DESIGN AND DEVELOPMENT OF GEARING SYSTEM FOR CAR SIMULATOR

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DESIGN AND DEVELOPMENT OF GEARING SYSTEM FOR CAR SIMULATOR

KHAIRULANWAR BIN ABD RANI

Report submitted in partial fulfilment of the requirements
for the award of
Bachelor of Mechanical Engineering with Automotive Engineering

Faculty of Mechanical Engineering
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DECEMBER 2010

UNIVERSITI MALAYSIA PAHANG
FACULTY OF MECHANICAL ENGINEERING

We certify that the project entitled *"Design and Development of Gearing System for Car Simulator"* is written by *Khairulanwar bin Abd Rani*. 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 fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering with Automotive Engineering.

Mr Lee Giok Chui .....
Examiner Signature

SUPERVISOR'S DECLARATION

I hereby declare that I have read this project report and in my opinion this project report is sufficient in terms of scope and quality for the award of Bachelor in Mechanical Engineering with Automotive Engineering

Signature
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STUDENT'S DECLARATION

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

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ABSTRACT

Nowadays, the prototype will be designed and be tested prior produces the real car. It is done to ensure better performance of the design especially for high cost products. The cost of prototype sometimes becomes higher and higher due to our demand to high performance system of the car itself. Therefore, it is important to have a system that can simulate the performance of the car before it can be used by the customer. For this purposes, the car simulators are being used as testing machine on car performance. This project will focus more on gearing system since that system is the most important parts for car performance. Simple electrical circuit will be design in order to take the data/signal on gearing design and to ensure the design is functional.

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ABSTRAK

Saat ini, prototaip direka dan diuji sebelum menghasilkan sesuatu kereta yang nyata. hal ini dilakukan untuk memastikan prestasi yang lebih baik dari rekebentuk terutama untuk produk yang mempunyai kos tinggi. kos prototaip kadang-kadang menjadi lebih tinggi dan lebih tinggi kerana permintaan untuk sistem berprestasi tinggi daripada kereta itu sendiri. oleh kerana itu, adalah penting untuk mempunyai sistem yang dapat mensimulasikan prestasi kereta sebelum boleh digunakan oleh pelanggan. untuk tujuan tersebut, simulator kereta digunakan sebagai ujian prestasi enjin kereta. projek ini akan lebih tertumpu pada sistem sejak gear yang merupakan bahagian yang paling penting untuk prestasi kereta.suatu litar elektrik akan dirancang dalam rangka untuk mengambil data atau isyarat pada rekabentuk gear dan untuk memastikan ia berfungsi.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Gear is a machine that can change the speed of the vehicle. It has a part having cut teeth, or cogs, that mesh with another toothed part in order to transmit torque. The rotating teeth is the cause of the changing energy from mechanical energy to kinetic energy. Two or more gears working in tandem are called a transmission and can produce a mechanical advantage through a gear ratio and thus may be considered a simple machine. Geared devices can change the speed, magnitude, and direction of a power source. The most common situation is for a gear to mesh with another gear. However a gear can also mesh a non-rotating toothed part, called a rack, thereby producing translation instead of rotation.

In gear system, there has important element that makes it in function clearly which is speed and torque. These two elements are provided by transmission or gearbox by converging from a rotating power source to another device using gear ratios, the transmission adapts the output of the internal combustion engine to the drive wheels. Engines need to operate at a relatively high rotational speed, which is inappropriate for starting, stopping, and slower travel.

The transmission reduces the higher engine speed to the slower wheel speed, increasing torque in the process. Transmissions are also used on pedal bicycles, fixed

machines, and anywhere else rotational speed and torque needs to be adapted. Often, a transmission will have multiple gear ratios (or simply "gears"), with the ability to switch between them as speed varies. This switching may be done manually (by the operator), or automatically. Directional (forward and reverse) control may also be provided. Single-ratio transmissions also exist, which simply change the speed and torque (and sometimes direction) of motor output.

In motor vehicle applications, the transmission will generally be connected to the crankshaft of the engine. The output of the transmission is transmitted via driveshaft to one or more differentials, which in turn drive the wheels. While a differential may also provide gear reduction, its primary purpose is to change the direction of rotation. Conventional gear/belt transmissions are not the only mechanism for speed/torque adaptation. Alternative mechanisms include torque converters and power transformation (e.g., diesel-electric transmission, hydraulic drive system, etc.). Hybrid configurations also exist.

Simulation is the imitation of some real thing, state of affairs, or process. The act of simulating something generally entails representing certain key characteristics or behaviors of a selected physical or abstract system. Simulation is used in many contexts, including the modeling of natural systems or human systems in order to gain insight into their functioning. Other contexts include simulation of technology for performance optimization, safety engineering, testing, training and education. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Key issues in simulation include acquisition of valid source information about the relevant selection of key characteristics and behaviours, the use of simplifying approximations and assumptions within the simulation, and fidelity and validity of the simulation outcomes. Simulation is a powerful and important tool because it provides a way in which alternative designs, plans and/or policies can be evaluated without having to experiment on a real system, which may be prohibitively costly, time-consuming, or simply impractical to do. That is, it allows you to ask "What if?" questions about a system without having to experiment on the actual system itself (and hence incur the costs of field tests, prototypes, etc.)

To demonstrate the design installation and the use of the right gear, we need a simulation system that allows us to know the performance of an invention so that we can be evaluated before using the actual design. This system will show us whether the use of gear in a vehicle are functioning properly. If we use the wrong gear, it can cause damage to the gearbox and the gear teeth on a moving train speed. It thus damages the whole system in gear. We can also use this system to determine whether the driver uses the correct gear. In addition, this system can also train their drivers to use the gear properly while driving.

1.2 BACKGROUND OF STUDY

In this project, design and development of gearing system for car simulator will be conducted. The details phases of the new simulator development, from concept design consideration to hardware selection, fabrication and finally the testing process will be studies. The project will be started with literature review to gather all the information related to car simulation design.

Next the design concept or sketching the prototype of gearing system for car simulator will be evaluated using matrix chart method in order to select the best design will be finalized and drawn using Solidwork or Autocad software's prior to the final design being fabricated.

This process will follow by fabrication process in order to develop the design. Fabrication process involves all basic mechanical processes such as grinding, drilling, cutting and etc. Once the fabrication process finished, the electrical circuit will be designed and will be attached to the final design for signal detection.

1.3 PROBLEM STATEMENT

This study is about the design and develops the gearing system for car simulator. The prototype will be designed and be tested before produces the real car. It is done to ensure better performance of the design especially for high cost products. Sometimes the cost of the prototype becomes higher and higher due to our demand to high performance system of the car itself. So that, it is important to have a system that can simulate the performance of the car before it can be used by the customer. The car simulators are being used as testing machine on car performance for this purpose. This project will focus more on gearing system since that system is the most important parts for car performance. Simple electrical circuit will be designed in order to take the data or signal on gearing design and to ensure the design is functional.

Figure 1.1: Example of car simulation programme

Source: www.oktal.fr

1.4 RESEARCH OBJECTIVE

The main objectives of the study are:

- To design the gearing system for car simulator
- To fabricate the gearing system for car simulator
- To design electrical circuit for simulator

1.5 SCOPE OF THE RESEARCH

The ability to contribute the scope in designing the product is important to make it success. It can be the benchmarking for the development of the product. To accomplish the objectives, there are three scopes project which are:

- Sketching and designing processes will be done by using Solidwork software
- Fabrication of the gear system using various mechanical processes such as welding, cutting, fitting etc.
- Design the electrical circuit for signal detection

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Gear are used in most types of machinery, Nuts and bolts are a common machine elements that be needed on from time to time by almost all machines. It has been use for over three thousand years and they are in important element in all manner of machinery used in all times. Gear design is difficult complicated art. The constant pressure to build less expensive, quieter running, lighter weight, and more powerful machinery has resulted in a steady change in gear designs. At present much is known about gear load carrying capacity, and many complicated processes for making gears are available. The industrialized nations are all doing gear research work in their universities and manufacturing companies. Even less developed countries are doing a certain amount of research work in mathematics of gears and in gear applications of particular interest.

Early transmissions included the right-angle drives and other gearing in windmills, horse-powered devices, and steam engines, in support of pumping, milling, and hoisting. Most modern gearboxes are used to increase torque while reducing the speed of a prime mover output shaft (e.g. a motor crankshaft). This means that the output shaft of a gearbox will rotate at slower rate than the input shaft, and this reduction in speed will produce a mechanical advantage, causing an increase in torque. A gearbox can be setup to do the opposite and provide an increase in shaft speed with a

reduction of torque. Some of the simplest gearboxes merely change the physical direction in which power is transmitted.

Many typical automobile transmissions include the ability to select one of several different gear ratios. In this case, most of the gear ratios (often simply called "gears") are used to slow down the output speed of the engine and increase torque. However, the highest gears may be "overdrive" types that increase the output speed.

The efficiency of these power transmission systems is an important design factor due to the following reasons:

i. Efficient power transmission systems ensure fuel economy of automobiles, marine vessels and aircrafts.

ii. With less fuel consumption, less pollutant gases and particulate are emitted to the environment

iii. Since power losses amount to heat generation within the gearbox, several gear failure modes such as scoring and fatigue can be directly influenced by the efficiency of the gearing system.

iv. Improved efficiency of a gearing system can reduce the requirements on the capacity of the lubrication system and the gearbox lubricant and thereby reducing the operation costs of the system.

iv. Efficiency prediction can assist in estimating the power requirements during the design stage of a machine and thus ensuring that the system operates reliably. It can also assist in estimating the power output for a given power input.

2.2 GEAR MANUFACTURING HISTORY

On the way mechanics actually cut gears. Edward Sang produced a treatise in Edinburgh in 1852 that ultimately laid the groundwork for the generating type of gear-cutting.

By 1867, William Sellers had exhibited a milling machine gear cutter in which the sequence of automatic motions was so controlled by stops. The cutter could not advance unless and until the gear blank had been correctly indexed for the next tooth. When all the teeth had been cut, the machine stopped automatically. Then the moulding generating cutter was devised. Instead of indexing the gear blank, the cutter and the gear blank are given synchronous motions, so that the two are correctly meshed together. In 1880 Ambrose Swasey for Pratt & Whitney developed one machine that operated on the "describing-generating" method. In 1889, George B. Grant developed another one and started a gear-cutting shop.

In 1884, Huge Bilgram of Philadelphia came out with a gear shaper working on the moulding generating principle to make small bevel gears for the chainless bicycle. In 1898, James E. Gleason invented a machine that generated bevel gears by using a rotary cutter and a combination of motions- rotary, swinging of the cutter carrier, and lateral. Gleason's machine was fully automatic that provided the manufacturing solution to bevel gearing used in differential drive. Oscar J. Beale developed the other bevel-gear generator for Brown & Sharpe in 1900 that was of significant commercial significance.

The most advanced gear cutting machine of the moulding generating type was Fellows' gear shaper of 1897 that was invented just in time to produce gears that would be needed for automobiles. Edwin Fellows designed the teeth of his cutter in such a way that one cutter could be used to make gears of any diameter provided the pitch was the same. The only qualification was that their teeth must be of the specific helix angle the cutter was designed to produce. To make hardened cutters for his shaping machine, Fellows created another machine.

Hobbing was the last to come. The first attempt to cut gears by using a worm with teeth on it may have been by Ramsden in England in 1766. In 1835, Josheph Whitworth produced a machine that would hob spiral gears. Many improvements by others followed. But the hobber did not become practical until Pfauter, working in Germany built a machine with a cutter axis that was not at 900 to the gear axis. There were many problems in developing the process, but by 1909, there were at least 24 firms manufacturing gear-hobbing machines.

2.3 DEFINITION OF GEAR

A round or cylindrical mechanical component with teeth, used to transmit power. Gears are designed to mesh with one another and can alter the speed, torque, or direction of mechanical energy.

2.4 GEAR SHIFT

A gear stick (also known as gearstick, gear lever, selection lever, shift stick and gear shifter) is the lever used to change gear in a vehicle, such as an automobile, with manual transmission or several common forms of automatic transmission. The device is used to change gear; in a manual transmission vehicle this will normally be done whilst depressing the clutch pedal with the left foot to disengage the engine from the drive train and wheels. Automatic transmission vehicles, robotized manuals, and those with continuously variable transmission gearboxes, do not require a clutch pedal.

Gear sticks are most commonly found between the front seats of the vehicle, either on the center console (sometimes even quite far up on the dashboard), the transmission tunnel, or directly on the floor. Some vehicles have a column shift where the lever is mounted on the steering column - this arrangement was once almost standard practice in the United States until relatively recently, which had the added benefit of allowing for a full width bench-type front seat (though some models with bucket seating as an option include it). It has since fallen out of favor, although it can still be found widely on US-market pick-up trucks, vans, and "full-size" US sedans such

as the Ford Crown Victoria. A dashboard mounted shift was common on certain French models such as the Citroen 2CV and Renault 4. The Bentley Mark VI had its gear lever to the right of the right-hand drive driver's seat, alongside the driver's door, where it was not unknown for British cars to also have their handbrake. (Left-hand drive models received a column shift.)

In some modern sports cars, the gear lever has been replaced entirely by "paddles", which are a pair of levers, usually operating electrical switches (rather than a mechanical connection to the gearbox), mounted on either side of the steering column, where one increments the gears up, and the other down. Formula 1 cars typically used to hide the gear stick behind the steering wheel within the nose bodywork before the modern practice of mounting the "paddles" on the (removable) steering wheel itself.

A gear knob is the physical interface between the manual transmission stick shift and the drivers hand. The gear knob or gear shift knob or stick shift knob is at the end of the gear stick; it forms the handle of the gear stick. Typically the gear knob includes a diagram of the shift pattern of the gear selection system. As an example, gear shift has a position to which the gearstick should be moved when selecting a gear. In some older manual transmission vehicles it may incorporate a switch to engage an overdrive; in some automatic transmission vehicles it may incorporate a switch to engage a special mode such as a sports mode. Both of the above-mentioned switches may also be found on the console or on steering column stalks instead. Shifters on the steering column are typically called a "three on the tree" being a three speed transmission in the forward gears. The lowest of these gears is also called a "Granny Gear".

Many automatic transmission vehicles have extra controls on the gear stick, or very close by, which modify the choices made by the transmission system depending on engine and road speed; for example, "sports" or "economy" modes which will broadly speaking allow, respectively, for higher and lower revolutions per gear, before changing up.

Some specialist vehicles have controls for other functions on the gear stick. The Land Rover Freelander introduced a button for that company's Hill Descent Control system feature, which uses the brakes to simulate the function of a low-ratio gearbox in steep descents.

2.5 MATERIAL

In order for gears to achieve their intended performance, life and reliability, the selection of a suitable gear material is very important. High load capacity requires a tough, hard material that is difficult to machine; whereas high precision favors materials that are easy to machine and therefore have lower strength and hardness ratings. Gears are made of variety of materials depending on the requirement of the machine. They are made of plastic, steel, wood, cast iron, aluminum, brass, powdered metal, magnetic alloys and many others. The gear designer and user face a myriad of choices. The final selection should be based upon an understanding of material properties and application requirements.

2.5.1 ALUMINUM GEARS

The metal is lightweight, non-corrosive and easy to machine. The metal is malleable and has non-magnetic characteristics. Because it's malleable, it can be molded to any shape. Aluminum gears can be of various shapes. It offers spark proof starting of the engine and offers high strength. Aluminum gear offer smoother running, longer life and silent operation. They are designed to resist wear for long lasting durability and maximum performance. Aluminum gear is protected with a coating of anodize.

Aluminum is widely used for light duty instrument gears. Aluminum gears are also used in aircraft industry but it has a drawback if an off airport landing has to be made on a rough terrain.

2.5.2 STEEL GEARS

Steels are divided into carbon steel and alloy steel. Carbon steel offers low cost and can be hardened. A major disadvantage is the lack of resistance to corrosion. Alloy steel is elements like stainless steel, and elements other than carbon. They offer high strength and a wide range of heat treatment properties. They provide highest strength and durability. Stainless steel may be stainless steel (austenitic) that is non-magnetic and has good corrosion resistance; they may be of stainless steel (martensitic) that can be easily hardened by heat, is magnetic and have reasonable corrosion resistance. Stainless steel (aust) can be used where low power ratings are there and the other stainless steel is used where low to medium power ratings is there. Alloy steels are used in industrial field.

2.6 MANUFACTURING PROCESS

2.6.1 Equipment or Machining for Each Part (Types and Process)

There are two basic methods of manufacturing gear: the generating process and the forming process. When a gear tooth is generated, the workpiece and the cutting or grinding tool are in continuous mesh and the tooth form is generated by the tool. In other words, the work and the tool are conjugate to each other. Hobbing machines,shaper cutters, shaving machines and many grinders use this principles.

When a gear tooth is formed, the tool is in the shape of the space that is being machined out. Some grinding machines use this principle with an indexing mechanism which allows the gear teeth to be formed tooth by tooth. Broaches are examples of form tools that machine all the gear teeth simultaneously.

Hobbing

In this process the gear teeth are generated with the hob and workpiece rotating in a constant relationship while hob is being fed into the work. This process is a versatile and economical method of cutting gears. A hob of any given normal pitch and pressure angle will cut the teeth of all spur and helical gears having the same normal pitch and pressure angle. Hobs producing involutes gears are basically straight sided and generate the involute form on the gear tooth by the meshing action.

Broaching

A machining operation which rapidly forms a desired contour in a workpiece surface by moving a cutter, called a broach, entirely past the workpiece. The broach has a long series of cutting teeth that gradually increase in height. The broach can be made in many different shapes to produce a variety of contours. The last few teeth of the broach are designed to finish the cut rather than to remove considerably more metal. Broaches are often used to cut internal gear teeth, racks, and gear segments on small gears, and usually are designed to cut all teeth at the same time.

Casting

It is defining as a process of pouring molten metal into a mold so that the metal hardens into the desired shape. Casting is often used to make gear blanks that will have cut teeth. Small gears are frequently cast complete with teeth by the die-casting process, which uses a precision mold of tool steel and low melting point alloys for the gears.

Drawing

A metal forming process used to make gear teeth on a small diameter rod by pulling the rod throng a small gear shaped hole

Extruding

A process that uses extreme pressure to push solid metal through a die of the desired shape.

Generating

Any gear cutting method in which the cutter rolls in mesh with the gear being cut. A generating method allows a straight sided cutter to cut a curved involute profile into the gear blank.

Lapping

A polishing operation which uses an abrasive paste to finish the surfaces of gear teeth. Generally a toothed, cast iron lap is rolled with the gear blank.

Milling

A machining operation which removes the metal between two gear teeth by passing a rotating cutting wheel across the gear blank.

Molding

A process involves filling a specially shaped container (the mold) with liwuid plastic or metal, so that the material has shape of the mold after it cools. Injection-molidng machines use high pressure to force the hot plastic into steel gear molds.

Punching

A fast, inexpensive method of producing small gears from thin sheets od metal. The metal is shearded by punching die which stamps through the sheet stock into mating hole.

Rolling

A process which rapidly shapes fine gear teeth or worm threads by high-pressure rolling with a toothed die.

Shaping

A gear cutting method in which the cutting tool is shaped like a pinion. The shaper cuts while traversing across the face width and rolling with the gear blnak at the same time.

Shaving

A finishing operation that uses a serrated gear shaped or rack shaped cutter to shave off small amounts of metal as the gear and cutter are meshed at an angle to one another. The crossed axes create a sliding motion which enables the shaving cutter to cut.

2.6.2 Manufacturing the Gear Shift

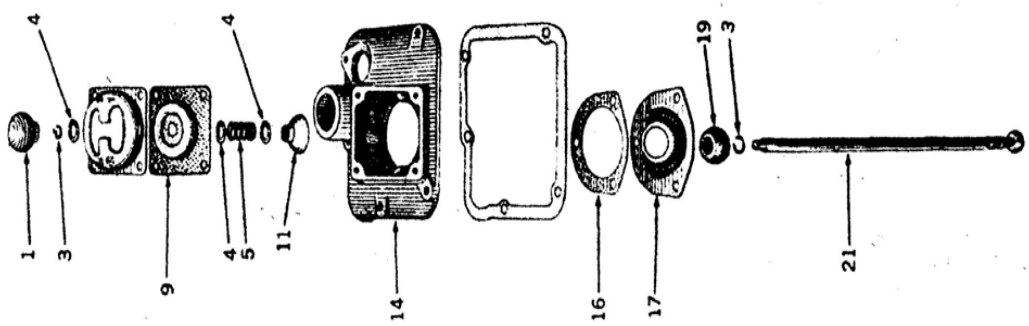


Figure 2.1: The Gear Shift -- Illustration

Source: John Deere (2004)

The initial discrepancy report item read something to the effect: "Found H378R cover (11) and H718R socket (17) rusted to Smithereens". Before it was over, nearly every item along the H722R lever (21) was replaced except the lever itself and the Handle Ball (knob) (1). Even the lever was machined some. Truly, this was a worst-case rust bucket.

Figure 2.2: Some parts of gear shift

Source: John Deere, (2004)

Work began with PB Blaster applied, followed by a soak, then heat along with patience and persuasion for total disassembly which included removal of H717R ball (19). The ball was so deeply pitted that it was beyond recognition had it not been on the lever.

On the H722R lever (21), you should find two grooves milled into the lever that are to accept B387R snap rings (3). This interface is the design weakness of this tractor's gear shifter, and of the A's and B's (1941 and up) and all the G's out there too! The snap ring, as a result of age, is no longer a good match for the groove - if it ever was. The most widely accepted work-around in the John Deere Restoring Community is to weld a modified 5/8 inch lock washer (bent straight) in for a snap ring at the lower groove; this being just under the H717R ball for the JD □H□ tractor. I am told this same

fix is to be used for the upper groove as well, but I found an upper welding fix to be impractical because it makes final assembly extremely difficult. You have to have welding capability and perform final assembly at the same time, same place! And inaddition, to weld an upper ring in place makes later maintenance actions much more difficult.

Figure 2.3: Tractor's gear shifter

Source: John Deere, (2004)

Figure 2.4: External Clip EC-62 in use and compared with B387R

Source: John Deere, (2004)

Rather than a second weld, a decision was made to have the upper groove slightly enhanced on a lathe. The machinist found the lever to be very tough and hard indeed. At any rate, so little was removed that it is fair to say the upper groove was "cleaned up" on the lathe. It was soon learned, however, that the B387R snap ring still would not hold even after "enhancement" of the upper groove. Some experimentation and struggle brought forth a solution in the form of a 5/8 inch External Clip. It did the job nicely. The clip is not quite as thick as the B387R and so fits down into the lever groove much better.

The Order of Things

With lessons learned, a complete inventory of parts on hand, and a H723R (9) leather seal that was conditioned with a light leather oil, final assembly of the gear shift subassembly can proceed. It is imperative that the H701R/H702R casting (14) IS NOT involved until AFTER the upper snap ring (now an EC-clip) is in place.

Begin

Weld modified 5/8 inch lock washer in place of the lower B387R snap ring, and then (in order ref fig 406), onto the H722R lever shaft (21), install H717R ball (19), H718R socket (17), H719R gasket (16-dry), H378R cover (11), B2274R washer (4), D377R spring (5), B2274R washer (4), H723R leather seal with it's crown up (9), and B2274R washer (4). You are now ready for a compression job.

Pretreatment

Treatment of the H723R leather seal (boot) is best done with Neats-foot Oil. However, readers are having trouble find this product. Also, many commercial so-called

Neats-foot products contain substantial amounts of petroleum additives. Thus, a two or three-day soak of the H723R in ordinary engine oil will generally prove satisfactory.

Compression

Once again, special tooling comes into play. Here, a combination was used: a 3/8 x 6 inch machine bolt with two nuts to hold a 5/8 inch crowfoot wrench with 3/8 inch drive, a bench vise, and a person to help. I inserted one end of the stack-up into the crowfoot wrench and applied pressure sufficient to compress all elements installed on the lever while my helper snapped the EC-62 external clip into place. Removal (straight up) is all that remained, and it went like clockwork.

2.6.3 Final Assembly

To put a wrap on final assembly, insert lever sub assembly up through H701R/702R casting, being gentle with H723R leather seal so as to work it up through the casting. Flip this group over. Then bolt and safety wire H719R gasket and H718R socket to casting. With cover and gear shift back upright and in place, temporarily install 5/16 x 9/16 inch long cap screws to secure H723R leather to H701R/H702R cast over.

Figure 2.5 : Crowfoot Wrench w/bolt

Source: John Deere (2004)

Figure 2.6 : Socket Safety-Wired in Place

Source: John Deere (2004)

All that remains is installation of H721R quadrant and F292R shift ball, both left to one′s discretion, depending on the relevant "final assembly and paint plan". Unit is otherwise complete.

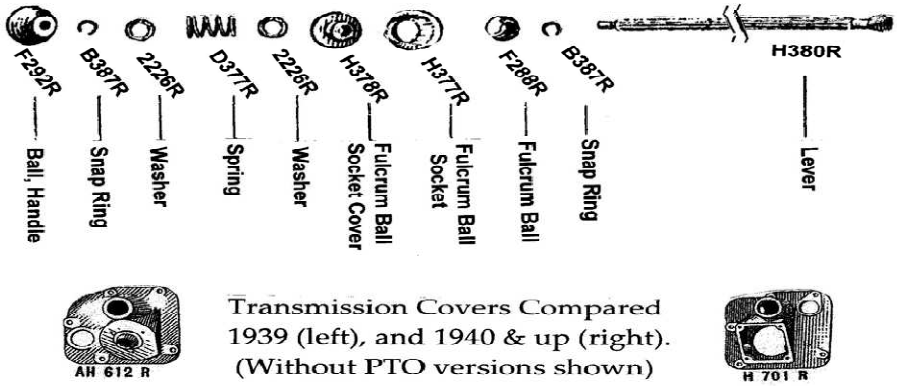


Figure 2.7: The Gear Shift Illustrated

Source: John Deere (2004)

Shown in figure 8 (at left - above) is the transmission cover with H377R fulcrum ball socket installed. This socket is a near-press-fit into the cover, making removal a bit of a challenge. To remove the gear shift assembly, remove the F292R ball handle (The handle unscrews from the gear shift lever), and remove the three small cap screws securing quadrant. Lift quadrant away. Reinstall the F292R ball handle to assist in removal of the gear shift assembly which is not easy, and is best done by means of penetrating fluids, moderate heat, and gentle tapping and prying around the outside of the fulcrum ball socket.

Figure 2.8: 39-H Gear Shift Assembly

Source: John Deere (2004)

Figure 2.9: Transmission cover port

Source: John Deere (2004)

Trouble with the snap rings. This is not unusual. For the bottom, it is becoming customary to spot-weld a ring in place. The ring can be an old B387R snap ring, or a 5/8" lock washer with the bend taken out of it. For the top snap ring, a few choices exist. If you are real adept with a small Dremel™ type grinding disk, you might try enhancing the groove in the gear shift lever. There is the EC-62 External Clip solution as outlined in earlier text. One enterprising fellow proposed drilling at the groove so as to insert a cotter pin (tricky at best - and may weaken the gear shift lever at a critical point).

Once inspection and repairs are completed, reinstall by reversing disassembly steps above. Ensure the fulcrum ball, its socket and cover are well treated with bearing grease during build-up. Apply a coating of Permatex 2B™ (or equivalent) to the interface of the fulcrum ball socket and transmission cover. You will note that the three holes for mounting the quadrant are not symmetrical. The quadrant piece will fit only one way. In the unlikely event the quadrant base plate breaks away from the "top hat" part, observe the "up" orientation of the base plate before welding so that its "up" direction is coincident with the "up" direction of the "top hat" part.

2.7 PIC MICROCONTROLLER

A highly integrated chip that contains all the components comprising a controller. Typically this includes a CPU, RAM, some form of ROM, I/O ports, and timers. Unlike a general-purpose computer, which also includes all of these components, a microcontroller is designed for a very specific task -- to control a particular system. As a result, the parts can be simplified and reduced, which cuts down on production costs.

Microcontrollers are sometimes called embedded microcontrollers, which just means that they are part of an embedded system -- that is, one part of a larger device or system

Microcontroller are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

Figure 2.10: Example of microcontroller

Source: http://savingenergy.wordpress.com

2.7.1 History of Microcontroller

A long time ago General Instruments produced a chip called the PIC1650, described as a Programmable Intelligent Computer. This chip is the mother of all PIC chips It was intended as a peripheral for their CP1600 microprocessor. Maybe that is why most people think PIC stands for Peripheral Interface Controller. Microchip has never used PIC as an abbreviation, just as PIC. And recently Microchip has started calling its PICs microcontrollers PICmicro MCU's.

Figure 2.11: Digital electronic that programmable with microcontroller

Source: Petruzella (2002)

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Project methodology is a body of practices, procedures and rules used by those who work in a discipline or engage in an inquiry and a set of working methods. Project methodology for development of a gear system is shown by flowchart

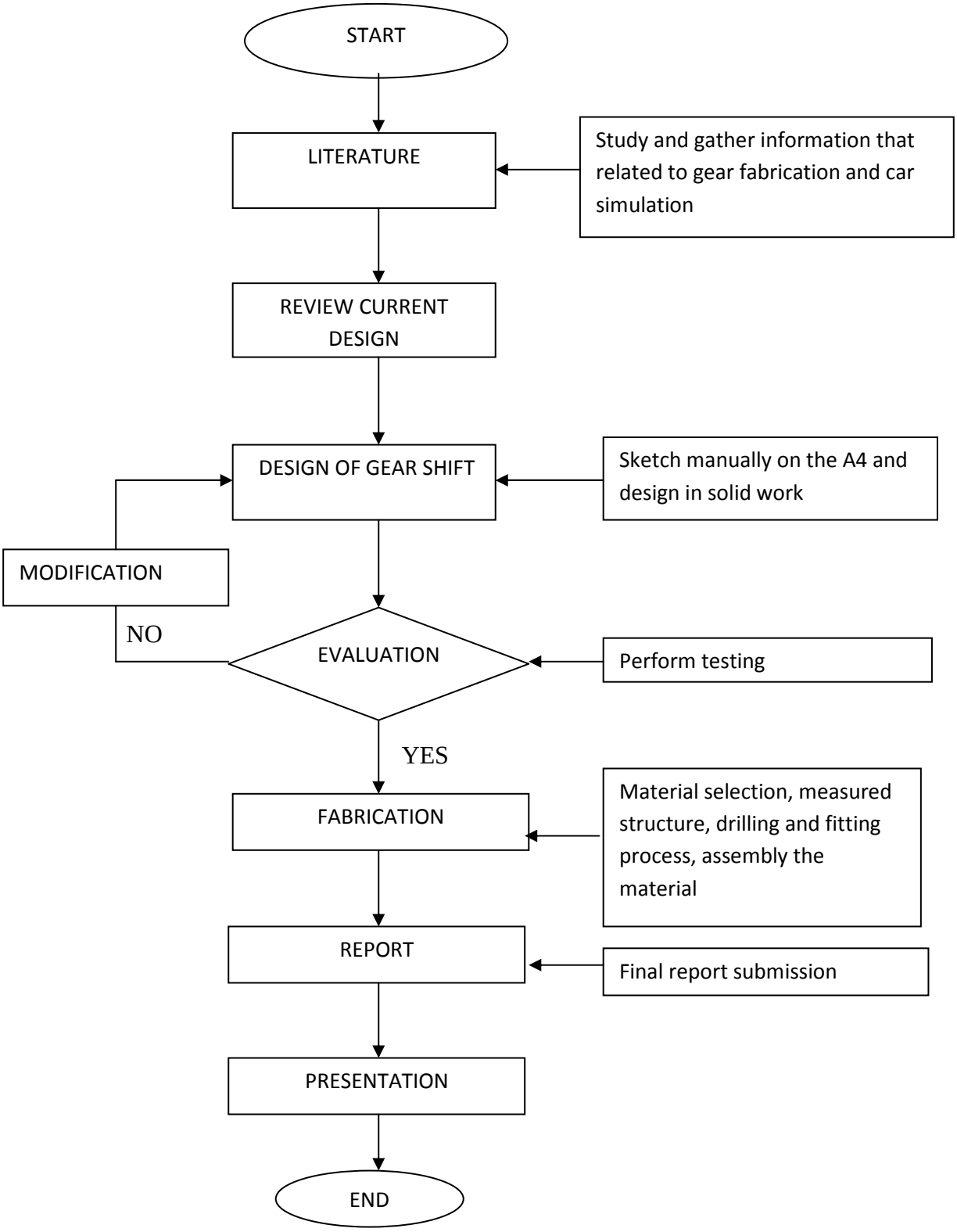


Figure 3.1: Flow chart of the project methodology

From the flow chart in Figure 3.1, this project started with the literature review and research about the title. The main important of the project is determination is the objective. Then, study and make a lot of research about gearing and simulation system. These tasks have been done through research on the internet, books and others sources.

Then the information has been collect and gather, after that, the project will be continuing with the design process. In this stage, the knowledge and lessons that have studied will be applied in sketching. The manual sketching is on the A4 it is to make a suitable design for the project. After several design sketched, design consideration have been made and one of the design have been chosen. The selected sketch will be transfer to engineering drawing by using Solid works program

After all the drawing finished, the drawing was used as a reference for fabricate the gear shift. This process is consists fabricate all the parts that have design before by following all the dimension using various type of manufacturing process. The manufacturing process included in this process is using drilling and fitting process, and also painting. For assemble the part, I just use a masking tape and gum only.

3.2 GANTT CHART

Table 3.1: Gantt Chart for FYP 1

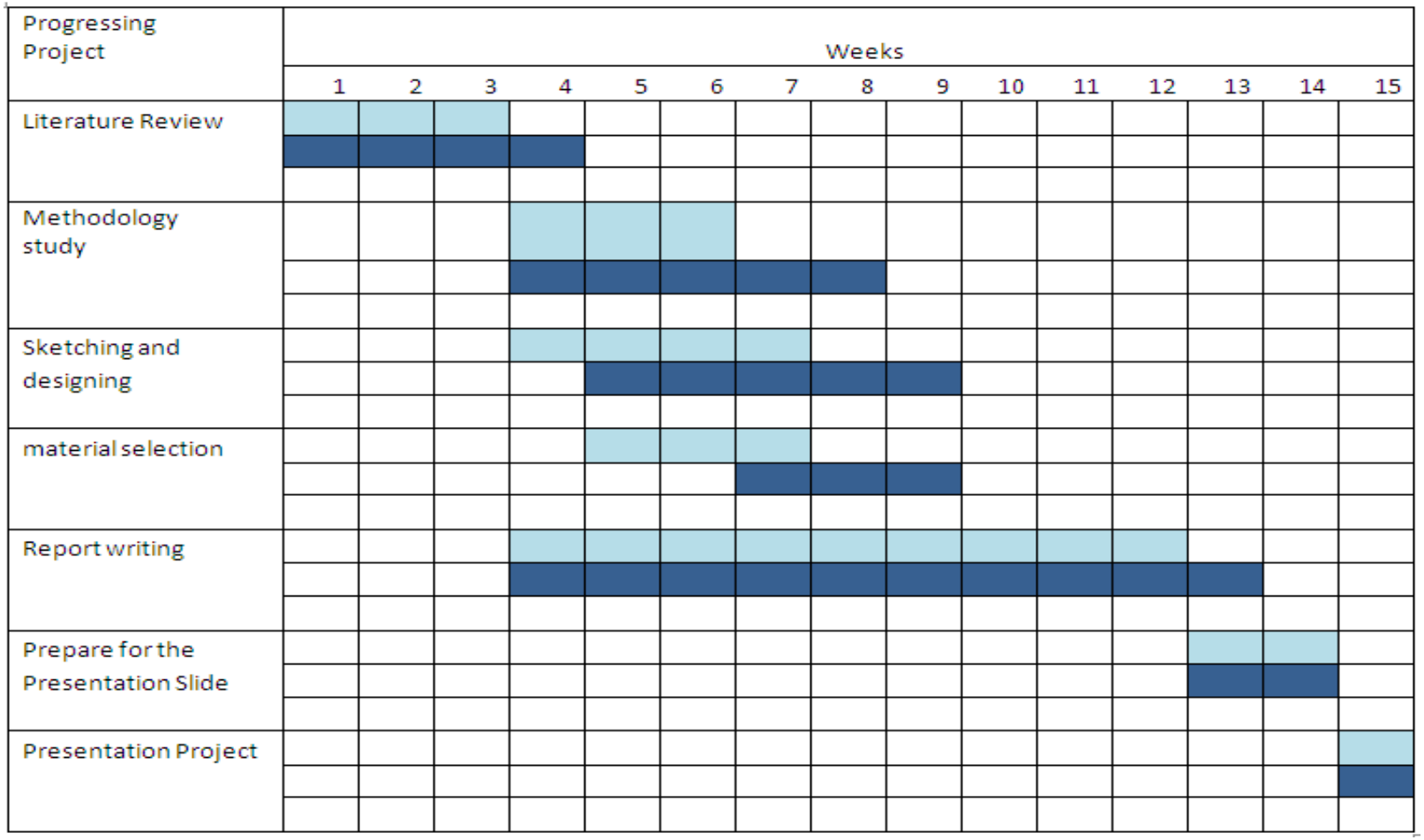
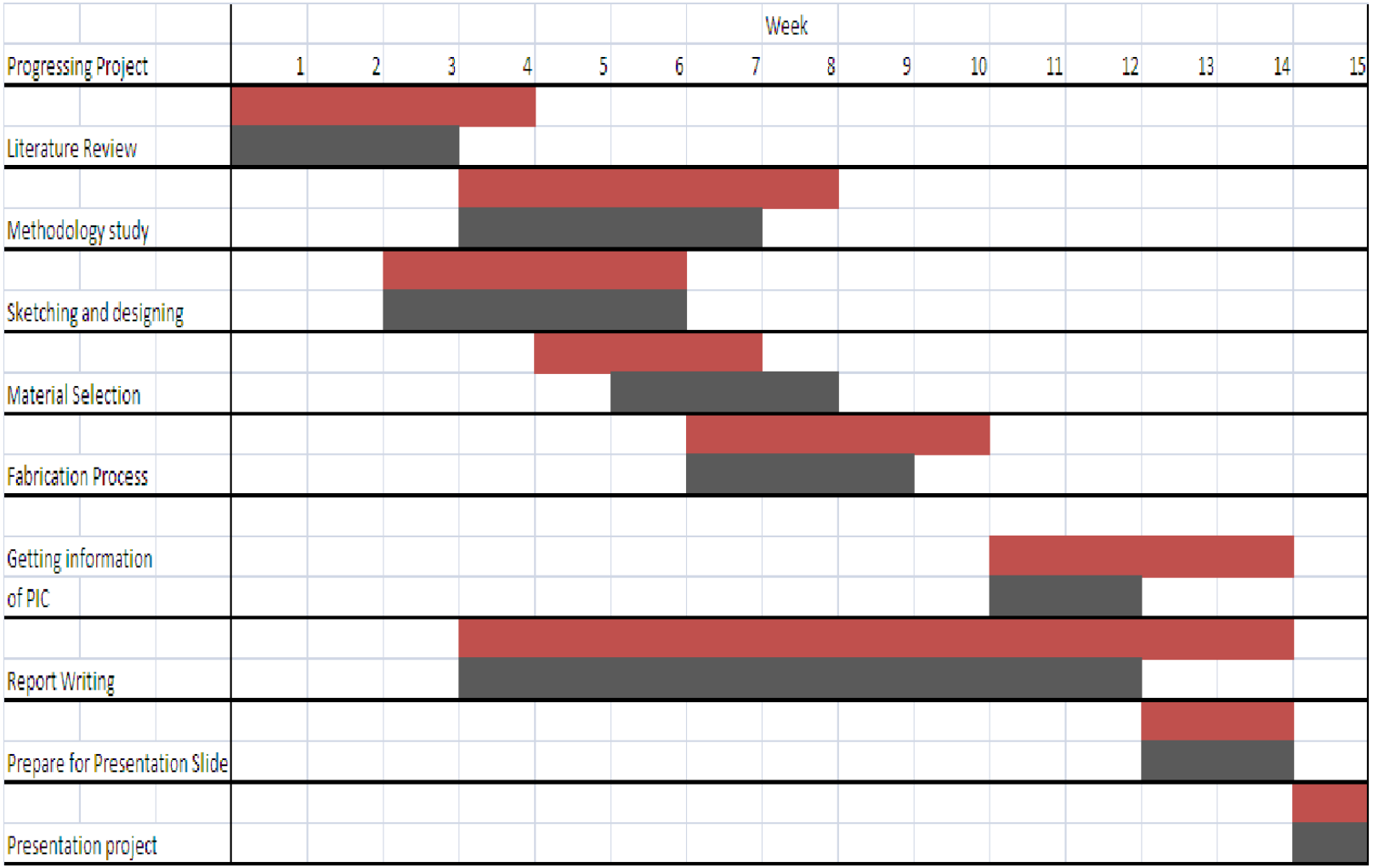


Table 3.2: Gantt Chart for FYP 2



3.3 MATERIAL SELECTION

3.3.1 Box of gear

This part is used to keep spring of the gear lever. This part is made by aluminium which is can capable from become rusty compare to other types of metal. Furthermore, it is easy to find at shop and its price is also cheap. Other criteria of this metal is flexible and it can be designed and fabricated to any height and strength, are easy to install, process structural reliability and easy to maintain

3.3.2 Spring and gear lever

Spring is made from stainless steel. It is rustless even exposed to the moisture for a long time. The spring is come together with the lever so not to take many hours to combine the parts. It is also elasticity and this special characteristic makes it easy to move the gear lever to everywhere we move on.

3.3.3 Gear cover

The gear cover is used to cover the above parts of box and also the lever. This part makes the gear looks neat and tidy. It is made from rubber and its elasticity does not make the lever difficult to move according to the pattern of the gear shift.

3.4 DESIGN SPECIFICATION

Table 3.3: Design specification of gear shift

Parts	Material	Type	Size (mm)	Quantity
Box of gear	Aluminium	Sheet metal	Length: 170 Width: 150	1
Spring with gear lever	Stainless steel	Rod metal	Length: 300	1
Gear cover	PVC / rubber	-	Length:120 Width: 100	1

3.5 DESIGN CONCEPTS

Before the drawing process, the designs of the gear shift concepts have be made by doing the sketching. After all the concept designs have done, it will continue with the concept generation as the evaluation process to determine the best concept.

3.5.1 Sketching

All the ideas for the gear shift fabrication are sketched on the paper first to ensure that idea selection can be made after the selected design is choose.

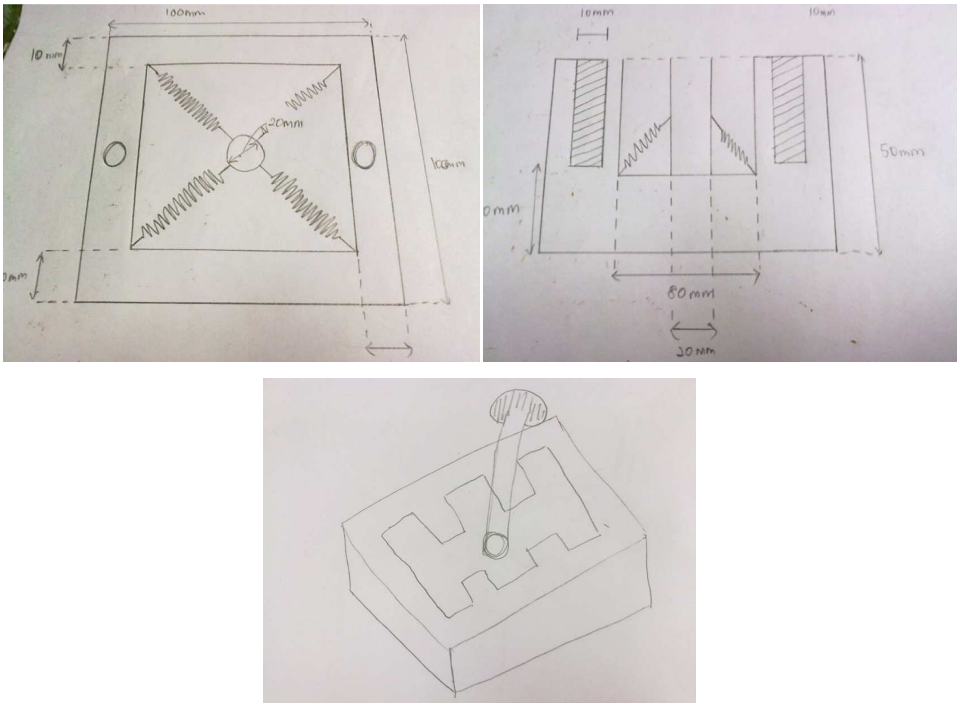


Figure 3.2: Design concept A

Table 3.4: Advantages and Disadvantages of Concept A

ADVANTAGES	DISADVANTAGES
The springs can hold the lever for a long time.	Too many springs required
	Need long time to fabricate

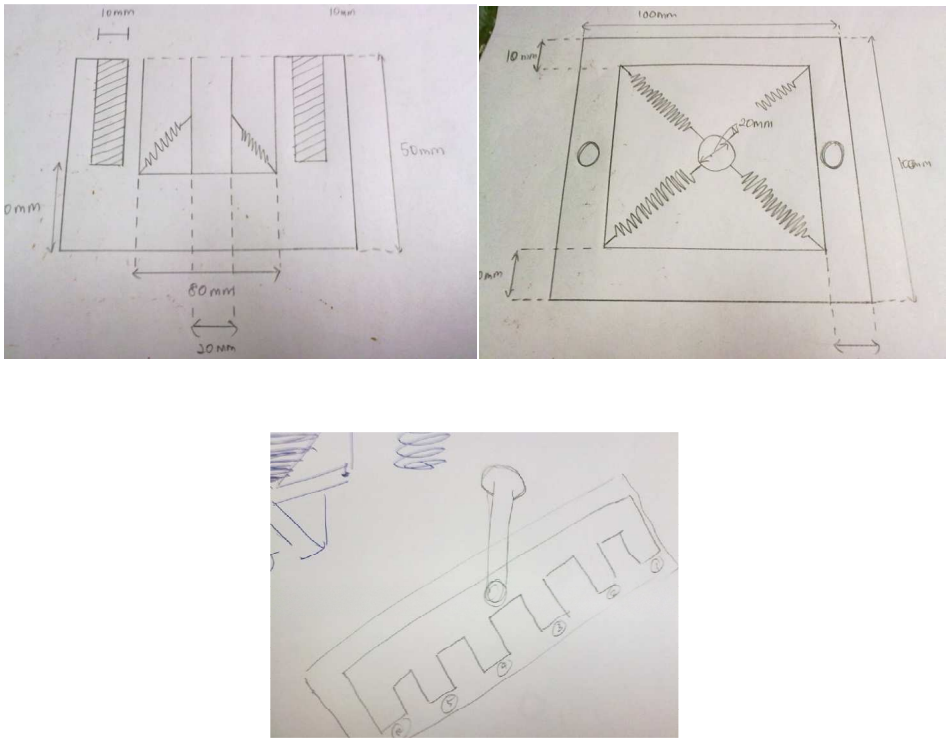


Figure 3.3: Design concept B

Table 3.5: Advantages and Disadvantages of Concept B

ADVANTAGES	DISADVANTAGES
The springs can hold the lever for a long time.	Too many springs required Need long time to fabricate Difficult to change gear to another gear

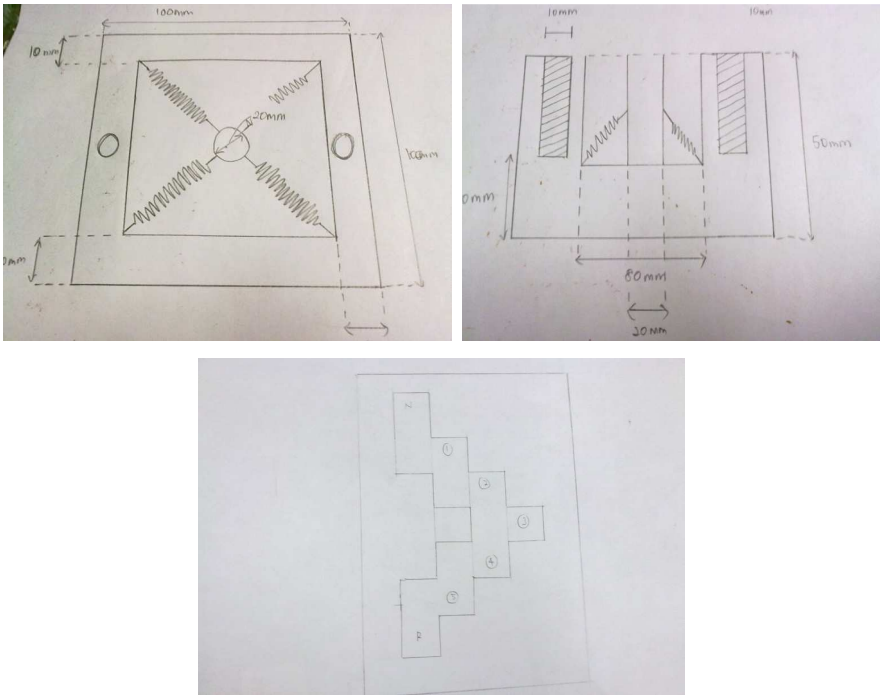


Figure 3.4: Design concept C

Table 3.6: Advantages and Disadvantages of Concept C

ADVANTAGES	DISADVANTAGES
The springs can hold the lever for a long time.	Too many springs required Need long time to fabricate Difficult to change from the reverse gear to first gear

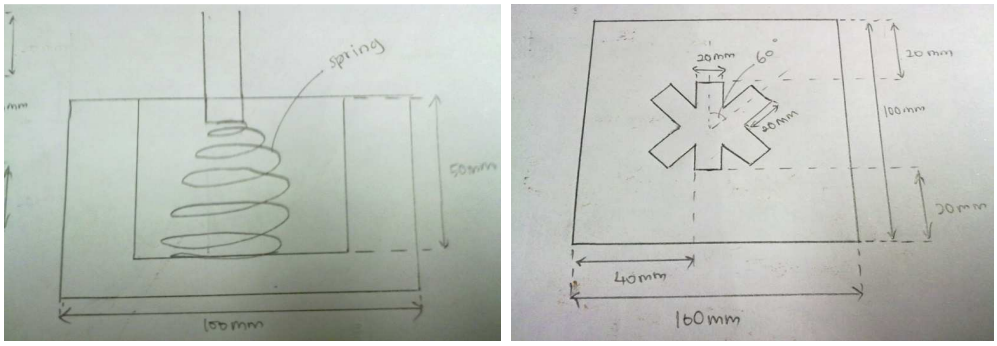


Figure 3.5: Design concept D

Table 3.7 Advantages and Disadvantages of Concept D

ADVANTAGES	DISADVANTAGES
The springs can hold the lever for a long time.	Not last longer than other concept
Easy to change gear	
Only one spring is needed	
Fabrication only take a few time	

3.5.2 Solid Works Software

The selected design or concept sketched is transfer to solid modeling and engineering drawing using Solid work software. On this, the pictures below show the design of technical view of the product.

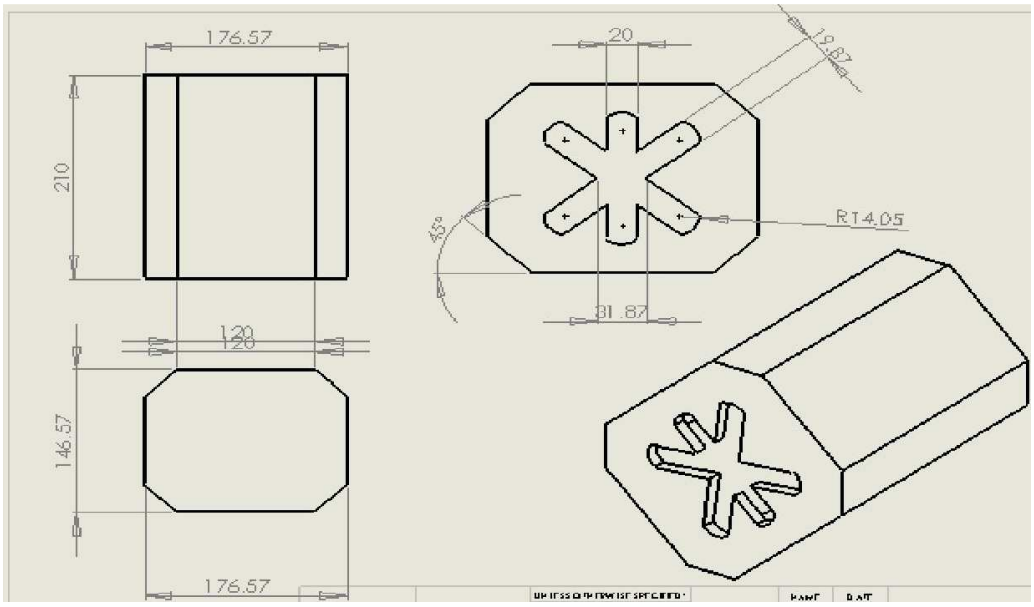


Figure 3.6: Design in solidwork (box of gear)

Figure 3.7: Spring with gear lever

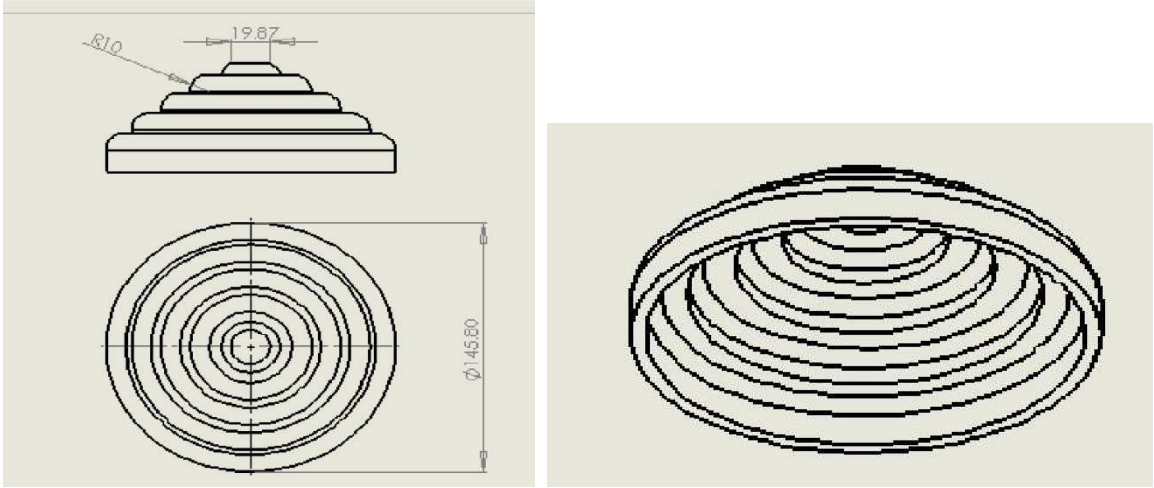


Figure 3.8: Gear cover

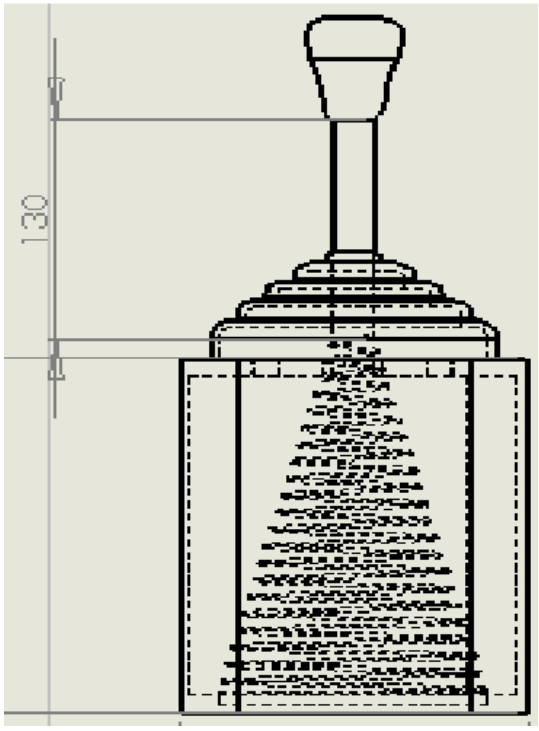


Figure 3.9: Assembly parts using Solidwork

3.6 CONCEPT SCREENING

Table 3.6: Concept screening table

Selection/ Criteria	Concept variants			
	a	b	c	d
Time response	+	+	0	+
Less manufacturing cost	-	-	0	+
Less manufacturing time	-	-	0	+
Less springs required	0	0	0	+
Durability	+	+	0	-
Σ + pluses	2	2	0	3
Σ 0 sames	1	1	4	0
Σ - minuses	2	2	0	1
Σ net score	0	0	0	2
ranking	4	3	2	1
continue	no	no	no	yes

3.6.1 Studies of the concept screening table show that concept D get the highest positive sign. So, as a result, concept D is the best concept to fabricate.

3.7 FINAL CONCEPT

After making the evaluation of the concept designs, concept D is the most suitable gear shift design to produce. Even it is less durability because of less of springs to hold the lever, but it has a good quality.It is also easy to change the gear and less time response than other design. The driver just only need to push out the lever and the gear will change.

3.8 FABRICATING

- Collect the materials

After decide the design and the materials that include on this project, first collect the materials as a first step to do the fabrication process. Material that have been collected will put on the safe area to make the materials are not broke or missing.

- Drilling process

Then, drill the box of gear according to dimension that has been decided on the designing in technical drawing. After done the drilling, fitting is performed to make the side smooth and safety to hand.

- Painting/ spraying

This process is performed because it can make the box looks neat. After painting, let the box dry for 5 or 6 minutes.

- Assembly the parts

Assembly the basic parts of fabricating gear shift like spring, gear lever and box of gear. This process can make the gear move for functioning.

- Cover up the gear

Use gear cover to cover up the spring, lever and also the shape of gear shift. This purpose of this process is also to make the project neat and tidy.

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter discusses about the result that obtained from designation from Solidwork and also analysis by diagram of the function of PIC microcontroller. The objective of this chapter is to show the design of gear shift and also the function of PIC microcontroller. In this chapter of result and discussion, all the result from Solidwork is shown.

4.2 FABRICATION PRODUCT

Figure 4.1: Box of gear

Figure 4.2: Egg beater as a spring with gear lever

Figure 4.3: Gear cover

Figure 4.4: Parts that have been assemble

4.3 HOW PIC MICROCONTROLLER FUNCTION

Microcontrollers are single-chip microcomputers, more suited for control and automation of machines and processes. Microcontrollers have central processing unit (CPU), memory, input /output ports (I/O), timers and counters, analog-to-digital converter (ADC), digital-to-analog converter (DAC), serial ports, interrupt logic, oscillator circuitry and many more functional blocks on chip. Note that there may be variations in the functional blocks from device to device and from one manufacturer to another.

All these functional blocks on a single Integrated Circuit (IC), results into a reduced size of control board, low power consumption, more reliability and ease of integration within an application design. The usage of microcontroller not only to reduce the cost of automation, but also provides more flexibility. The designer is little bit relieved from the complex interfacing of external peripherals like ADC/DACs, etc. and can concentrate on applications and development aspects.

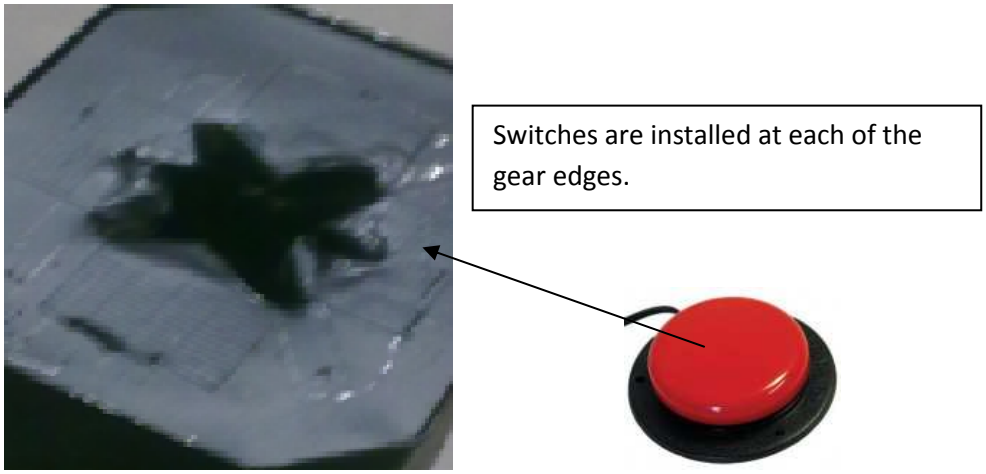


Figure 4.5: Top of gear box and example of switch that will be use

4.3.1 Common Cathode Vs Common Anode

There are two types of LED 7-segment displays: common cathode (CC) and common anode (CA). The difference between the two displays is the common cathode has all the cathodes of the 7-segments connected directly together and the common anode has all the anodes of the 7-segments connected together. Shown below is a common anode seven segment.

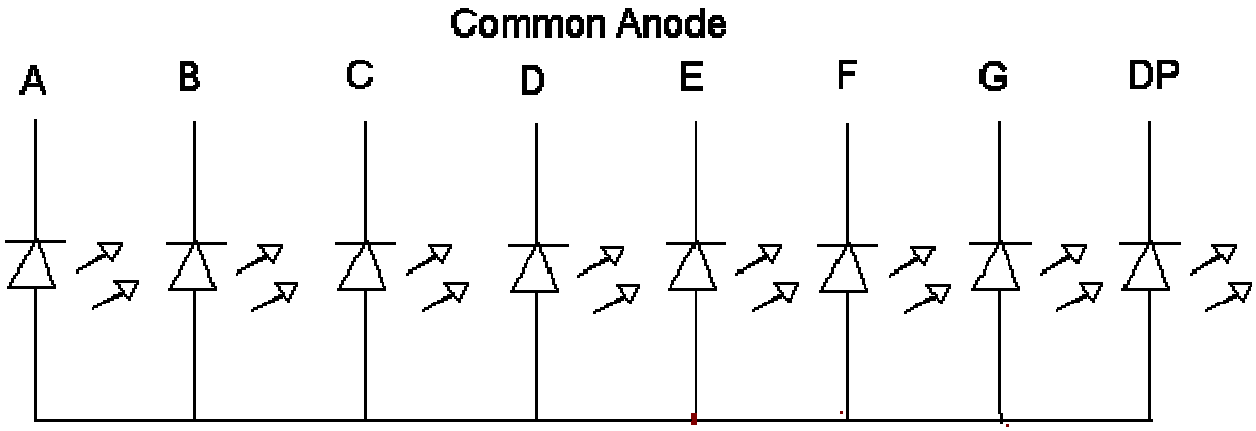


Figure 4.6: Common anode

Source: Aaron Ohta (1995)

As shown above all the anode segments are connected together. When working with a CA seven segment display, power must be applied externally to the the anode connection that is common to all the segments. Then by applying a ground to a particular segment connection (a-g), the appropriate segment will light up. An additional resistor must be added to the circuit to limit the amount of current flowing through each LED segment.

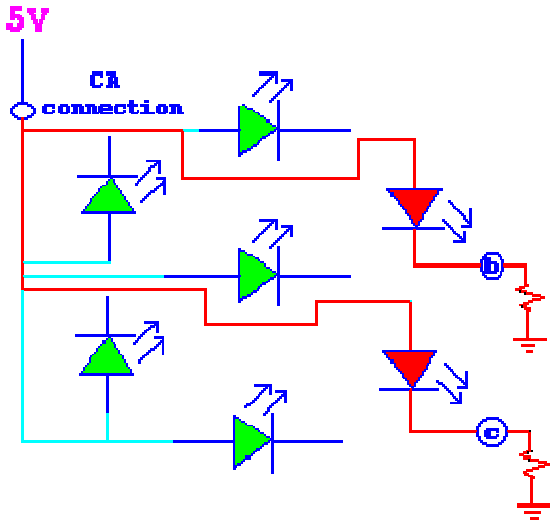


Figure 4.7: Common anode current flow

Source: Aaron Ohta (1995)

The above diagram shows the instance when power is applied to the CA connection and segments b & c are grounded causing these two segments to light up. A typical pinout for a seven segment common anode display is shown below.

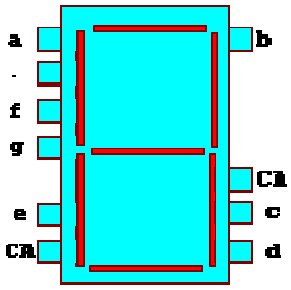


Figure 4.8: 7 segment led common anode

Source: Aaron Ohta (1995)

A common cathode seven segment is different from a common anode segment in that the cathodes of all the LEDs are connected together. For the use of this seven segment the common cathode connection must be grounded and power must be applied to appropriate segment in order to illuminate that segment.

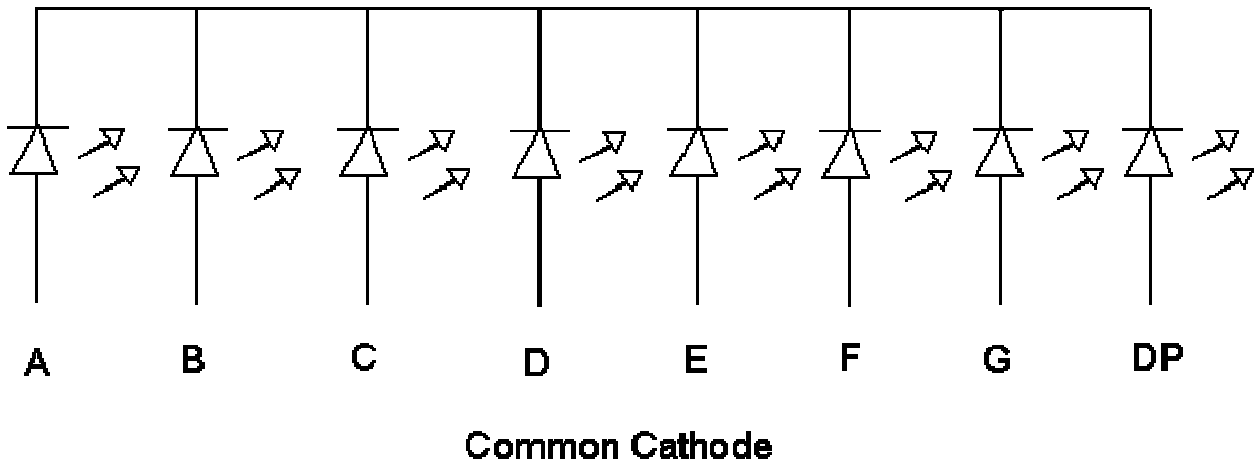


Figure 4.9: Common cathode 7 segment led

Source: Aaron Ohta (1995)

4.3.2 Result from Simulation by Using Logic Circuit Designer

To approve the circuit is correct, the circuit is being tested by using software. The software, Logic Circuit Designer, can show how the current flow on the circuit. Some of the results of the simulation are showed in this thesis.

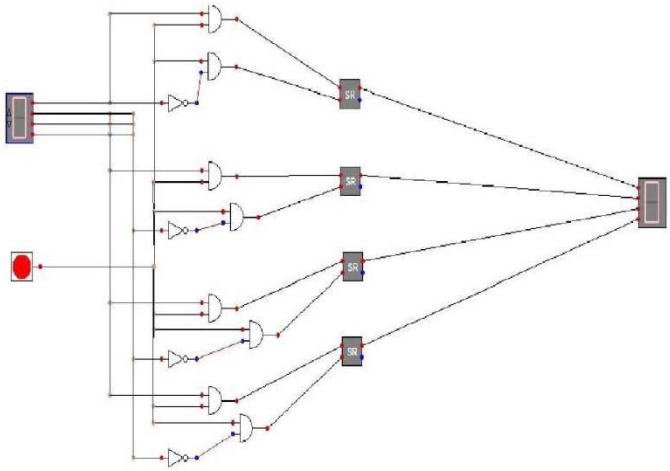


Figure 4.10: Gear Neutral shows “0” on the display

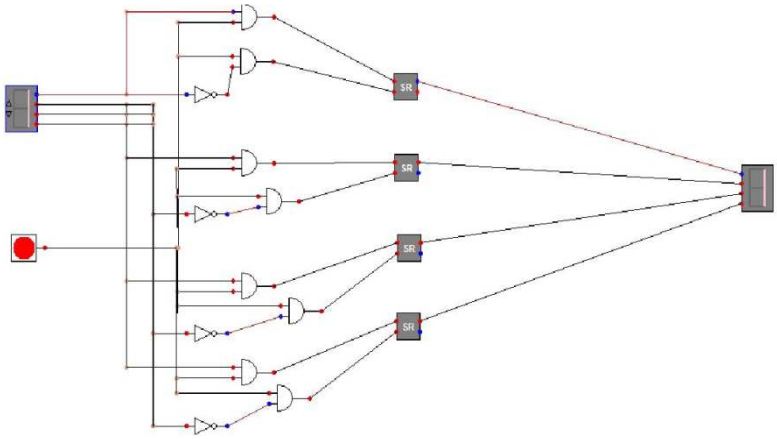


Figure 4.11: Gear 1 shows “1” on the display

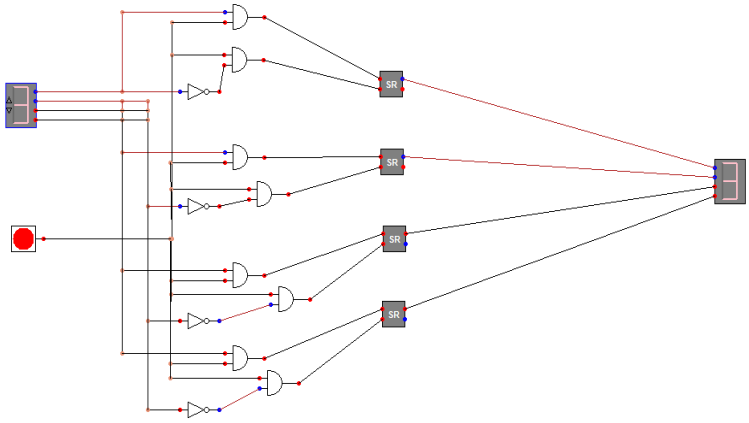


Figure 4.12: Gear 3 shows “3” on the display

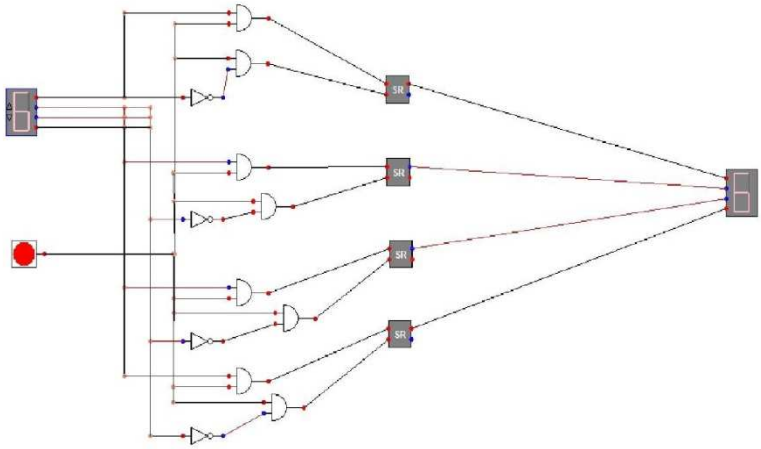


Figure 4.13: Gear reverse shows “6” on the display

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter is the conclusion of the project and the finding based on the literature review and from the progressing that have been done. The objectives of the project will also be evaluated in this chapter. The recommendations in improving the project for the future will also be discussed.

5.2 CONCLUSION

As a closing for this project, many challenges and obstruction have been faced to finish it. The problems such as how to make a design, times to get the material and assembly it, and the materials cost that I need to produce by myself first.

From this project, gear shift was designed by using Solidwork software and fabricate the product by using any type of mechanical skills such as drilling and fitting, and painting the product. Besides that, the project will helps the student in making a good knowledge before develop one a new ideas. It also learns the students about step by step how to complete the project by following a guide.

Results obtained from the fabrication works had successfully fulfilled the objective of this project. The study establishes the following:

The first objective of the project which is to design the prototype of gear has been achieved by using sketching and designing with Solidwork software. Several design concept has been done and the one that been selected is design in Solidwork.

The second objective is to develop the prototype of gear shift. It is achieved from the fabrication process. The prototype is followed the design which is done in sketching and Solidwork to know how gear is function.

The last objective is to design on the software of the electrical circuit to get the signal of the gear. This objective should use software which is Labjack, but unfortunately it cannot fulfill. So, this objective is replaced to design a simple electric circuit to know how is electrical functioning to bring signal to show the usage of gear shift.

5.3 RECOMMENDATION

1. Use different size of box as a gear console
2. Use PIC microcontroller on gear to make the gear functionate.
3. Programming test must be done.

REFERENCES

This guide is prepared based on the following references;

Barry B. Brey, Applying PIC18 Microcontrollers (Architecture, Programming and Interfacing Using C and Assembly, 2007,

Faydor L. Litvin, Alfonso Fuentes, Gear Geometry and Applied Theory, 2nd edition , 2004

Franklin Jones, Gear Design Simplified 3rd edition, 1984

Greenberg J., Artz B., Cathey L. The Effect of Lateral Motion Cues During Simulated Driving. Driving Simulator Conference North America 2003 Proceedings, Dearborn, Michigan, October 8-10, 2003, CD-ROM (ISSN 1546-5071) from http://en.wikipedia.org/wiki/Driving_simulator

Miles Cook Manual Transmission Basics Tech Center from http://www.edmunds.com/ownership/techcenter/articles/46029/article.html

Power and Torque Explained A clear explanation of the relationship between Power and Torque, and how they relate to engine performance from http://en.wikipedia.org/wiki/Torque

Roger D. Smith: Simulation Article, Encyclopedia of Computer Science, Nature Publishing Group, from http://www.answers.com/topic/simulation

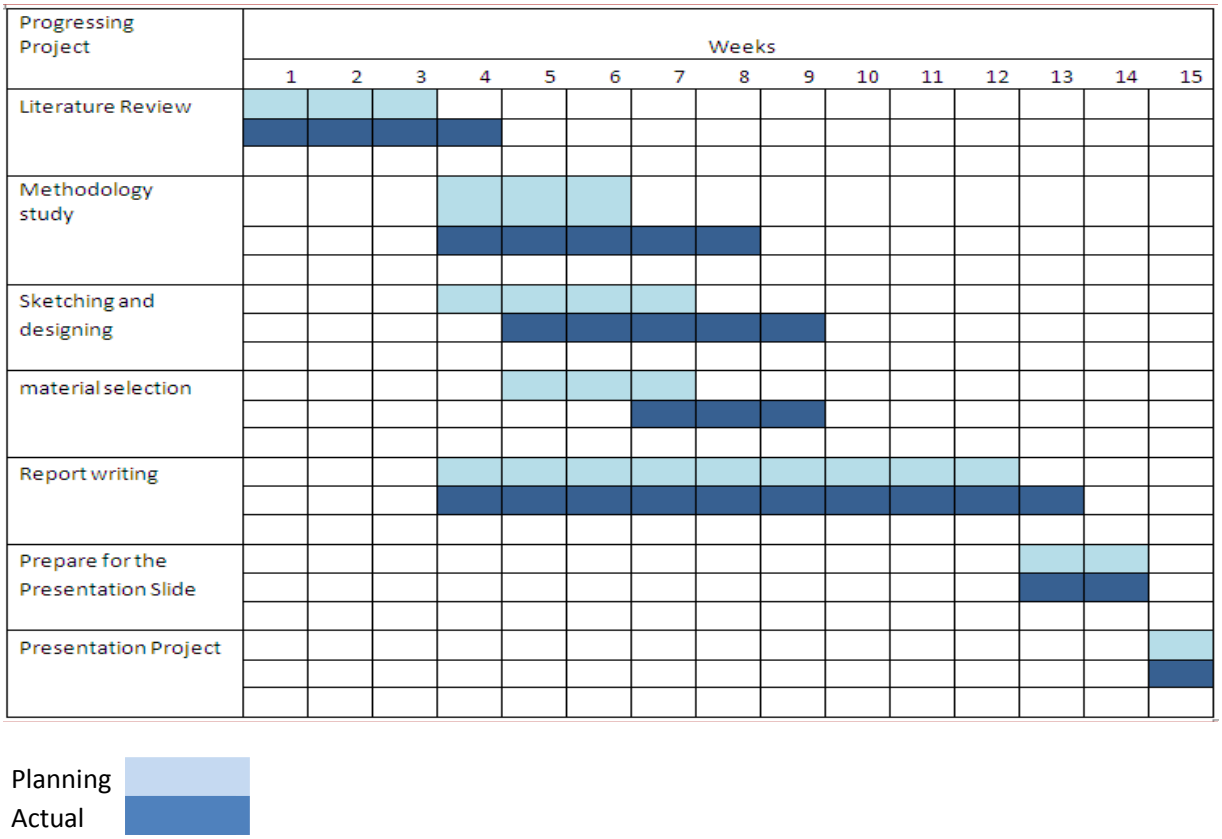
Stephen P. Radzevich, Handbook of Practical Gear Design, 2002, (Mechanical Engineering Series), pg 1.1

Stiesdal, Henrik (August 1999), The wind turbine: Components and operation, retrieved 2009 10-06.http://en.wikipedia.org/wiki/Transmission_%28mechanics%29

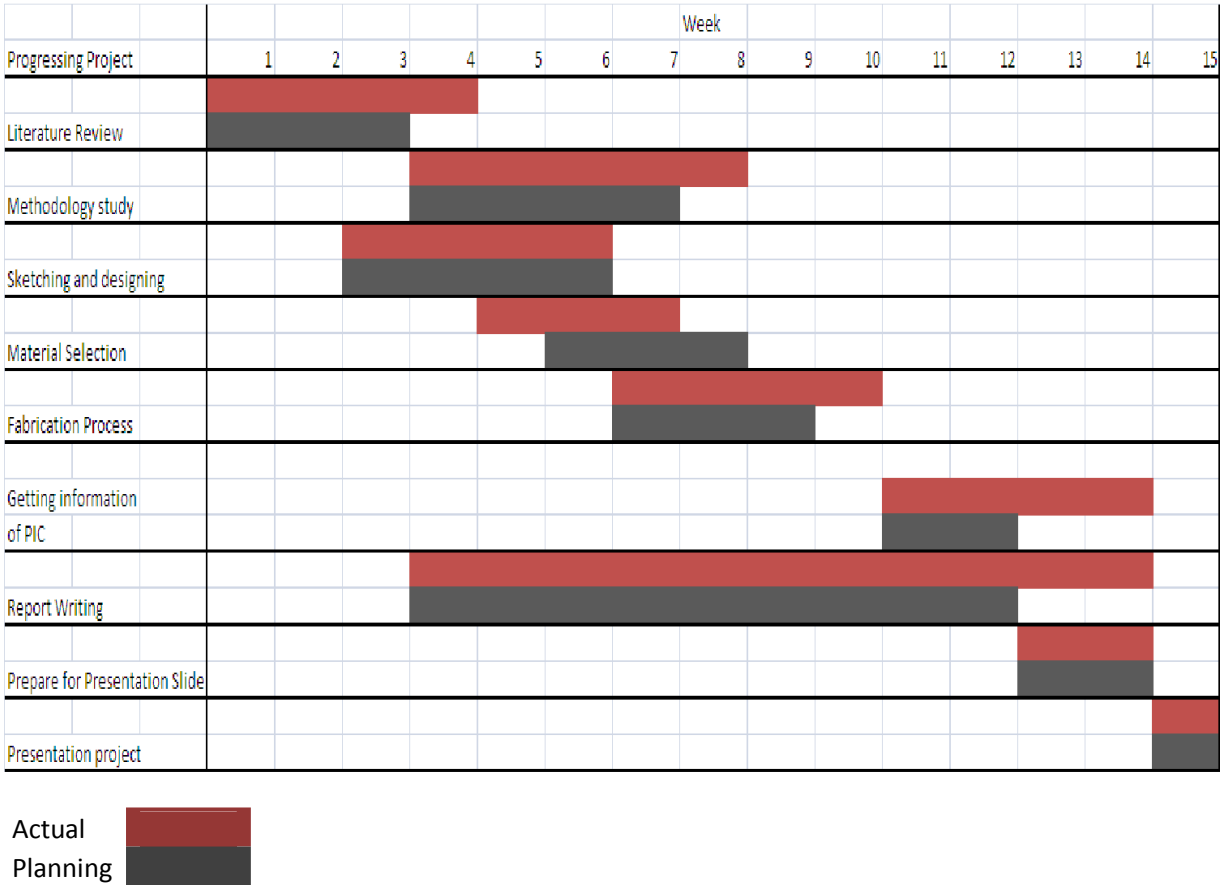
V Udayashankara, M S Mallikarjunaswamy, 8051 Microcontroller (Hardware, Software and Applications, 2009, pg 7, 162

APPENDICE A

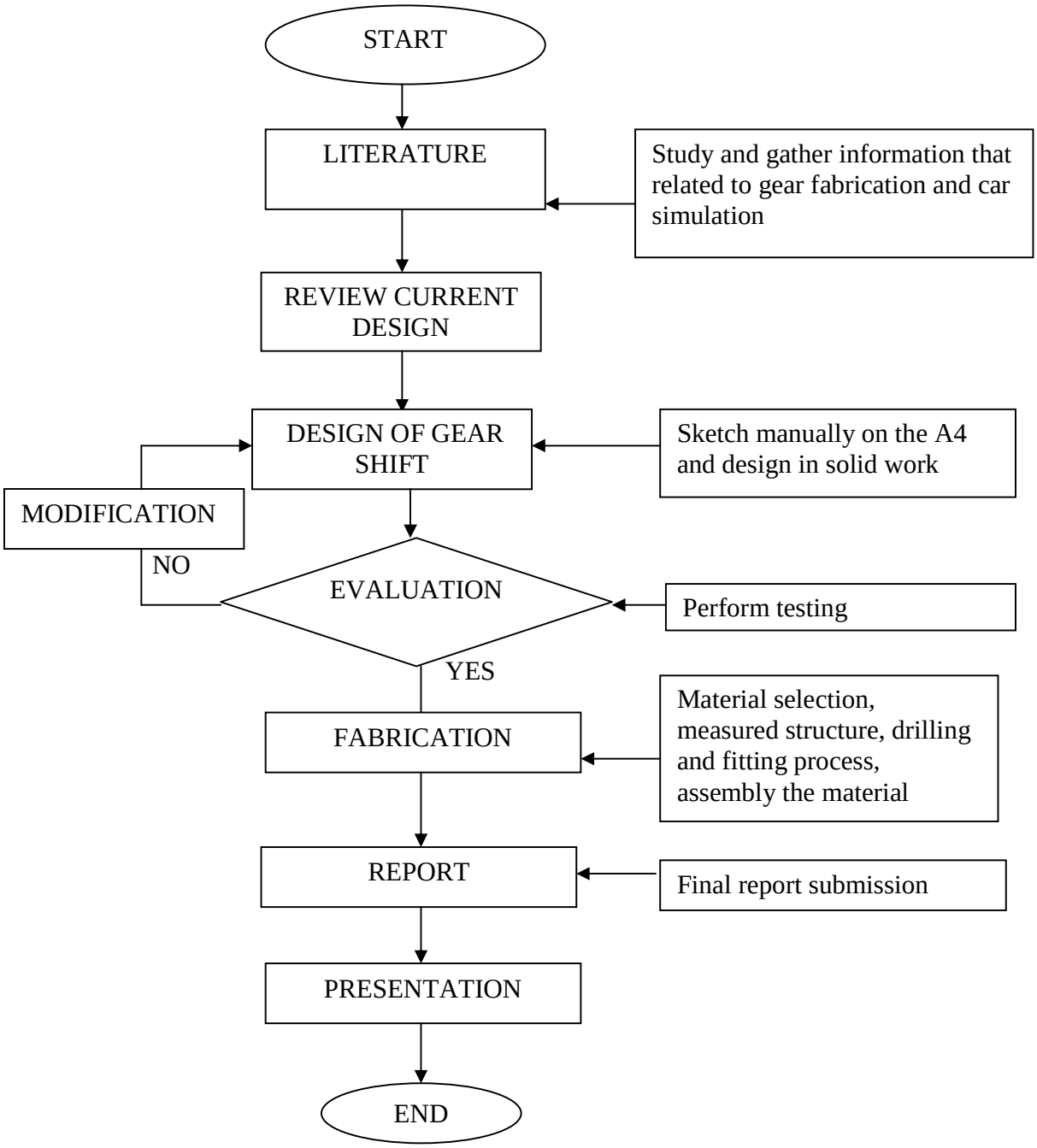
Gantt Chart FYP 1



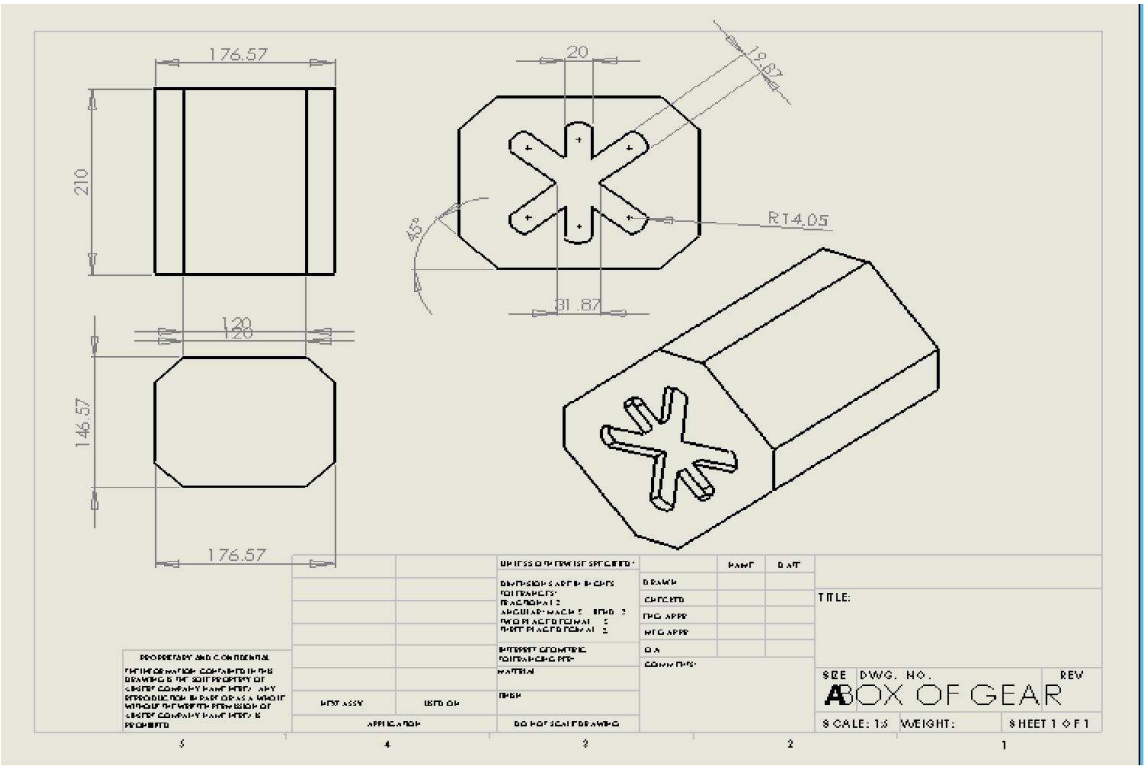
Gantt chart FYP 2



APPENDICE B


START
LITERATURE
Study and gather information that related to gear fabrication and car simulation
REVIEW CURRENT DESIGN
DESIGN OF GEAR SHIFT
Sketch manually on the A4 and design in solid work
MODIFICATION
NO
EVALUATION
Perform testing
YES
FABRICATION
Material selection, measured structure, drilling and fitting process, assembly the material
REPORT
Final report submission
PRESENTATION
END

APPENDIX C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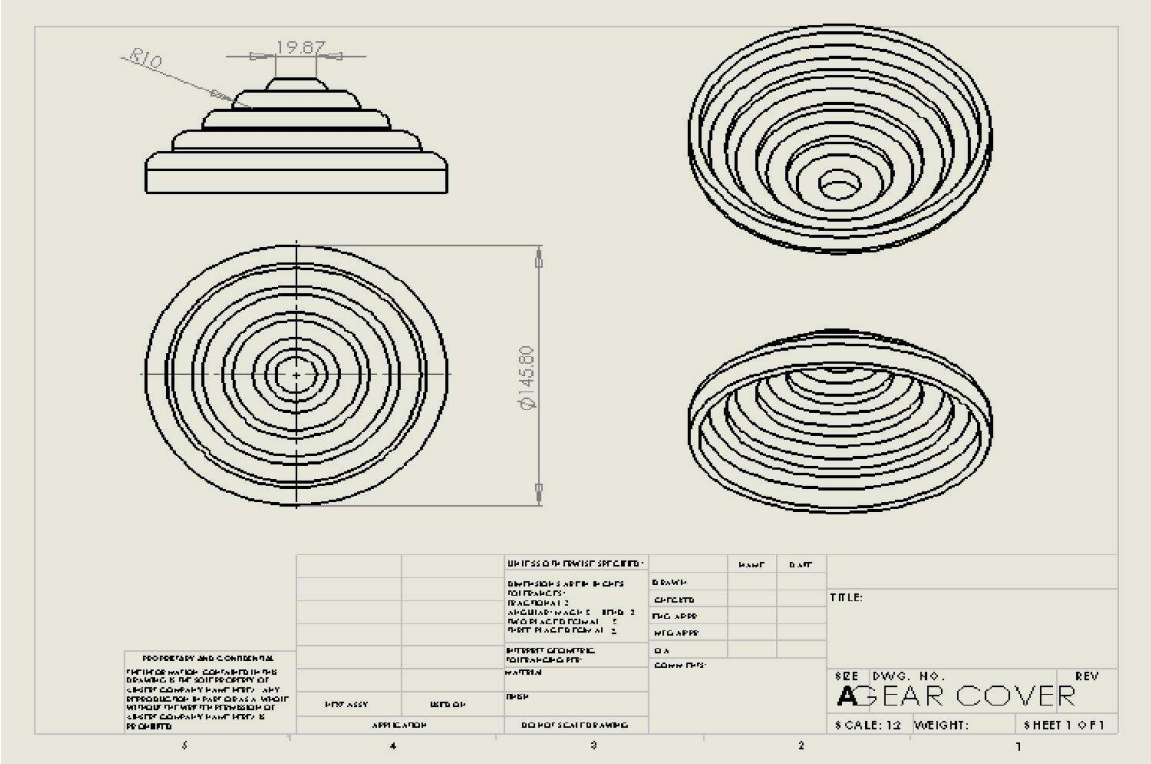
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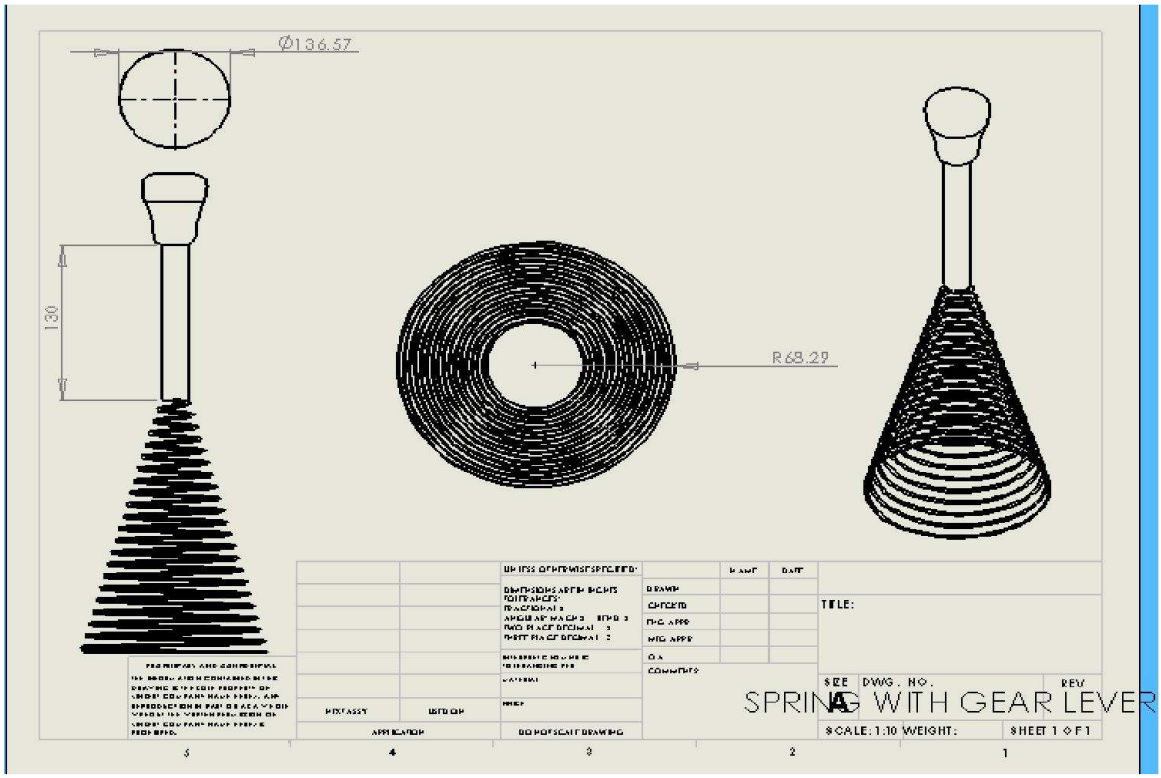
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SPRING WITH GEAR LEVER
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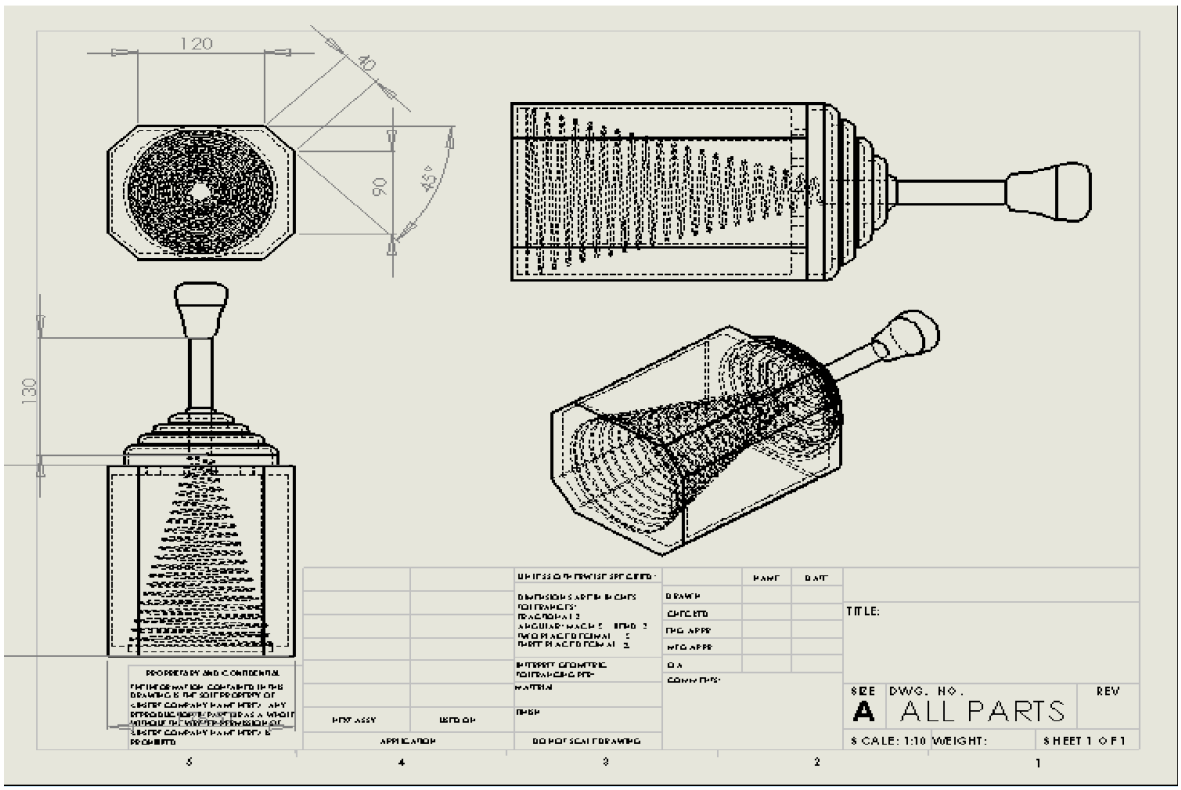
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ALL PARTS
SCALE: 1:10 WEIGHT:
SHEET 1 OF 1