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Development of Conceptual Design for Wheel Hub Retainer Tool

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ABSTRACT

A wheel hub retainer tool is a tool used to facilitate maintenance and drive shaft replacement. The drive shaft will suffer from wear and tear as the age of a car increases and the driving style is relatively rugged. on the side of the road. The method of opening the drive shaft nut manually requires a special tool as a hub retainer when the nut is opened so that the hub will not also rotate in the same direction as the nut rotation. The absence of special tools to hold the hub when opening the drive shaft nut led to the existence of various techniques and ways to open the drive shaft nut by mechanics. However, it is feared that this situation could cause damage to other components such as broken or bent bold studs that could slow down maintenance work or drive shaft replacement. The conceptual design for designing this tool involves a morphology chart and design selection based on Weighing Result Matrix Table. There are four design concept options that have been studied. Based on the selection of the best concept, a selected design concept involves five components that can be stitched together. As a result of this study, a concept design has been produced with the appropriate dimensions.

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1. Introduction

1.1 Introduction

On a vehicle especially a car, the drive shaft (Dewan, K., 2015) is located on the front side of which one is located on the right side of the wheel while the other is on the left side of the wheel. It is one of the important components to transmit the rotational power of the engine from the gearbox to the wheels to allow a car to move. The drive shaft will suffer from wear and damage as the age of a car increases and the driving style is relatively rugged. Usually damage to the drive shaft does not occur immediately, but it will suffer damage gradually. If the drive shaft damage is not repaired immediately, it can invite danger to the driver and passengers in the car. Maintenance or replacement of the drive shaft requires a nut (axle nut) in the center of the hub (hub) to be removed. This drive shaft nut is normally opened using a 32 mm wrench socket and requires high torque to open it.

1.2 Problem statement

Nowadays, maintenance work or drive shaft replacement is done in the workshop using an impact wrench. However, this method of changing the drive shaft often causes problems, especially during power outages or during damage to the air compressor machine in the workshop as well as when it requires immediate replacement outside the workshop such as on the side of the road. The method of opening the drive shaft nut manually requires a special tool as a hub retainer when the nut is opened so that the hub will not also rotate in the same direction as the nut rotation. The absence of special tools to hold the hub when opening the drive shaft nut led to the existence of various techniques and ways to open the drive shaft nut by mechanics. However, it is feared that this situation could cause damage to other components such as broken or bent bold studs that could slow down maintenance work or drive shaft replacement. Therefore, a special tool that simplifies work with a minimum number of employees and saves time should be designed to overcome the problem.

2. Methodology

A design concept is a method of providing functionality through the design of a pre -defined specification product. There are four concepts derived from the ideas and information that have been gathered. According to Jalil, M. K. A. (2000), the ideas that have been collected need to be drawn or sketched to be easily understood through morphological charts. Figure 2.1 shows the morphological chart represents the ideas created by combining each criterion with a selection of other criteria.

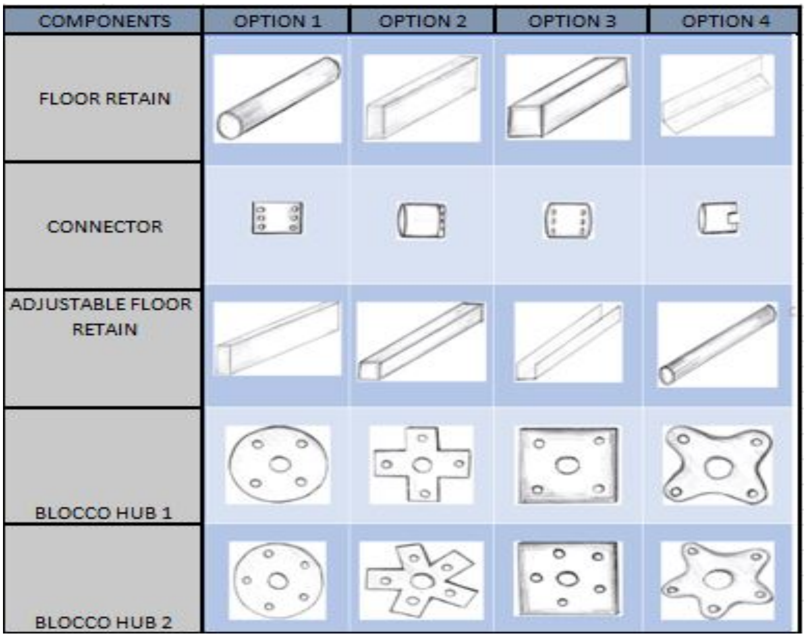

Figure 1. *Morfology Chart*

2.1 Concept 1 (3-1-1-2-2)

The first concept used the third option for the floor retaining part which is rectangular in shape.

It is connected between components using connectors on the first option. For the adjustable floor retainer part it uses the first option which is rectangular in shape. On the retaining part of hub 1 and hub 2, it uses the second option. This First Concept is a bit heavy and not ergonomic.

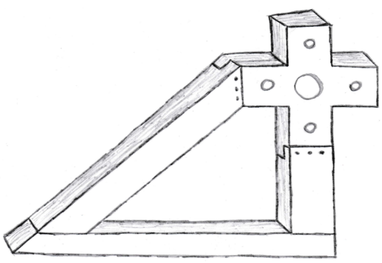

Figure 2. *First Concept*

2.2 Concept 2 (1-2-2-3-3)

This second concept used the first option for the floor retaining part which is cylindrical in shape. It is connected between components using connectors on the second option. For the adjustable floor retainer section, it uses the second option which is rectangular in shape. On the retaining part of hub 1 and hub 2, it uses the second option. This second concept is quite difficult to operate and requires careful safety measures.

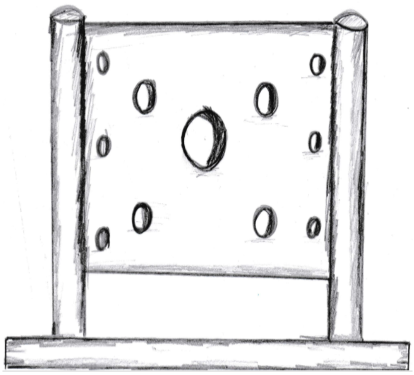

Figure 3. *Second Concept*

2.3 Concept 3 (2-3-1-5-5)

The third concept uses the second option for the floor retaining part which is rectangular in shape. It is connected between components using connectors on the third option. For the adjustable floor retainer part, it uses the first option which is rectangular in shape. On the retaining part of hub 1 and hub 2, it uses the fourth option. This third concept is quite difficult to machine to form the fifth component.

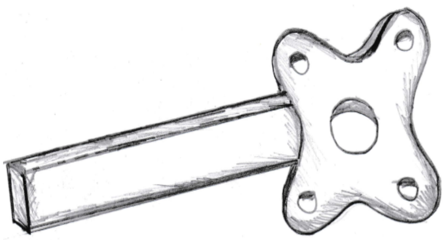

Figure 4. *Third Concept*

2.4 Concept 4 (1-2-4-1-1)

This fourth concept uses the first option for the floor retaining part which is cylindrical in shape. It is connected between components using connectors on the second option. For the adjustable floor retainer section it uses a fourth option which is cylindrical in shape. On the retaining part of hub 1 and hub 2, it uses the first option. This fourth concept is more realistic and ergonomic and easy to operate.

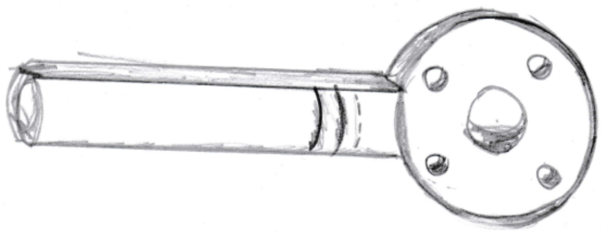

Figure 5. *Fourth Concept*

There are ten design criteria evaluated with different weights. The value of the weight is determined based on its level of importance. The method of calculating the total value points is shown in Table 2.1. The actual number of points is the sum of the points multiplied by the importance of the criteria. The selected concept needs to be developed with refinement in more detail to produce the final design. According to Golenko, A. (2010), decision matrix is a method of evaluating concepts competing with the ranking of design criteria with weighting factors and design scoring for criteria. The following is a table of weighting results matrix for the four concepts that have been evaluated. From the table, the data show Concept 4 is the best.

Table 1. *Weighting Results Matrix Table*

Design Criteria	Weighting Factor	Concept							
		1		2		3		4	
		Score	Position	Score	Position	Score	Position	Score	Position
1. Handling	14	8	112	6	84	8	112	8	112
2. Safety	12	5	60	5	60	7	84	8	96
3. Material	7	6	42	6	42	6	42	6	42
4. Ergonomic	11	5	55	6	66	5	55	7	77
5. Installation	8	7	56	6	48	7	56	7	56
6. Size	10	7	70	6	60	7	70	7	70
7. Weight	6	5	30	6	36	5	30	5	30
8. Maintenance	9	7	63	6	54	7	63	7	63
9.Cost	10	6	60	7	70	5	50	6	60
10. Performance	13	8	104	7	91	8	104	8	104
Rating	100		652		611		666		710

The final design is a combination of selected concepts. According to Taib, J. M., & Hanafiah, K. A. (2006), after all concept designs are analyzed, the design that is considered best will be selected. Once the evaluation was made, Concept 4 was the concept that obtained the highest results and became dominant in this final design. The application of other conceptual concepts also makes this final design complete.

3. Result and analysis

Determination of actual dimensions needs to be done after the final design is selected. The final design that has been selected will be divided into 5 components to be drawn through computer -assisted engineering drawings to produce detailed drawings. It will produce an engineering drawing that has actual dimensions on each component that has been separated. With computer -assisted engineering drawings this can also be a guide and reference during the fabrication process. This fabrication process involves lathe, grinding, drilling, welding and others. The components that have been fabricated will be assembled to each other before the testing process is done on the car.

3.1 Designing First Component (Floor retaining part).

This first component is the floor retaining part when this tool is used. The actual size and dimensions of this component are as in Figure 6.

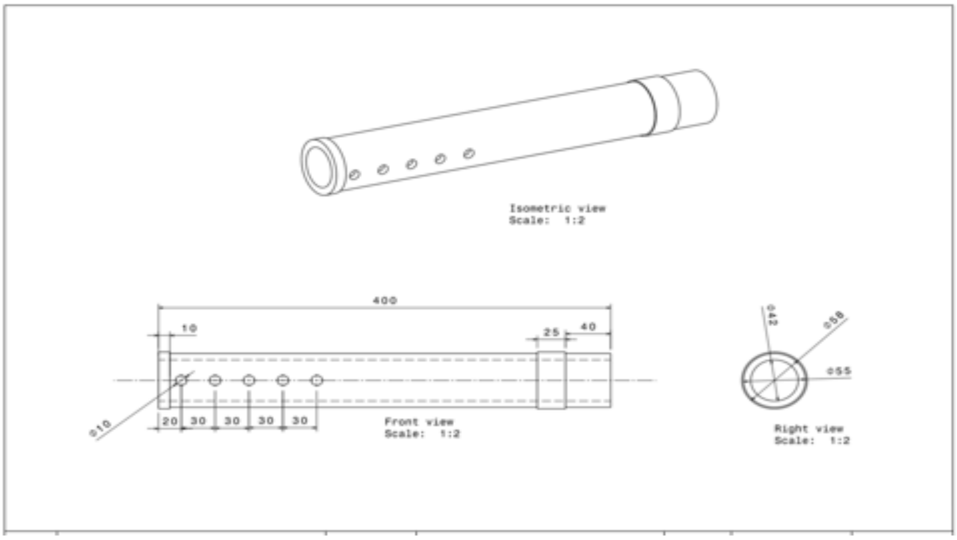

Figure 6. *First Component Design*

3.2 Designing Second Component (Connecting Part)

This second component is the connecting part between First Component and Fourth Component or Fifth Component . The actual size and dimensions of this component are as in Figure 3.2 below.

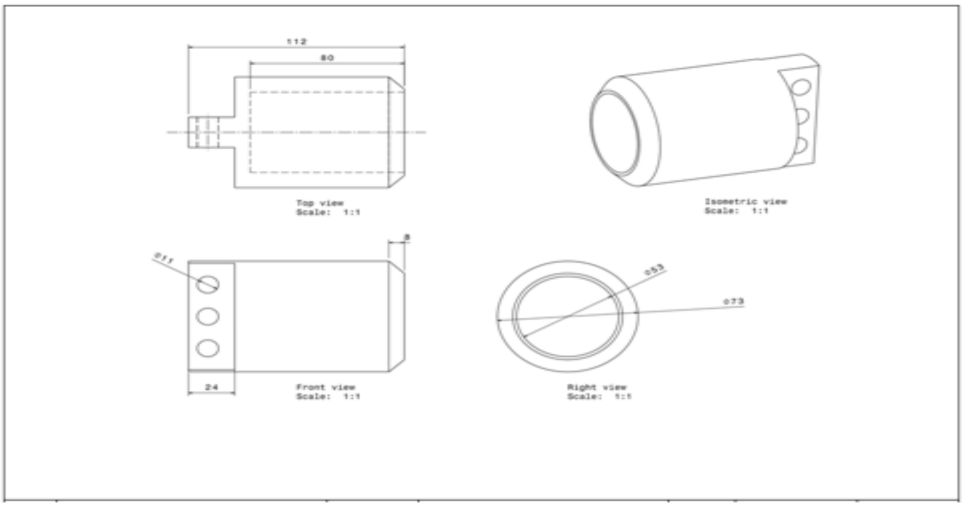

Figure 7. *Second Component Design*

3.3 Designing Third Component (Adjustable Floor Retainer).

This third component is the adjustable floor retainer part when this special tool is used. The actual size and dimensions of this component are as in Figure 3.3.

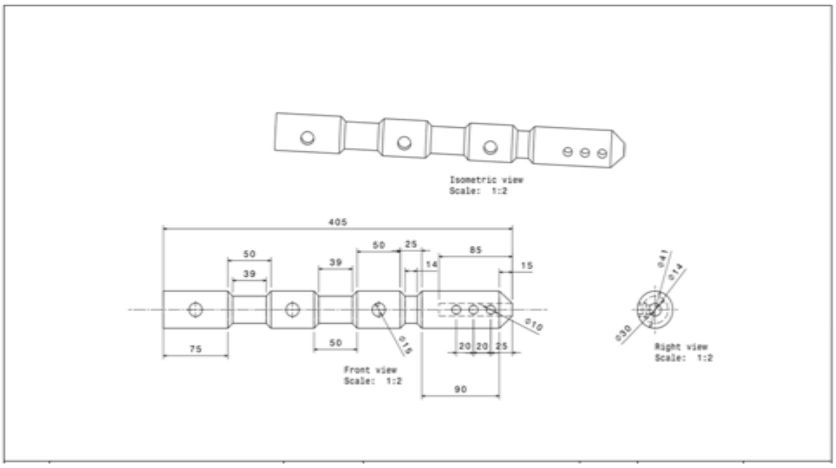

Figure 8. *Third Component Design*

3.4 Designing Fourth Component (First Retainer Hub)

This fourth component is the First Retainer Hub. The actual size and dimensions are as in Figure 9.

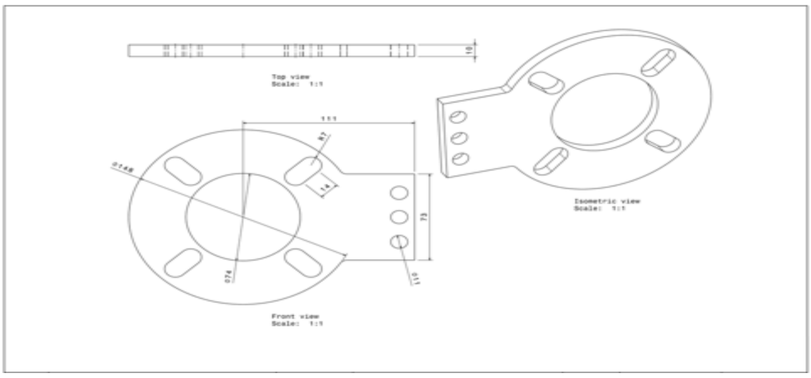

Figure 9. *Fourth Component Design*

3.5 Designing Fifth Component (Second Retainer Hub)

This fifth component is the Second Retainer Hub. The actual size and dimensions of this component are as in Figure 10.

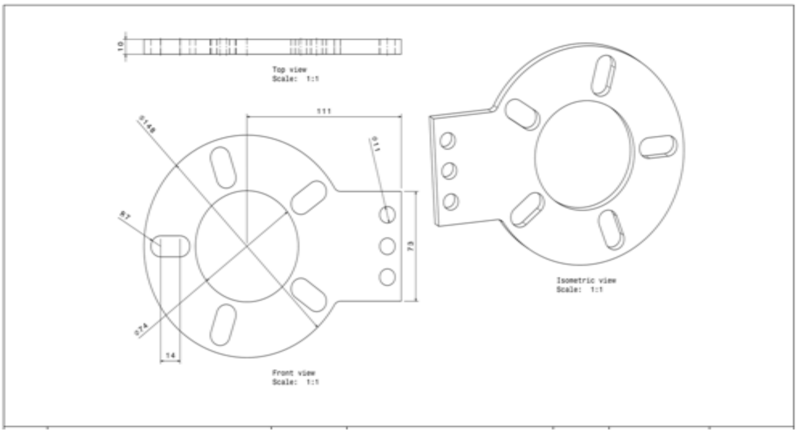

Figure 10. *Second Retainer Hub*

4. Conclusion

The conclusions that can be drawn from the conceptual design development for wheel hub retainer involve the selection to several designs based on several choices of ideas from the Morphology Chart. The selection of this design is the best based on the factors considered in the Weighting Decision Matrix Table. The selection of materials and manufacturing processes need to be scrutinized to produce Wheel Hub Retainer tools that can be used to assist the drive shaft conversion work manually.

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