?	Wed 10/28/09	Wed 10/28/09
21				
22	**Submit Report**	1 day?	Tue 9/1/09	Tue 9/1/09

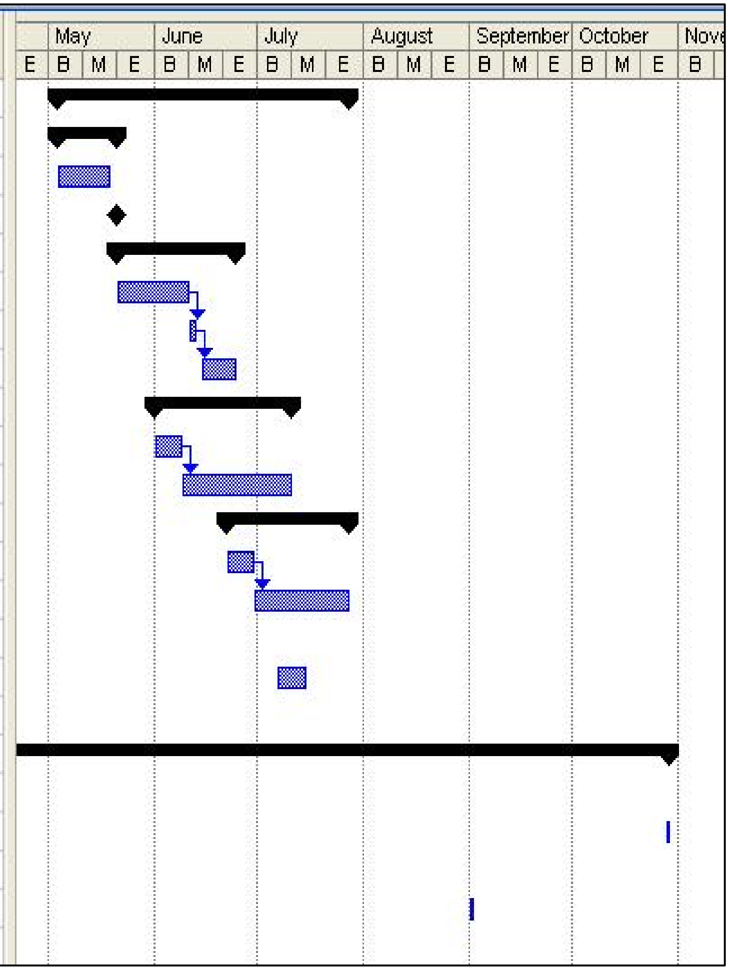


Figure 3.3 : Project Gantt chart 2

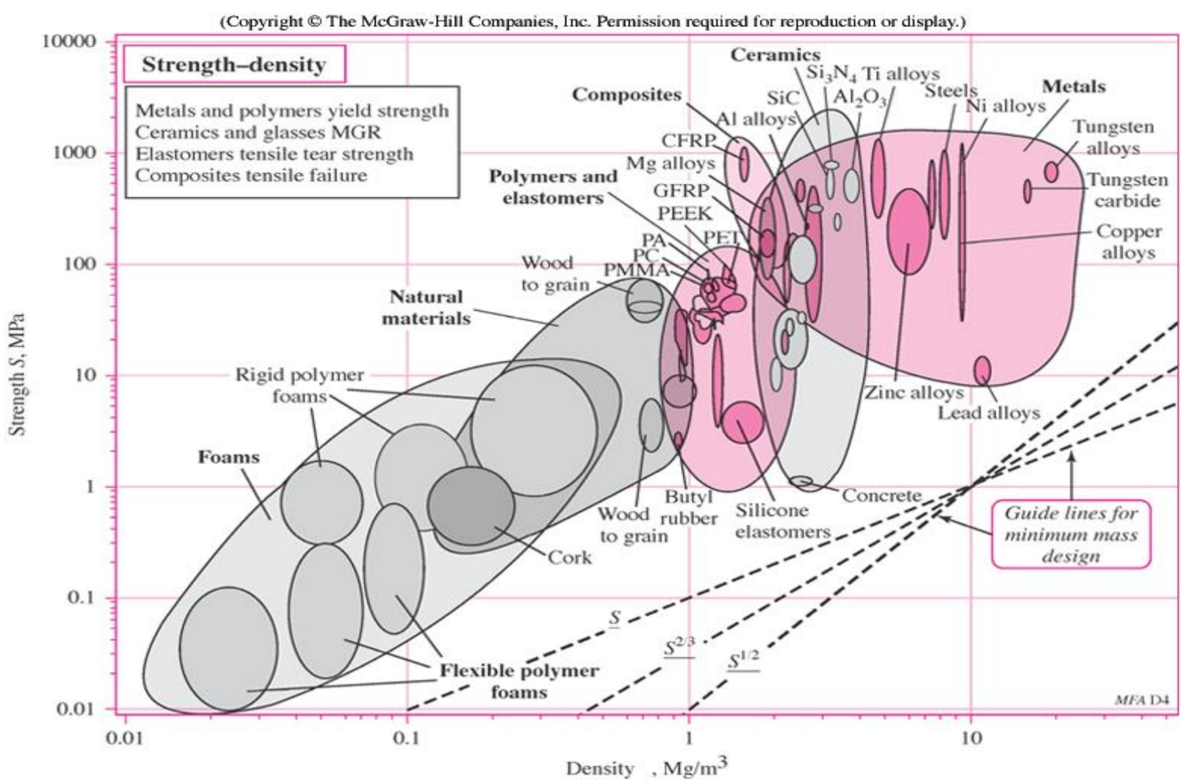
3.2 MATERIAL SELECTION PROCESS

A lot of users don't realize it, but a good car seat can save lives, especially in rear collision instances. Structurally safe seats have special metal structures that absorb impact so that the backrest remains sturdy during collision and the safety belt can function to its fullest. Top-quality car seats are usually subjected to rigorous safety tests before it is marketable to users.

Material is likewise an important consideration when choosing car seats, because it determines how long the units will last and how strong the seat will be to endure the crash impact. A strong, yielding seat that have been introduce today, also can be called as high retention seat.

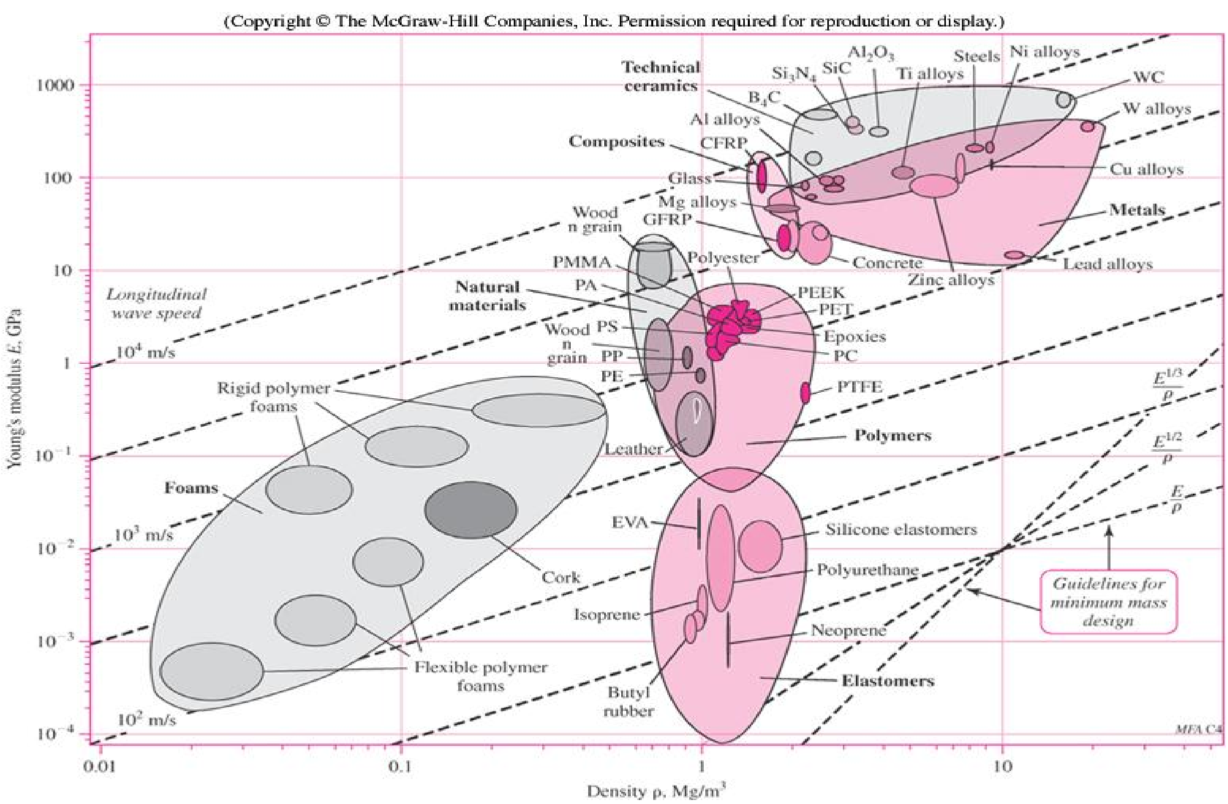
Basically there are two types of material that usually used for seat frame which is steel and aluminum. The suitability of each material has been selected based on this two main table which is Strength-Density table and Young's Modulus-Density Table.

Table 3.1 : Strength-Density Table



Based on the graph, steel and aluminum strength measures the resistance of a material to failure, given by the applied stress (or load per unit area).The chart shows yield strength in tension for all materials including steel which is proved to be higher than aluminum. This chart is useful also for identifying materials for components which require high strength combined with low weight (top left).High strength at low weight is so often important that a property called specific strength is defined as strength/density.

Table 3.2 : Young's Modulus-Density Table



'Stiffness' measures how much something stretches when a load is applied. Young's modulus measures stiffness and is a material constant. Seat frame applications require stiff materials, these materials lie at the top of the chart which is steel are higher than aluminum. Stiff lightweight materials are hard to find composites appear to offer a good compromise, but they are usually quite expensive.

3.3 GEAR SYSTEM

3.3.1 GEAR TRAX SOFTWARE

Gear Trax software provides a study on creating solid models of drive components which includes spur, helical, straight bevel and involutes tooth profiles. This software help to understand on changes to the gear parameters will reflect on gear mesh.

In this project, GearTrax helps creates solid model of rack and pinion, spur and internal gear. The solid gear then will be converted into SolidWork model to combine with other solid parts. GearTrax then integrates with Excel to create data sheets.

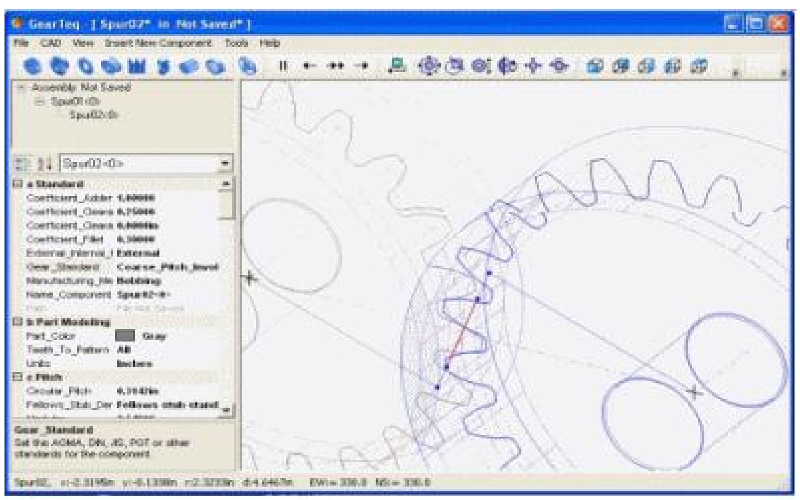


Figure 3.4: An example of GearTrax simulation in spur gears

3.4 CATIA

CATIA started as an in-house development by French aircraft manufacturer Avions Marcel Dassault, at that time customer of the CADAM CAD software. Initially named CATI (Conception Assistée Tridimensionnelle Interactive, ench for Interactive

Aided Three Dimensional Design) It was renamed CATIA in 1981, when Dassault created a subsidiary to develop and sell the software, and signed a non-exclusive distribution agreement with IBM.

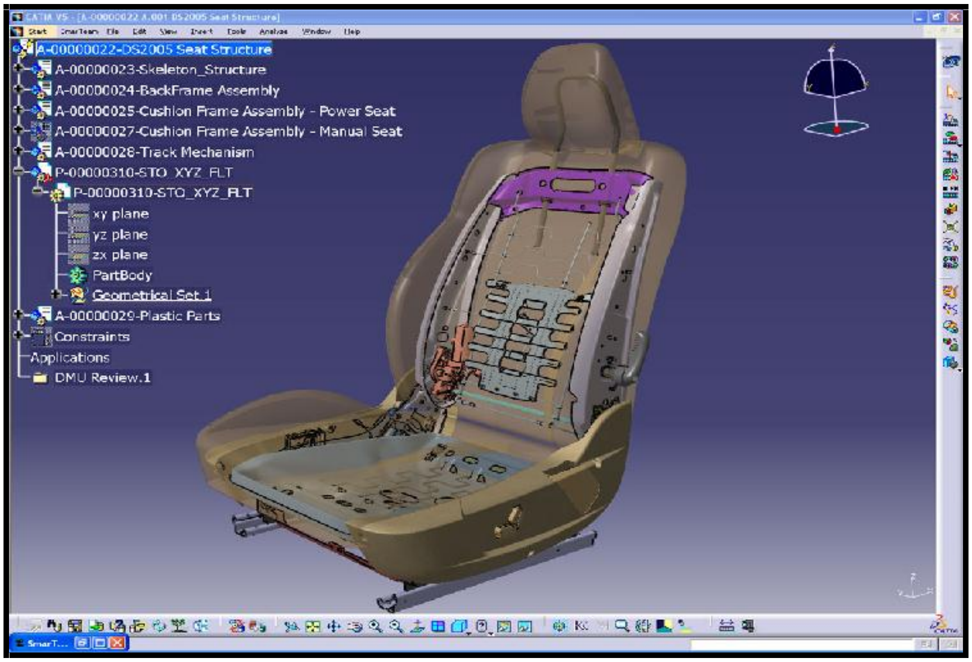


Figure 3.5: Catia on Seat Design

3.4.1 MECHANICAL DESIGN APPLICATION USING CATIA

This software has been tailored for manufacturing, design, and engineering professionals who need to develop skill and speed in using CATIA V5 to create and evaluate complex 3-D solid models and prepare fully dimensioned engineering drawings.

Some of the CATIA's application in engineering can be categorized in:

- Principles of feature based solid modeling
- Parametric and associative application

- Design intent
- Working in the Windows environment
- Screen layout and workbenches

3.5 FINITE ELEMENT ANALYSIS

Finite element analysis (FEA) is a software which basically including the discipline of mathematics, physics, and engineering and computer science. The method has wide application and enjoys extensive utilization in the structural, thermal and fluid analysis areas.

The finite element method is comprised of three major phases: (1) pre-processing, which means setup the finite element mesh and divide the subject geometry into subdomains for mathematical analysis, and applies material properties and boundary conditions, (2) solution, during which the program derives the governing matrix equations from the model and solves for the primary quantities, and (3) post-processing, in which the analyst checks the validity of the solution, examines the values of primary quantities (for example displacements and stresses), and derives and examines additional quantities (such as specialized stresses and error indicators).

The main advantages of FEA are numerous and important. A new design concept may be modeled to determine its real world behavior under various load environments, and may therefore be refined prior to the creation of drawings, when any changes will not involving any cost. Once a detailed CAD model has been developed, FEA can analyze the design in detail, saving time and money by reducing the number of prototypes required. Beside, FEA can be performed on increasingly affordable computer workstations and personal computers, and professional assistance is available.

CHAPTER 4

RESULT AND DISCUSSIONS

4.1 INTRODUCTION

This chapter will focus on the design and analysis of the anti theft seat system. Some of the important factor in designing new seat such as material selection, gearing system and anti theft seat system calculations is focused. Comparison of the commercial seat and new seat are made in order to highlight the differences between both models. At the end there are the discussion and analysis are made referring to the both of the models.

4.2 MATERIAL SELECTION

4.2.1 DESIGN REQUIREMENT FOR VEHICLE SEAT

Objective: Support Occupant seating during driving and to endure the crash impact to minimalist injuries.

Constrain: Must not Fail under Design Load-strength constrain.

Material Properties and Correspondent	Steel (Reynolds 531)	Aluminum (6061-T6)
Strength/Mpa	770-990	240-260
Density/Mg/m3	7.82-7.83	2.69-2.71
Shape Factor	7.0-8.0	5.5-6.3
Price	4.35	9.7

Figure 4.1: Comparison of Steel and Aluminum

In order to produce not only comfort seat with high-strength properties, two materials have been selected for the test to measure the suitability of each material. Based on the table, steel have proved to have higher strength, and density which is congruent in producing seat that can endure crash impact. Besides, instead of strength and density, material cost are the main factor that will be consider in design process, and steel also proved to cost is lower than aluminium.

Steel have been selected based on it properties by two main Material Properties Table which is Strength-Density table and Young's Modulus-Density table. The different strength effect also been tested in Finite Element Analysis (FEA) Software which is ALGOR.FEA also highlights on the ductility and yield strength of each material.

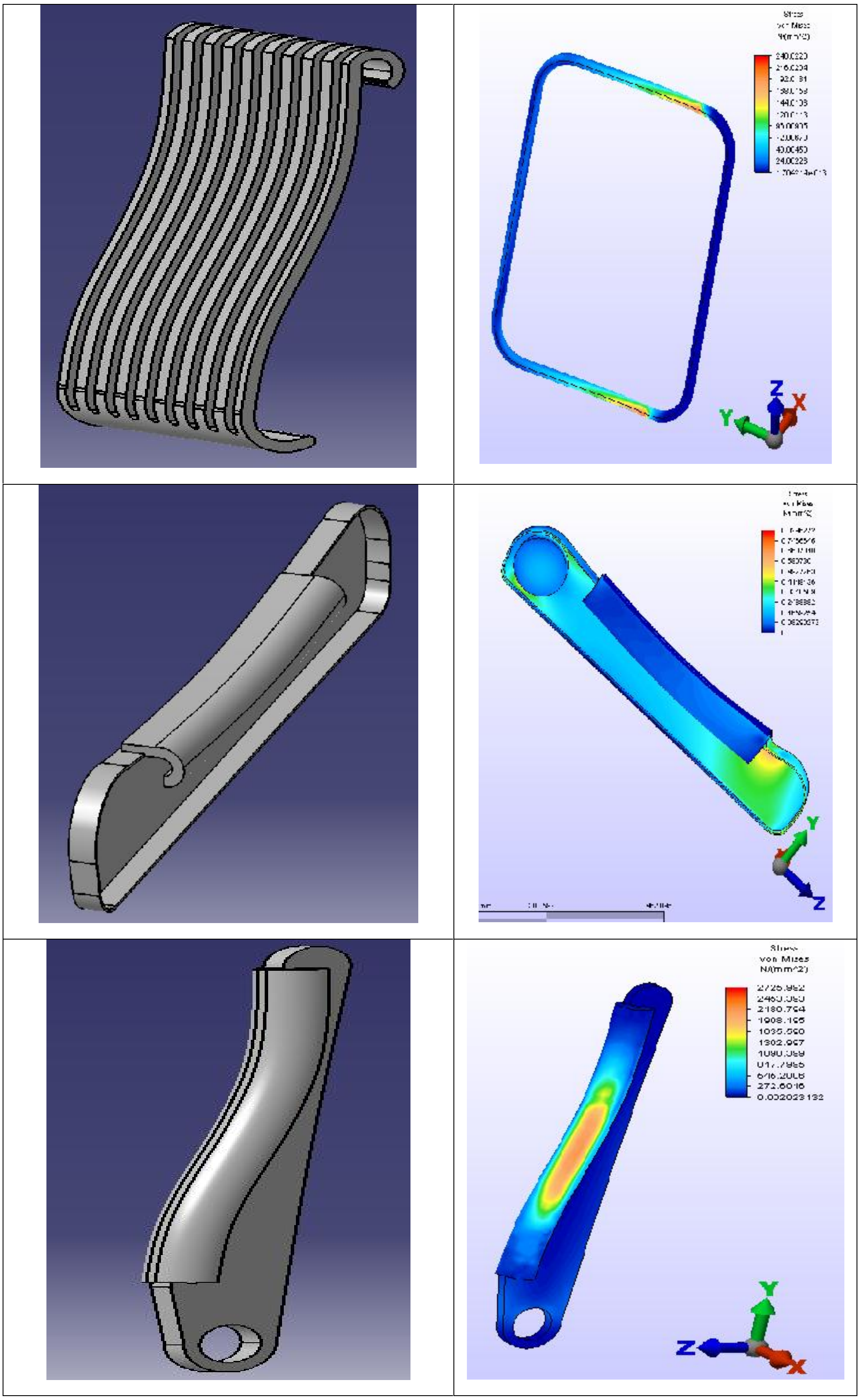


Figure 4.2: Test result of FEA analysis (1. backrest; side bottom support ; backrest support)

4.3 GEARING SYSTEM

In this project, gears are used in seat locking system. Based on the gears properties, calculation have been made using Gear Track 2003 Software

Table 4.1 : Test result of Rack and Pinion by Gear Track using Pinion(10teeth) and Gear(20 teeth) Specification

Pinion Data	
Pitch diameter:	10.0000mm
Major diameter:	11.9164mm
Minor diameter:	8.2634mm
Addendum:	0.9582mm
Dedendum:	0.8683mm
Add. mod. coef.:	0.4819
Addendum mod.:	0.4617mm
Pressure angle:	20.000deg
Base diameter:	9.3969mm
Whole depth:	1.8265mm
Circular pitch:	3.1416mm
Fillet radius:	0.4303mm
Backlash:	0.0000mm
Tooth thickness	1.9069mm
Face width:	11.0000mm

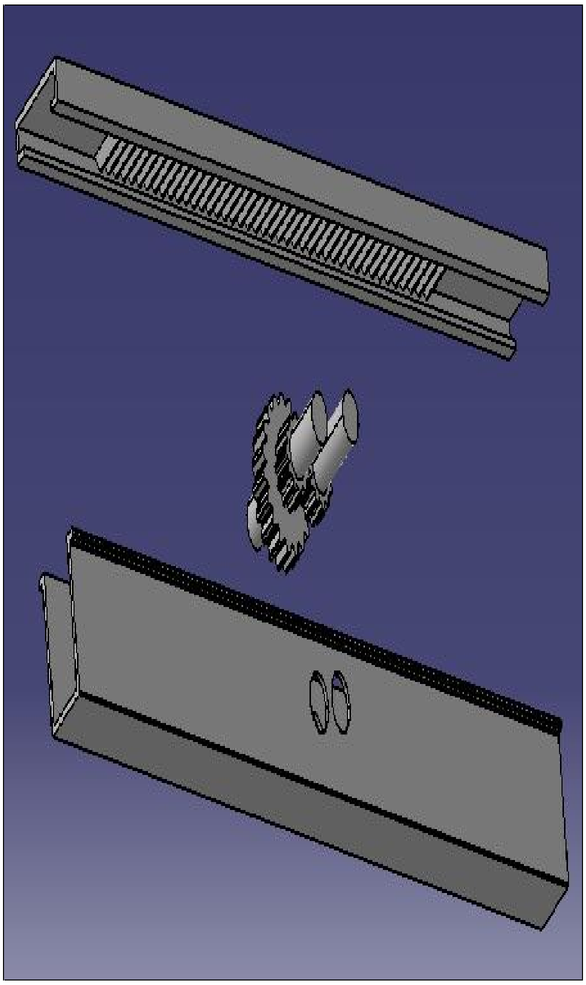


Table 4.2 : Test result of Internal Gear by Gear Track using Gear Ration=1:2

Gear Data	
Pitch diameter:	20.0000mm
Major diameter:	21.0766mm
Minor diameter:	16.4166mm
Addendum:	0.5383mm
Dedendum:	1.7917mm
Add. mod. coef.:	-0.4819
Addendum mod.:	-0.4617mm
Pressure angle:	20.000deg
Base diameter:	18.7939mm
Whole depth:	2.3300mm
Circular pitch:	3.1416mm
Fillet radius:	0.4303mm
Backlash:	0.0000mm
Tooth thickness	1.2347mm
Face width:	11.0000mm

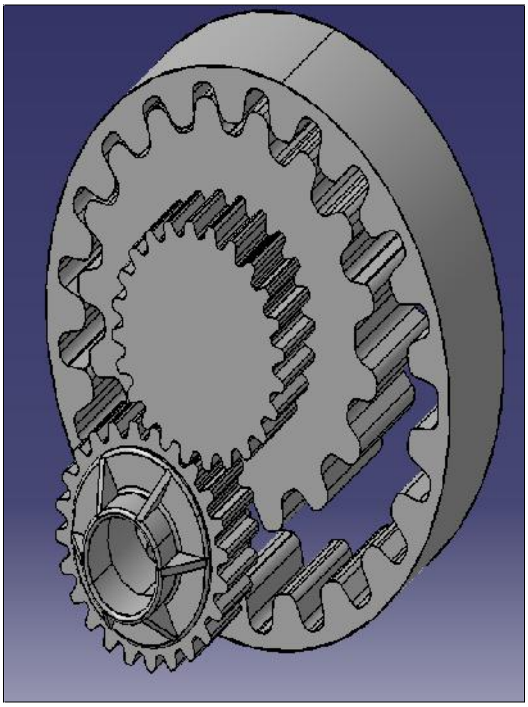
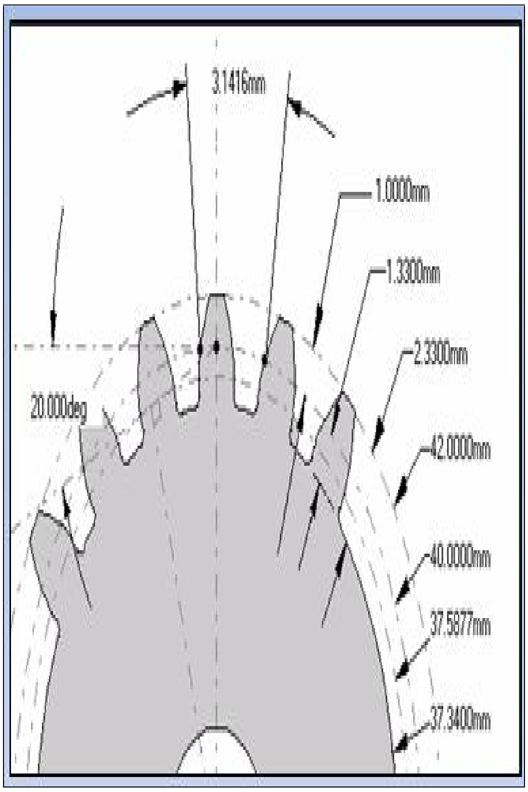


Table 4.3 : Test result of Spur Gear by Gear Track using Gear(40 teeth) Specification

Gear Data	
Pitch diameter:	40.0000mm
Major diameter:	42.0000mm
Minor diameter:	37.3400mm
Addendum:	1.0000mm
Dedendum:	1.3300mm
Add. mod. coef.:	0.0000
Addendum mod.:	0.0000mm
Pressure angle:	20.000deg
Base diameter:	37.5877mm
Whole depth:	2.3300mm
Circular pitch:	3.1416mm
Fillet radius:	0.4303mm
Backlash:	0.0000mm
Tooth thickness	1.5708mm
Face width:	11.0000mm



4.4 ANTI-THEFT SYSTEM CALCULATION

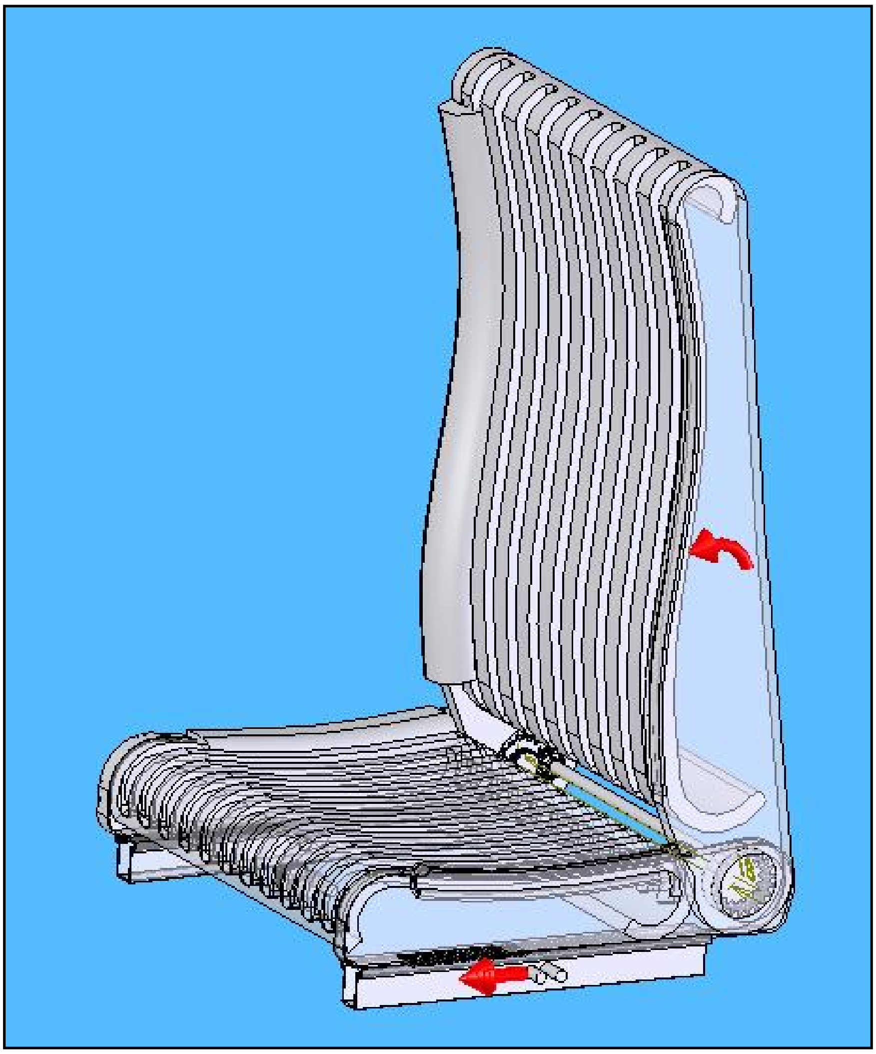


Figure 4.3 : Seat System Movement

4.4.1 Seat linear movement time duration and speed

Displacement= 320mm

$$s = s_o + v_o t + (1/2)a_c t^2$$

So = 0   S= 0.32m Vo= 0

$(0.32m) = 0 + (0)t + (1/2)\ 9.81\ t^2$

$0.32 = 4.905\ t^2$

$t^2 = 0.0652$

t =0.255s

$$v = v_o + a_c t$$

$V_o = 0$

$V = 0 + (9.81)(0.255)$

V= 2.51 m/s

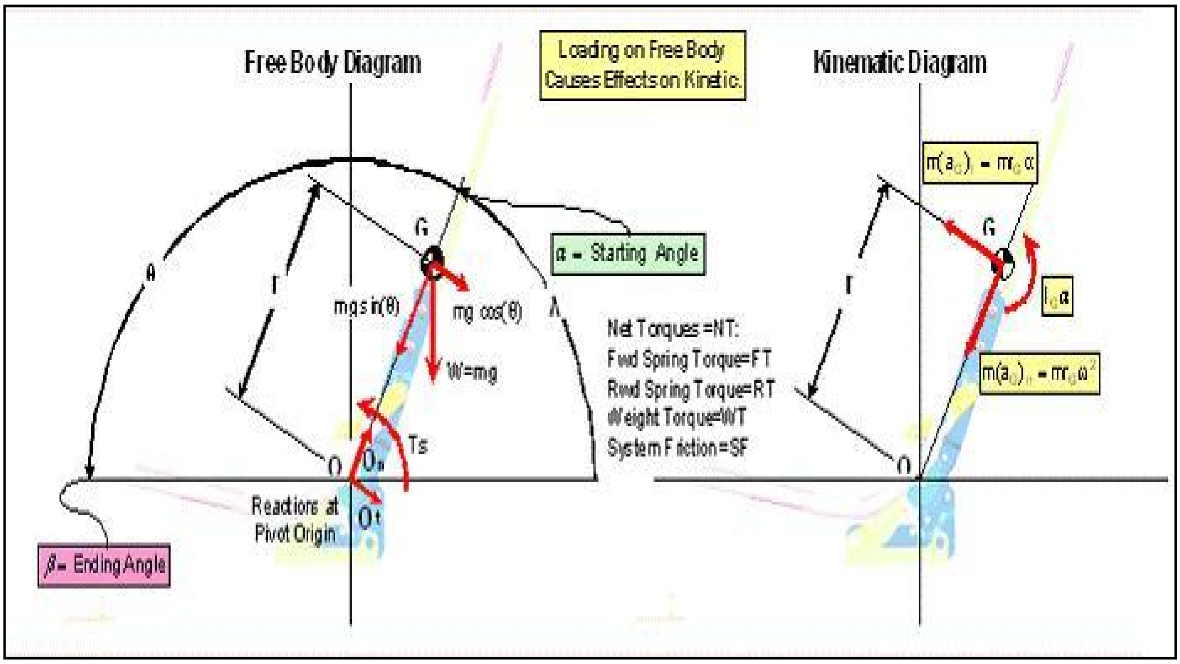


Figure 4.4 : Free Body Diagram and Kinematics Diagram of Seat System

4.4.2 Seat angular movement time duration and speed

Angle displacement

$\theta = 120^\circ - 60^\circ$

$\boldsymbol{\theta = 60^\circ}$

Evaluate time for $\theta = 60^\circ$

$60^\circ = 1.047\text{rad}$

$\theta = 0.15\ t^2$

$1.047 = 0.15\ t^2$

$\mathbf{t = 2.6425}$

Evaluated radial and angular position

$r = 0.9 - 0.12\ t^2$

$r = 0.9 - 0.12\ (2.642)^2$

$\mathbf{r = 0.062m}$

$\acute{r} = -0.24t$

$\acute{r} = -0.24\ (2.642s)$

$\acute{r} = -0.634\text{m/s}$

$\theta = 0.15\ t^2$

$\theta = 0.15\ (2.642)^2$

$\boldsymbol{\theta = 1.047}\textbf{rad}$

$\dot{\theta} = 0.30t$

$= 0.3\ (2.542)$

$= 0.793$ rad/s

=32.14 degree/s

Angular speed basically based on shaft rotating speed. Based on gears information and calculation:

Shaft's Diameter = 40mm

Max speed = 64.4rpm

Min speed = 42.3rpm

Shaft speed in m/s

$$\frac{\text{Shaft diameter (mm)} \times \text{r.p.m}}{19108}$$

$$= \frac{40\text{mm} \times 64.4 \text{ rpm}}{19108}$$

Max speed =0.1348 m/s

$$= \frac{40\text{mm} \times 42.3 \text{ rpm}}{19108}$$

Min speed =0.0885 m/s

4.5 NEW IMPROVED SEAT DESIGN

4.5.1 SEAT STRUCTURE

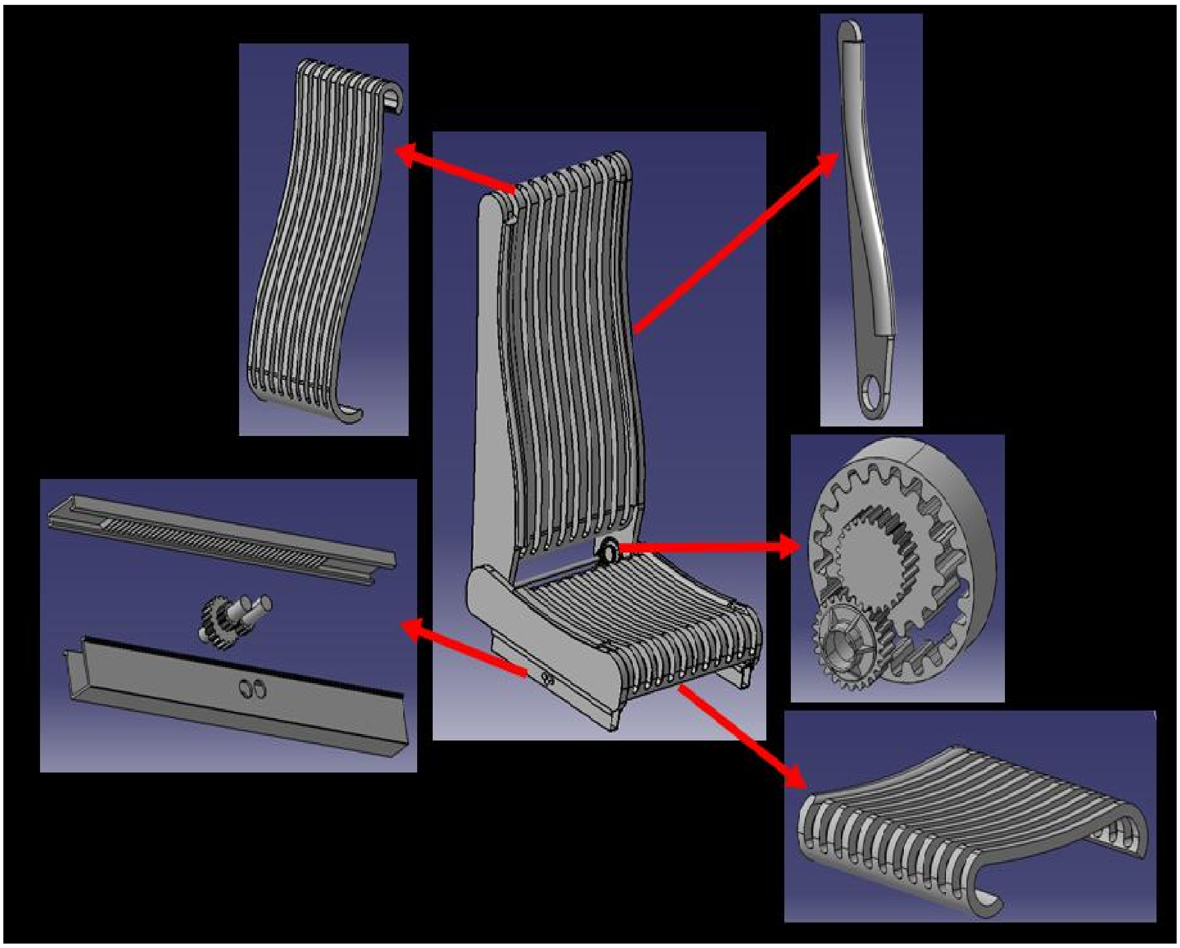


Figure 4.5 : New Improve Anti Theft Seat Model

Basically, the new model have 5 main parts which is the back rest, the bottom support, the seat rail mechanism, the angle linkages mechanism and lastly, backside and bottom side support. Each part is having almost totally different from the commercial seat part.

Based on the material selection, the whole frame is made of steel except for bottom support and backrest support which is made of injection polymers. The main reason why polymers are used is to reduce cost of renewing the whole structure without neglecting the factor of strength properties, the seat ergonomics and the seat safety features.

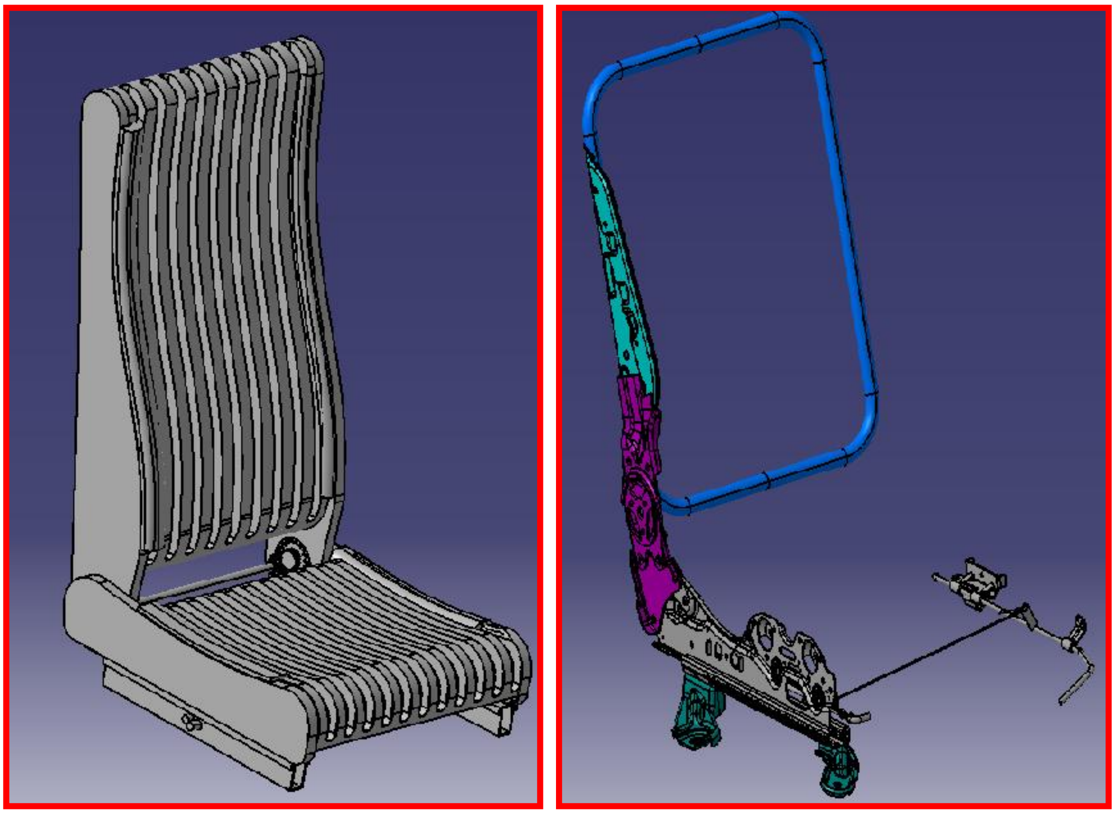
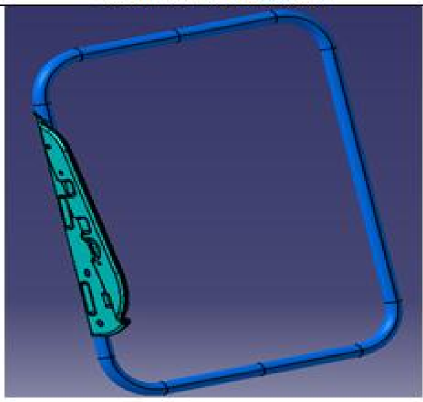
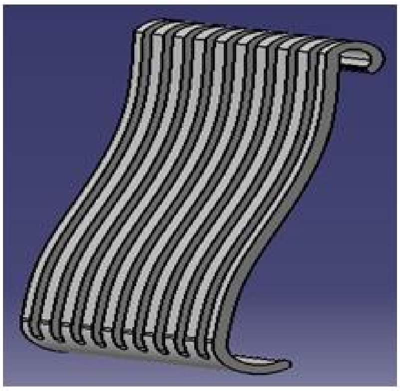
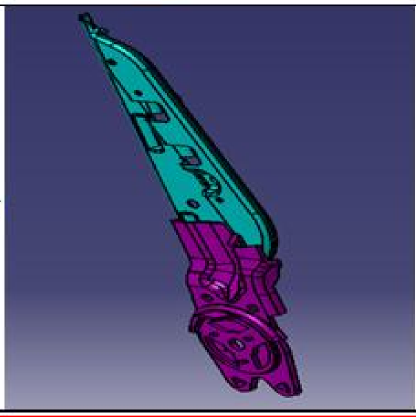
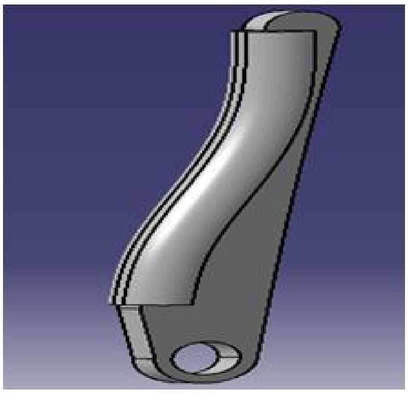
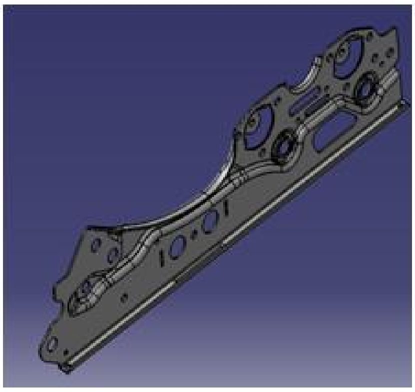
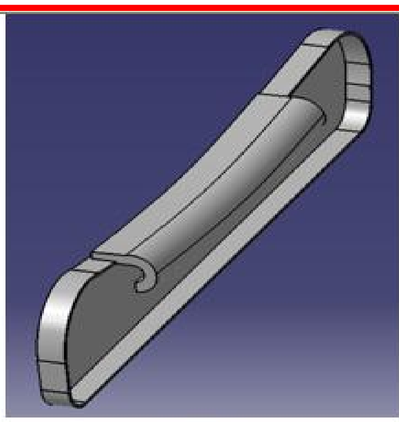
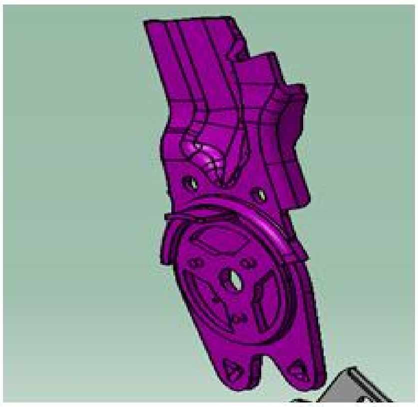
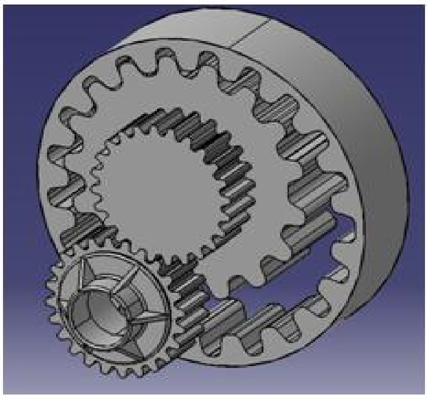


Figure 4.6 : The differential of new seat and commercial seat

4.5.2 COMPARISON OF NEW ANTI THEFT SEAT AND COMMERCIAL SEAT

	COMMERCIAL SEAT	NEW SEAT
BACKREST		
BACKSIDE SUPPORT		
BOTTOM SIDE SUPPORT		
ANGLE LINKAGE		

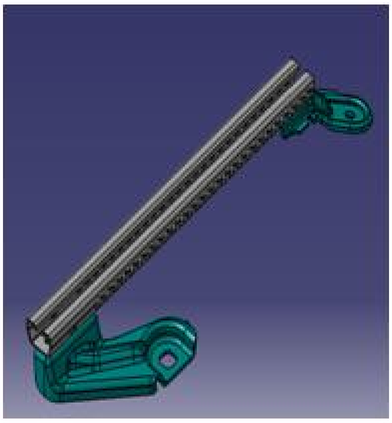
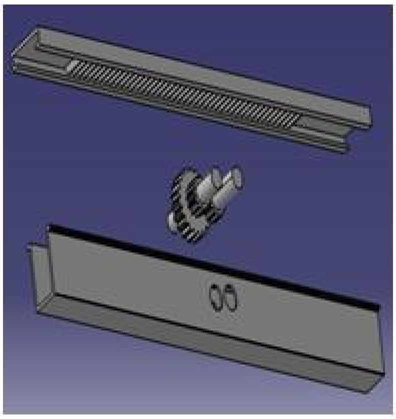
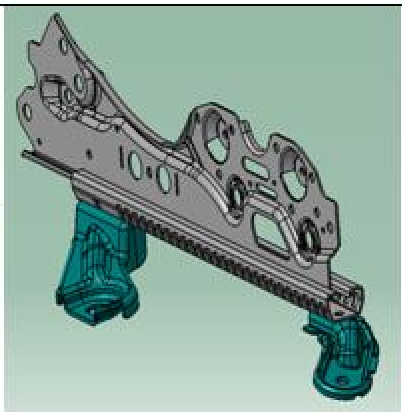
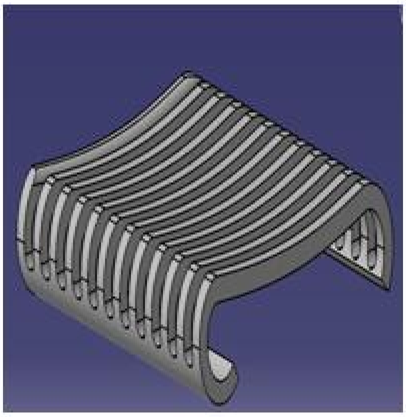
SLIDER		
BOTTOM SUPPORT		

Figure 4.7 : Comparison of New Anti Theft Seat and Commercial Seat

The seat parts of both seats have nearly different in many ways. The new anti theft seat are design not only to fully drive by motors, but also have been design to build-in with anti theft device. To fulfill the function as anti theft device as well as seating device, the whole structures have been redesign with its own function.

The backrest of new anti theft seat is designed to be more ergonomics without sacrificing the main function which is to support the back of occupant's body. It is different compare to commercial seat which is simpler but having less support structure. Beside the fact that the backrest support of new anti theft car seat are made of polymer, it is shaped to imitate human body's back shape. Both backrest are clamped with side support which is obviously been improved into single structure part to avoid the connection failure between parts. Bottom side support improvement is made based on the same method and reasons.

The angle linkage and the slider have been improved based on their new function as anti theft devices which are obviously converted into whole gearing system. Angle linkage are improved into internal spur system to strengthen up the linkage between bath backrest and bottom support set and act as fore and aft lock. Manual drive slider is converted into fully automated slider by using rack and pinion gearing system. Both gearing system are driven by 12 volt motor.

4.5.3 GEAR AS LOCKING SYSTEM

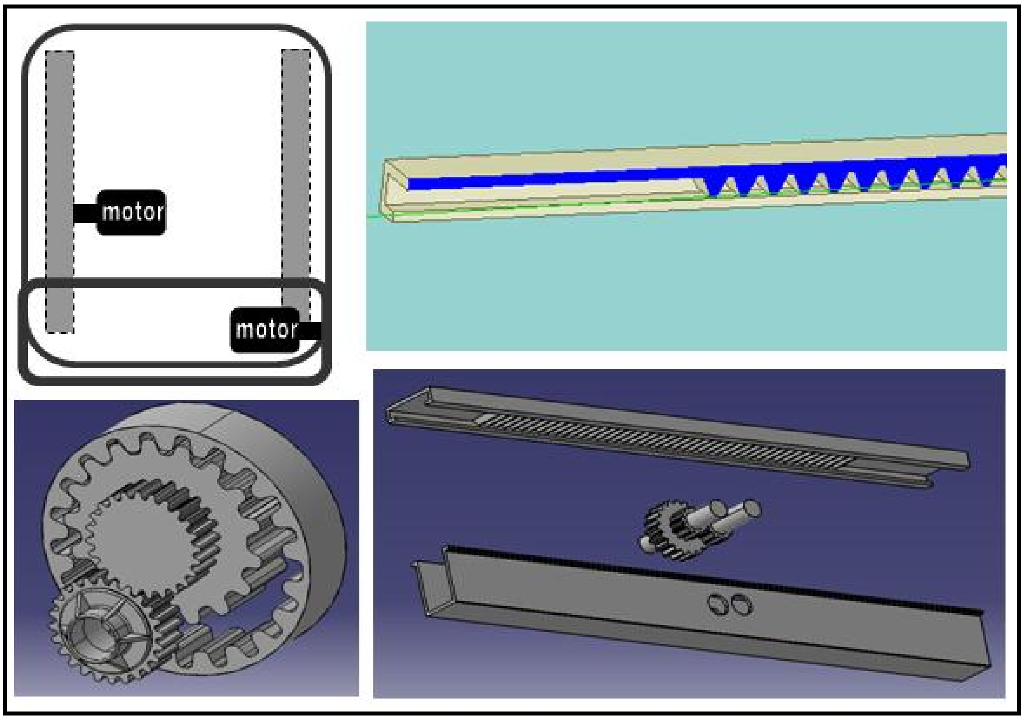


Figure 4.8 : Gear as locking part in anti theft car seat

In the seat rail locking system, the upper rail are attach with rack features to make sure it is moved forward and rearward. In order to freeze the upper rail on the lower rail, locking system is provided.

Locking and unlocking the system is certainly carried out by means of a switch, which receives voltage from the vehicle once the ignition key has been turned. The lock is concealed by appropriate covers that do not show any visible operating system to exterior. Beside, by making gearing system as locking system, hare is no need to add another component to the vehicle itself.

4.5.4 ANTI THEFT CAR SEAT CONTROL SYSTEM

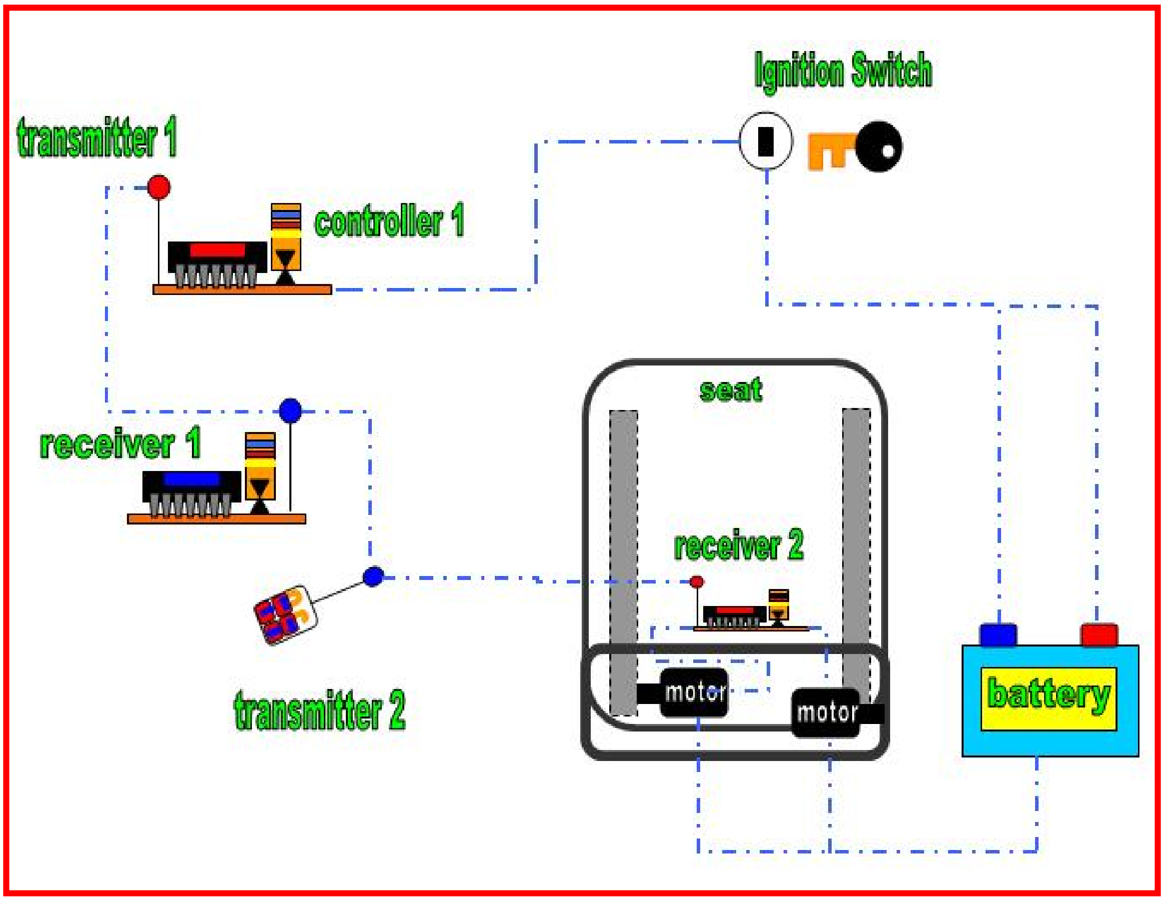


Figure 4.9 : Diagram of Anti Theft Car Sear Control System

Basically, the whole system starts off with the car a key is detect in ignition key switch. The ignition key switch will turn on the power sources which connect to 2 motors attached to the seat. The 1st motor is coupled to the seat back for moving the seat back between the fore and aft position; while the 2nd motor is coupled to the seat base for moving the seat base between front and rear position. A power source is preferably a conventional automotive power sources which is typically would be a 12-volt power supply.

The power sources are connected to the activation signals which no other than transmitter and receiver. Transmitter and receiver are the main component used in remote entry system to lock and unlock the seat anti theft system. Based on the input from both transmitter and receiver, controller controls the movement of the driver seat into undrivable position which refers to anti-theft position.

In anti theft position, the seat is placed in it fowardmost position. This is accomplished by moving seat back and seat base horizontal motor.

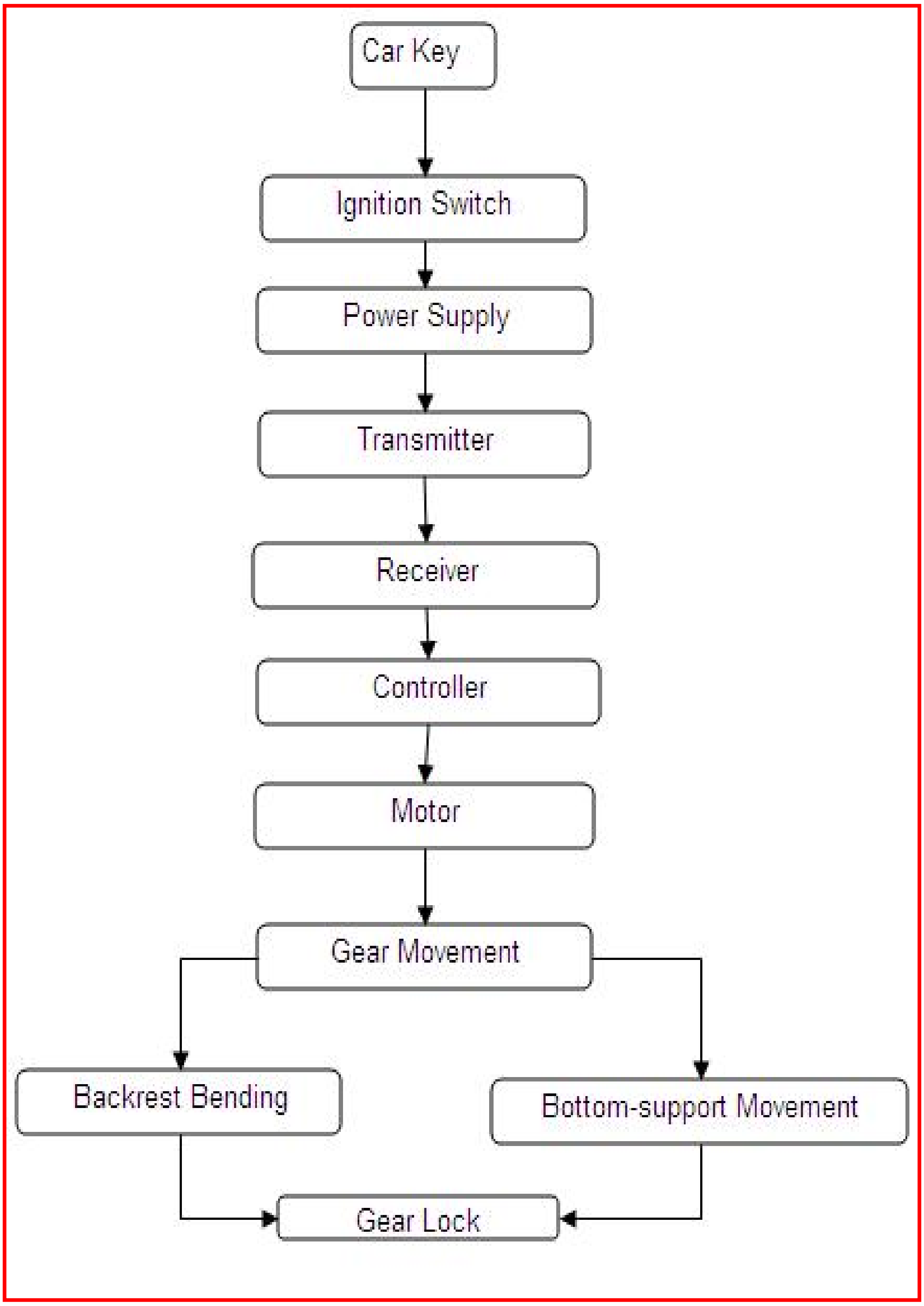


Figure 4.10 : Seat Movement Control Diagram

4.5.5 SEAT MOVEMENT AND LOCKING

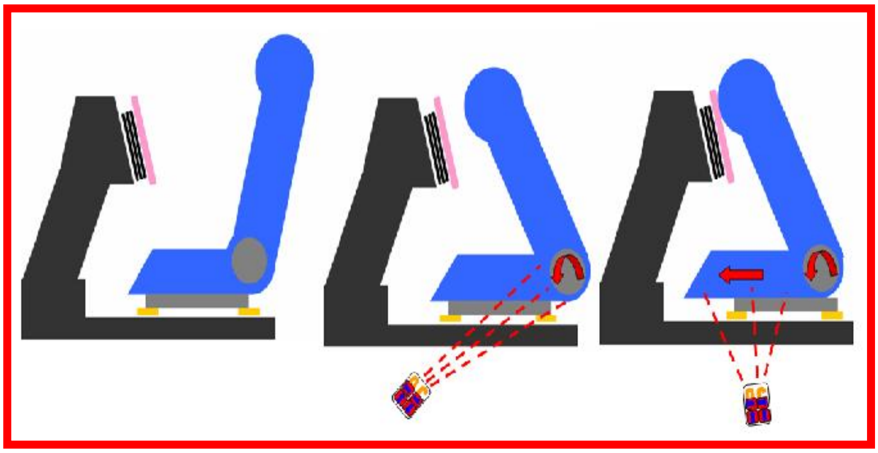


Figure 4.11 : Seat Movement and Locking Control

Figure 19 shows the whole movement and locking control of the seat for the entire operation. The first seat is a driver seat in aft position which is seat back and seat base are positioned in a drivable position away from steering wheel and instrument panel.

The second picture shows the position after 1st anti theft seat movement which is bending forward. The seat bending movement shown above is fully operated by remote control device using transmitter to transmit radio signal to the car seat's motor receiver.

The final picture is a picture of the driver seat in anti theft position which shows that seat base and backrest is in forwardmost position close to steering wheel and instrument panel. The seat base forward and rear movement also controlled by remote control radio transmitter system.

4.6 NEW SEAT PROTOTYPING

Based on the seat drawing and movement diagram, prototype of the new seat has been made. The main target of this prototype making is to show the seat movement and control.

Figure 4.11 : Seat Prototype

Figure 4.12 : Seat Prototype's main parts

This prototype is completed using several main parts which is:

- Polystyrenes-seat base support and backrest structure
- Remote Control Controller Unit-control the prototype’s movement
- Motor-12V motor(taken out from toys)
- Batteries-Four 12V batteries as power sources

CHAPTER 5

CONCLUSION

5.1 INTRODUCTION

This chapter will discuss about the recommendation and the overall conclusion of the project.

5.2 CONCLUSION

Overall, there are several features that have been highlighted in the new design of anti theft car seat. First is to make sure that the anti lock device are none other device than the seat itself which mean to minimalist the usage of additional device to cars. Car manual drive seat system have been upgraded fully into automated car seat competed with anti theft device on it. By using gearing system that attached to the seat, the device is less visible and will not easily be reached by theft.

The new design of car seat also focused on improving ergonomics factor and strength properties of the parts which is very important as car seat unit is the part that will be used daily by car users. Material selection have been done very carefully by mainly considering the cost, strength, density and the shape factors of the materials.

The seat parts have been reduce while the strength of each part have been improved to make sure that the seat will endure car crash and minimalist occupant injuries.

Conclusively, the main objective for this project which is to come out with the new anti theft design of car seat that will consistence with the car anti theft system which concerning vehicle user's needs have been achieved. The final model has proved to be fulfilling nearly every factor that needed in anti theft system and car seat system.

5.3 RECOMMENDATIONS ON FUTURE WORKS

As the basic design of anti theft car seat have been recognize, it is recommend to upgrading on ergonomics factor of the mechanism. Ergonomic car seats are great for vehicles used for long driving. Some very good car seats are pressurized to conform to the natural shape of every body type so that the passenger's back, neck, and hips are amply supported. So, it is highly important to focus on enhancing ergonomics factor without neglecting the safety factor and strength properties of the seat.

In order to produce an excellent model of car seat, each model must be very user-friendly as it can be. To achieve that target, the model is recommended to be added with a few devices such as weight sensor, shake alarm, or maybe door open sensor. This device are important to upgraded the anti theft system efficiency by improving the sensitivity factors.

As the engineering design areas are highly developing in these day, application of design software is very useful. The Finite Element Analysis (FEA) and design software such as SolidWork, CATIA and AutoCAD should be widely recognizable to student as it very helpful especially in engineering design study.

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APPENDIX A

FMEA TABLE

(POTENTIAL FAILURE MODEL AND EFFECT ANALYSIS)

ITEM / FUNCTION	POTENTIAL FAILURE MODE	POTENTIAL EFFECT(S) OF FAILURE	Sev.	POTENTIAL MECHANISM OF FAILURE	Occur	DESIGN CONTROLS PLAN	Detec	RPN	RECOMMENDED ACTIONS PLAN	TARGET COMPLETE DATE	ACTION RESULT Sev	ACTION RESULT Occ	ACTION RESULT Det	ACTION RESULT RPN
Car seat mechanism Function:	Seat Mechanism cannot move smoothly	Deteriorate function of seat mechanism lead to: 1) Unsatisfactory function due to unsmooth movement.	6	Design of the mechanism itself dosnt allow it to have smooth movements	5	drawing evaluation of seat mechanism	1	30	Add more drawing evaluation using design aid software such as Algor and CATIA	30/Mei/2009	6	2	1	12
	Car seat mechanism cannot support passanger weight		6	Improper measurement of weight supported by the material	6	Physical Lab Test/Laboratory test using proper weight and load applied to the mechanism	7	252	Test the strength of seat mechanism	30-Jun-09	6	2	2	24

APPENDIX B

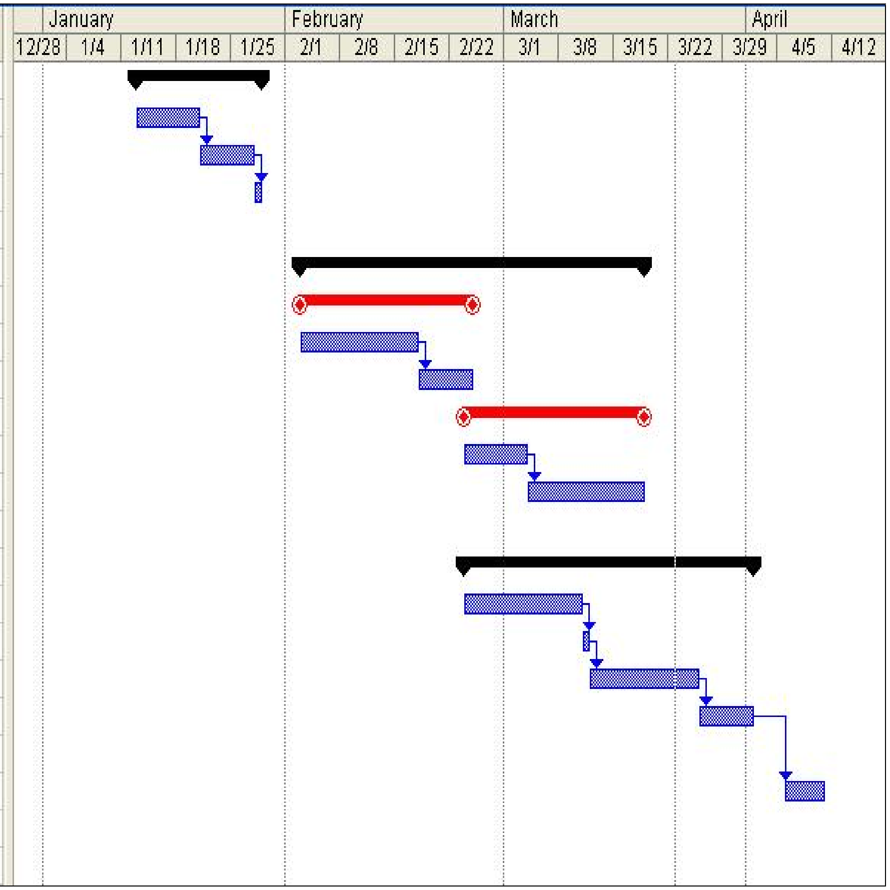
FMEA GUIDE

Severity Ranting Scale (SEV)	Detection Rating Scale (DETEC)	Occurrence Ranting Scale (OCCUR)
# Description	# Description	# Description
1 None	1 Almost Certain	1 Remote: Failure is unlikely
2 Very Minor	2 Very High	2 Low: Relatively few failures
3 Minor	3 High	3 Low: Relatively few failures
4 Very Low	4 Moderately High	4 Moderate: Occasional failures
5 Low	5 Moderate	5 Moderate: Occasional failures
6 Moderate	6 Low	6 Moderate: Occasional failures
7 High	7 Very Low	7 High: Frequent failures
8 Very High	8 Remote	8 High: Frequent failures
9 Hazardous with warning	9 Very Remote	9 Very High: Persistent failures
10 Hazardous without warning	10 Absolute Uncertainty	10 Very High: Persistent failures

APPENDIX C

Project Gantt chart 1

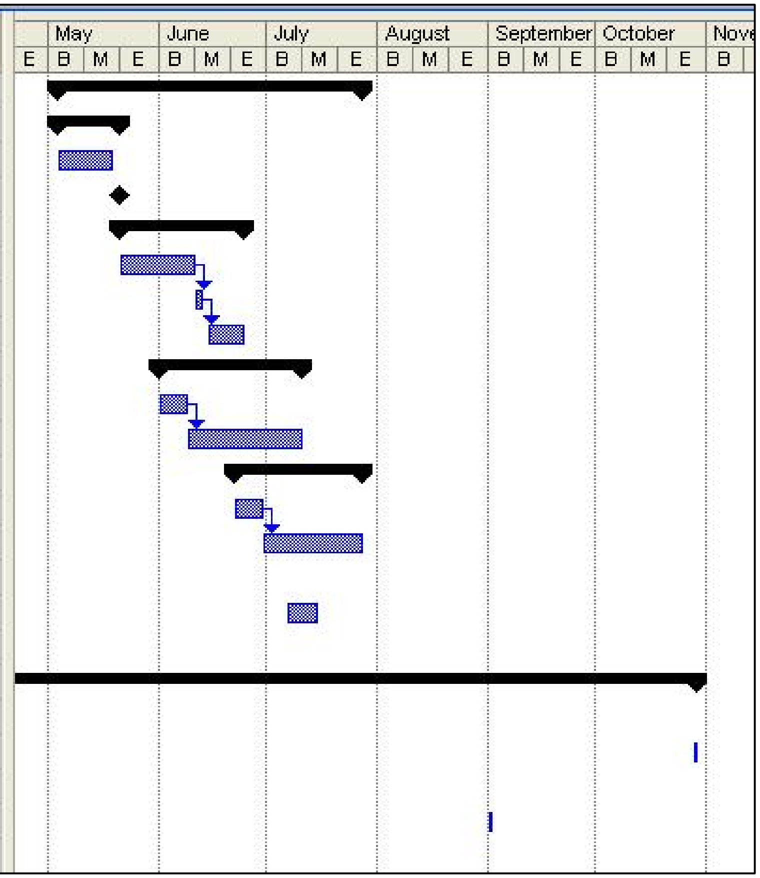
	Task Name	Duration	Start	Finish
1	**Project Development**	**12 days?**	**Tue 1/13/09**	**Wed 1/28/09**
2	Study The Problem	6 days	Tue 1/13/09	Tue 1/20/09
3	Identify Project requirement	5 days?	Wed 1/21/09	Tue 1/27/09
4	Submitted	1 day?	Wed 1/28/09	Wed 1/28/09
5				
6	**Literature Review**	**32 days?**	**Tue 2/3/09**	**Wed 3/18/09**
7	**Analyse Project Requirement**	**16 days?**	**Tue 2/3/09**	**Tue 2/24/09**
8	Technique	11 days?	Tue 2/3/09	Tue 2/17/09
9	Software	5 days?	Wed 2/18/09	Tue 2/24/09
10	**Analyse System Requirement**	**17 days?**	**Tue 2/24/09**	**Wed 3/18/09**
11	System	6 days?	Tue 2/24/09	Tue 3/3/09
12	Parts/ Material	11 days?	Wed 3/4/09	Wed 3/18/09
13				
14	**Design Phase**	**27 days?**	**Tue 2/24/09**	**Wed 4/1/09**
15	Preliminary Design	11 days?	Tue 2/24/09	Tue 3/10/09
16	Discuss and Choose The Best Design	1 day?	Wed 3/11/09	Wed 3/11/09
17	Design Using Solid Work	10 days?	Thu 3/12/09	Wed 3/25/09
18	Design Usig Catia	5 days?	Thu 3/26/09	Wed 4/1/09
19				
20	Presentation	5 days?	Mon 4/6/09	Fri 4/10/09



APPENDIX D

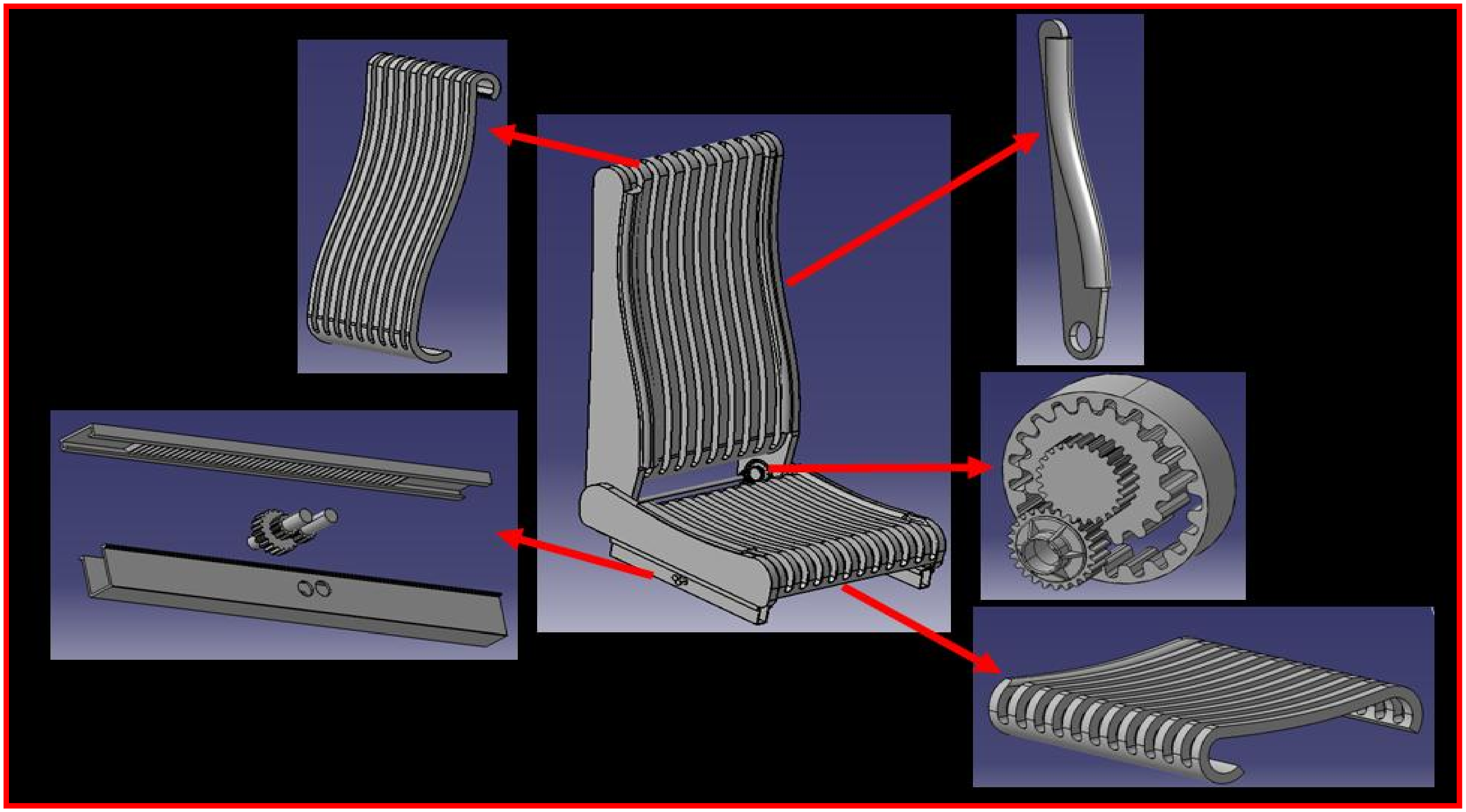
Project Gantt chart 2

	Task Name	Duration	Start	Finish
1	**Anti Theft Design of Car Seat**	**61 days**	**Mon 5/4/09**	**Mon 7/27/09**
2	**Analysis**	**13 days**	**Mon 5/4/09**	**Wed 5/20/09**
3	Analysis Material Requirement	11 days	Mon 5/4/09	Mon 5/18/09
4	Analysis Completed	1 day	Wed 5/20/09	Wed 5/20/09
5	**Design Phase**	**25 days**	**Thu 5/21/09**	**Wed 6/24/09**
6	Final design	15 days	Thu 5/21/09	Wed 6/10/09
7	Discuss and get the design approval	2 days	Thu 6/11/09	Fri 6/12/09
8	Develop System	8 days	Mon 6/15/09	Wed 6/24/09
9	**Measurement**	**30 days**	**Mon 6/1/09**	**Fri 7/10/09**
10	Measure seat mechanism	6 days	Mon 6/1/09	Mon 6/8/09
11	Construct an measurement testing	24 days	Tue 6/9/09	Fri 7/10/09
12	**Fabrication**	**26 days**	**Mon 6/22/09**	**Mon 7/27/09**
13	Remove the original seat adjuster	6 days	Mon 6/22/09	Mon 6/29/09
14	Install Lead Srew System to seat mech	20 days	Tue 6/30/09	Mon 7/27/09
15				
16	**Modification**	6 days	Tue 7/7/09	Tue 7/14/09
17				
18	**Report Writing Process**	**398 days?**	**Mon 4/21/08**	**Wed 10/28/09**
19		93 days?	Mon 4/21/08	Wed 8/27/08
20	**Final Presentation**	1 day?	Wed 10/28/09	Wed 10/28/09
21				
22	**Submit Report**	1 day?	Tue 9/1/09	Tue 9/1/09



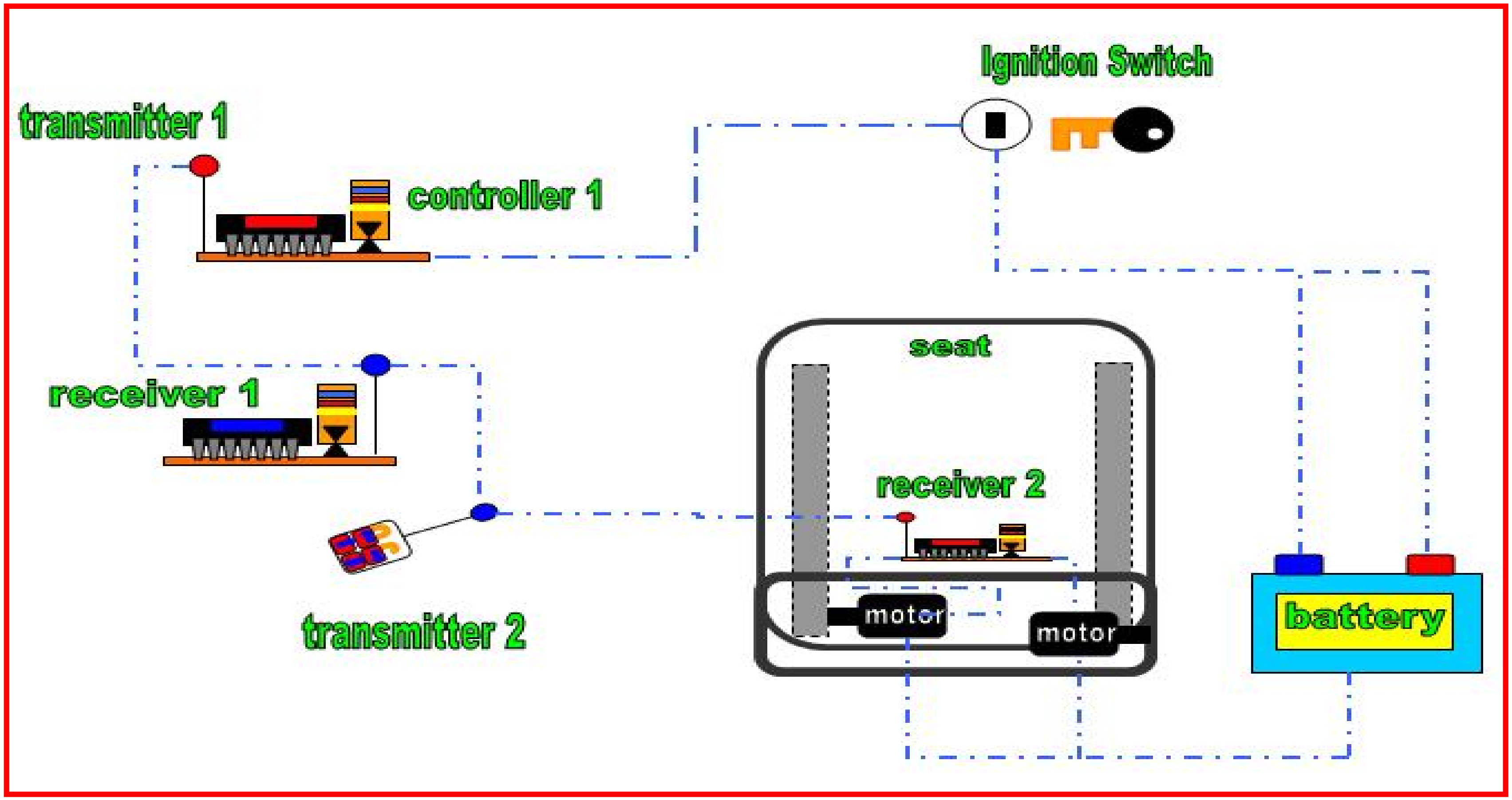
APPENDIX E

NEW SEAT DESIGN PART



APPENDIX F

SEAT CONROL DIAGRAM



UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS

JUDUL: **ANTI THEFT DESIGN OF CAR SEAT**

SESI PENGAJIAN: **2009/2010**

Saya **NURUL HUSNA BT. MOHAMAD SHARIFF(860627465072)**
(HURUF BESAR)

mengaku membenarkan kertas projek ini disimpan di Perpustakaan Universiti Malaysia Pahang (UMP) dengan syarat-syarat kegunaan seperti berikut:

1. Hakmilik kertas projek adalah di bawah nama penulis melainkan penulisan sebagai projek bersama dan dibiayai oleh UMP, hakmiliknya adalah kepunyaan UMP.
2. Naskah salinan di dalam bentuk kertas atau mikro hanya boleh dibuat dengan kebenaran bertulis daripada penulis.
3. Perpustakaan Universiti Malaysia Pahang dibenarkan membuat salinan untuk tujuan pengajian mereka.
4. Kertas projek hanya boleh diterbitkan dengan kebenaran penulis. Bayaran royalti adalah mengikut kadar yang dipersetujui kelak.
5. *Saya membenarkan Perpustakaan membuat salinan kertas projek ini sebagai bahan pertukaran di antara institusi pengajian tinggi.
6. **Sila tandakan (✓)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
✓	TIDAK TERHAD	

Disahkan oleh

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat Tetap:
No. 34, Taman Seri Seberang,
06700 Pendang,
Kedah Darul Aman.
Tarikh:20 NOVEMBER 2006

ZAMRI BIN MOHAMED
Nama Penyelia

Tarikh:20 NOVEMBER 2009

CATATAN: * Potong yang tidak berkenaan.
** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.
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