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Concept design for adjustable motorcycle handlebar

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Concept design for adjustable motorcycle handlebar

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Abstract. Transportation in this modern era became one part of human's daily lives. It helps people travel from one place to another. As a part of technology, transportation technology keeps on developing everyday, increasing the capability of human's physical limits. This article was conducted as an attempt to create a design concept of an adjustable motorcycle handlebar. Design process is done by initially searching for customer feedback through survey, then selecting materials used in the concept, adjusting the specifications of the concepts and creating a 3D model of the designs. The design of the adjustable handlebar of the motorcycle is created by using Aluminium Alloy 7075 as the primary material, and uses a railing design to grant parallel movement to the handlebar. Results of the concept designing process includes the 3D model of an adjustable handlebar, in which concept could be used in further design processes. Keywords: concept design, adjustable motorcycle handlebar.

1. Introduction

Transportation can be defined as the movement of passengers and cargo from one place to another. In transportation there is the element of movement, and physically movement happened to the cargo or passenger with and without the help of a vehicle (walking is an example of transport without a vehicle) [1], [2]. Transportation has been an important component in our lives. We move everyday from one place to another using the help of transportations; we will never ever stay in the same place. These transportations also helped us move our belongings, things with sizes so big or weight so heavy it's impossible to move with the limits of the human body [3], [4]. Not only the size of the cargo, with the growth of technology, other aspects in the transportation itself improves, i.e. power, maneuverability, etc. Bicycles and motorcycles are some examples of these transportations.

The study of motorcycles are conducted first by classifying motorcycles into classes. The CODEC system (Cockpit Design Classification) was created to help study motorcycle ergonomics that focuses not only on the human operator, but also the motorcycle itself [5], [6]. Comparing the distinguishable characteristics of the motorcyle with other transportations could bring us the result of knowing the advantages and disadvantages of using a motorcycle. Its highly compact shape and simpler contraption gives maneuverability and saves variable costs for fuels, treatment, etc. With prices cheaper and more affordable than other vehicles, study shows that in 2018 there was around 14,754,590 motorcyles ridden by the people in Jakarta with the amount of every other vehicles driven in Jakarta combined is only 5,239,990 [7]. But on the other hand, its compact design limited its storage capacity, power, and comfort as a vehicle for transportation, hence making it not suitable for long distance travels. Motorcyclists have been categorized as vulnerable road users with a higher risk [8]. A study conducted in Malaysia stated that fatality caused by mode of transport was dominantly constituded by

motorcyclist. About 60%; more than half of the total fatalities caused by mode of transport is caused by motorcycle accidents [9]. Motorcycle road accidents have become a global transportation safety issues where motorcyclists suffer mortality and non-fatal injury crashes [10]. In response to the dire motorcycle road accident statistics, researches on motorcycle were performed in various standpoints. Due to the fact that motorcycles come in various designs and specifications [11]. In this modern world, innovation drives humanity to keep growing as a whole community, which innovation takes shape in new technology. The people, created as a whole, was created each in different shapes and sizes, thus creating diversity. And so, a system that was adjustable for the user was needed to create a comfortable human-machine environment. The handlebar, as the main steering device of a motorcycle is a crucial part in a comfortable motorcycle ride experience. The handlebar station represents a collection of motorcycle parts which are needed in order for the user to control and maneuver the motorcycle. Parts like triple clamps, top yoke, handgrip, levers, controls, and gauges, which are needed to operate the motorcycle are attached in the handlebar station and thus the development of an adjustable system for the handlebar may help a lot of people.

The concept design needs a product mission statement to communicate the purpose of a concept. It contains the description of one product, in which from those descriptions will be given explanation. The product design statement is listed in the table below.

Table 1. Product mission statement

Mission Statement: Adjustable Handlebar	
Description	Contraption of a motorcycle handlebar in which its position can be adjusted
Primary Market	Motorcycle manufacturer Motorcycle workshops
Secondary Target	Motorcyle riders 'Ojek' riders
Assumptions	Manufactured with a lightweight, but durable material Its position is adjustable, and able to lock in position firmly Ergonomic and comfortable to use

2. Method

Concept design is done by following the procedure below:

- Survey to identify customer needs
- Create a contraption in the concept that focuses on answering customer needs
- Gather anthropometric data for specification design
- Pick the material used in the concept
- Adjust design specifications of the concept according to the anthropometric data
- Create a 3D model according to the adjustments made

3. Result and Discussion

To know the interest of people in the developed product, we asked people around Universitas Tarumanagara who voluntarily gave their response to some questions about their experience in riding the motorcycle, either as a rider or as a passenger, although some responder may not answer all the questions given. When asked about how long they were on the road on the motorcycle in one day, out of 27 people 11 of them spent 10 to 30 minutes on the road on the

motorcycle (40.7%), 7 of them spent 31 minutes to an hour on the road on the motorcycle (25.9%), 6 of them spent more than one hour on the road on the motorcycle (22.2%), and 3 of them spent less than 10 minutes on the motorcycle (11.1%), as shown in Figure 1.

How long do you usually ride a motorcycle in one day?

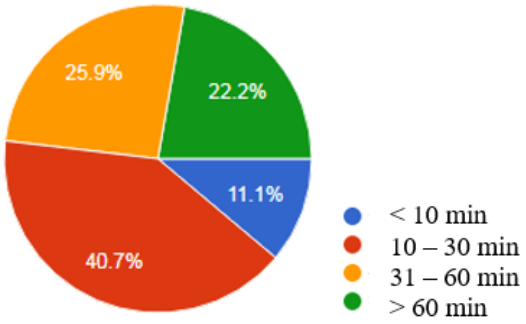

Figure 1. Amount of time spent on the motorcycle daily

When asked about whether they had any complaints while riding the motorcycle, 18 out of 26 responders (69.2%) agreed that they had complaints while riding the motorcycle, and the rest (30.8%) denied that they had complaints while riding the motorcycle. When asked about what their complaints was or if they had any complaints while riding the motorcycle, answers varied from 25 responders, 9 people complained about the height of the handlebar of their motorcycle, 12 people complained about the distance of the handlebar to their torso. 5 people complained about the width of their handlebar. 8 people complained about the weight of the handlebar, 4 people complained about the angle of the handlebar, and the rest individually complained about the girth of the handlebar, the distance of the handlebar and the brake pedal, the state of the handlebar that forces them to tiptoe while riding the motorbike, and the hardness of the grip. Last, when asked whether the development of an adjustable handlebar is useful, out of 27 people 18 (66.7%) agreed, 8 people (29.6%) were not sure, and one person (3.7%) disagreed, as shown in Figure 2.

If there is a product that can adjust the handlebar position, do you think it will help?

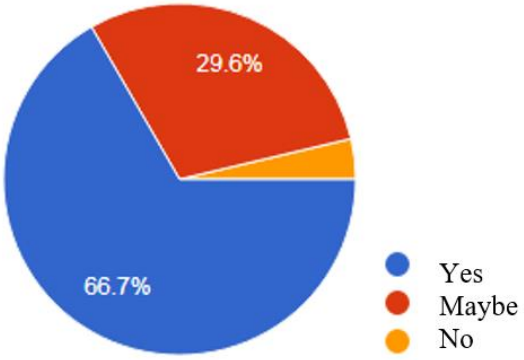

Figure 2. Amount of responders agreeing that development of adjustable handlebar is useful

The material used in the design is determined by checking the compatibility of the mechanical and physical properties of the material to the required mechanical and physical properties. The material used in the design needs to fulfill these requirements:

- Lightweight
- Has high yield and tensile strength
- Has good elastic modulus
- Has good shear modulus
- Has good corrosion resistance

With the requirements set as above, aluminium alloy 7075 was chosen to be the main material of the handlebar. The mechanical properties of Aluminium Alloy 7075 is shown in Table 2 [12-15].

Table 2. Mechanical properties of Aluminium Alloy 7075

Mechanical properties of Aluminium Alloy 7075	
Temper	T6 (Solution heat-treated–artificially aged)
Elastic Modulus	10.4×10^6 psi
Shear Modulus	3.9×10^6 psi
Yield Strength	70×10^3 psi
Tensile Strength	78×10^3 psi

Even though Aluminium Alloy 7075 was chosen as the designated material of the concept from the mechanical property standpoint, the use of aluminium is also connected with some additional. Compared on a pure mass basis, aluminium price is higher than steel. It is more meaningful to compare the material price depending on a volume basis or based on the applied surface. There is yet another addition in process–related costs for aluminium processing due to existing equipment not optimally suited for processing aluminium or missing knowledge and experience in processing aluminium [16-18]. Anthropometric data is also needed to specify the size of the handlebar. Some relevant anthropometric data was taken from Indonesian people aged 17 and up and is listed in the table below [17-18].

Table 3. Anthropometric Data of Indonesian People Aged 17 and Up*

Dimension	Explanation	5%	50%	95%	SD
D10	Shoulder height (seated)	48.98	60.61	72.24	D10
D11	Elbow height (seated)	18.96	29.27	39.57	D11
D17	Shoulder width	32.9	43.26	53.62	D17
D18	Upper shoulder width	29.7	37.08	44.47	D18
D22	Upper arm length	28.98	35.1	41.21	D22
D24	Front arm reach	51.13	69.65	88.16	D24
D25	Shoulder-grip length	48.3	59.39	70.48	D25
D36	Front shoulder-grip length	50.79	67.41	84.04	D36

*measurements in cm

After going through the design process, results came out in form of a 3D model of the prototype was made using Autodesk Fusion 360 to help visualize the concept made in the process. The initial prototype, as shown in Figure 5 and Figure 5, focuses on the ability to apply parallel

movement on the handlebar, granting the freedom for the user to adjust the parallel distance between the body and the handlebar.

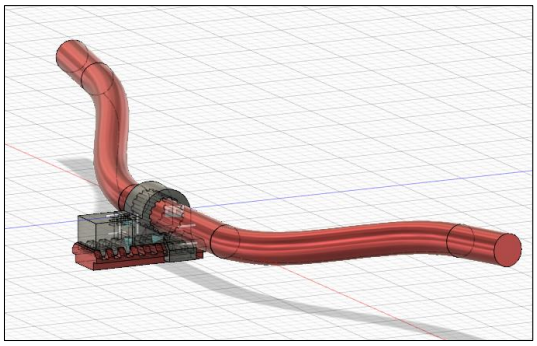

Figure 3. Adjustable handlebar

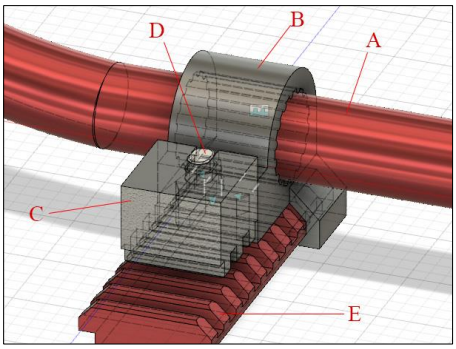

Figure 4. Part of the adjustable handlebar

A. Handlebar : used for steering the motorcycle
B. Riser : used for keeping the handlebar in place
C. Riser rail : part of the riser used for locking the riser in any position along the rail
D. Slide lock : used for locking the riser rail by jamming the riser rail from lifting up
E. Railing : used for locking the riser to the designated position adjustment.

The contraption of the adjustable handlebar consists of a slideable riser that slides along the railing and has a liftable railed part. The riser rail hold a slide lock that is useable for locking and unlocking the top of the riser rail for adjustments. Pictures of the locked riser is shown in Figure 7.

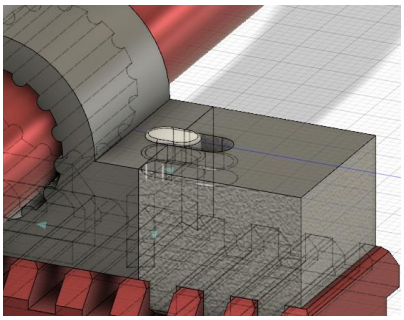

Figure 5. Locked riser

Specification was set as in Table 4, adapting the anthropometric data to the dimension of the design, maximizing efficiency of muscle work and reducing chance of fatigue.

Table 4. Design specification

Design Specification	
Length	72 cm
Diameter	2.5 cm
Material	Aluminium Alloy 7075
Railing Length	9 cm
Railing Width	4 cm
Riser Width	3 cm

4. Conclusion

The development of an adjustable handlebar enables adjustable comfort for users with various sizes. The use of Aluminium Alloy 7075 was used for a lot of motorcycle parts because of its light weight, but tough characteristics. The use of Aluminium Alloy 7075 is also suitable to create complex designs because of its good formability for custom made designs like 3D models created using Autodesk Fusion 360. This concept is finished and is open for further design processes and improvements.

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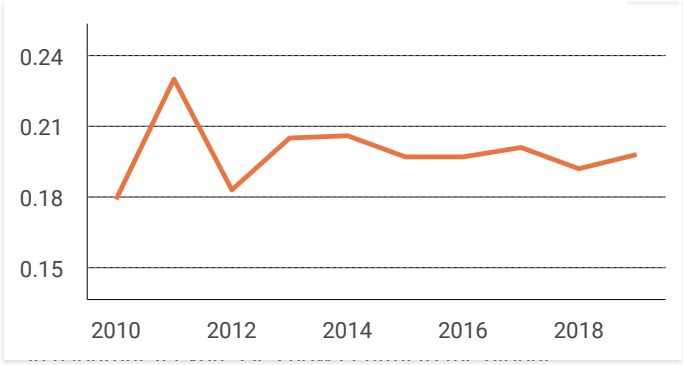
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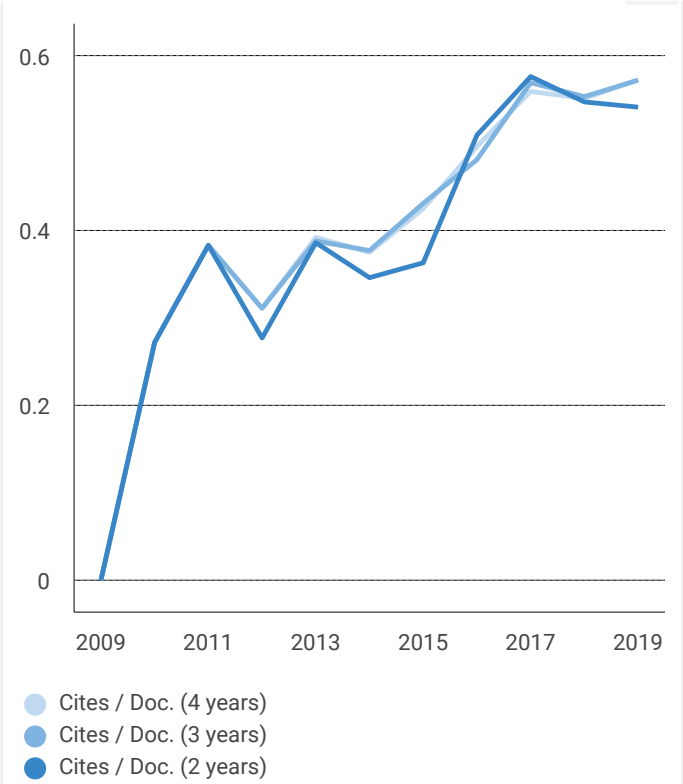
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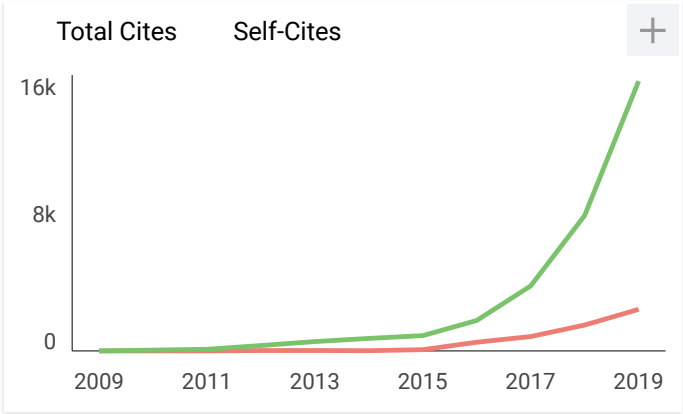
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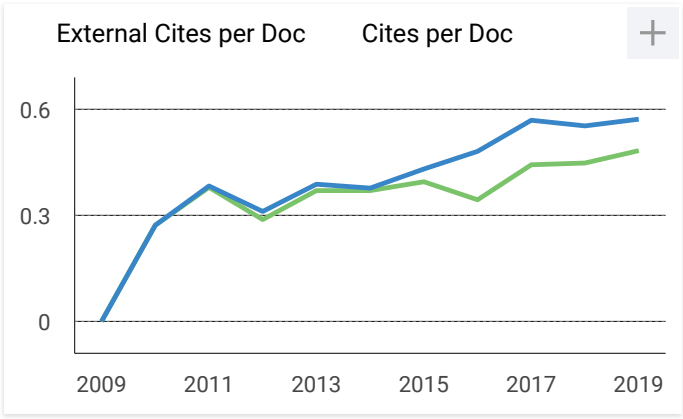
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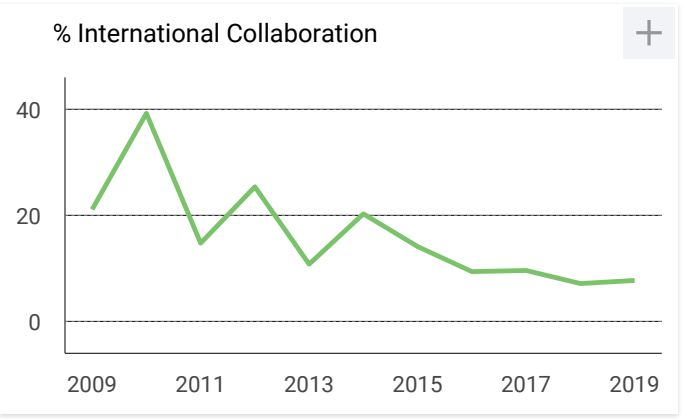
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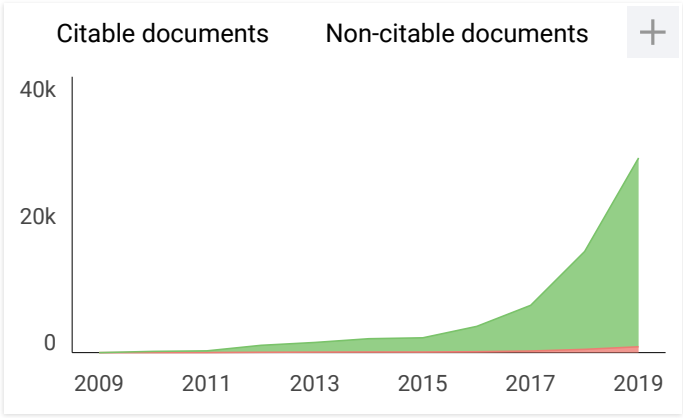
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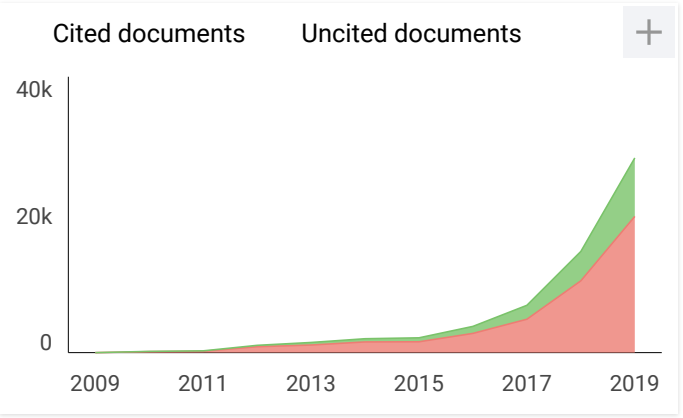
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