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# Preliminary Design and Packaging of Two Passenger Micro-Electric Vehicle (MEV)

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***Abstract*: This project titled Preliminary Design And Packaging Of Two Passenger Micro-Electric Vehicle focusses on the 5$^{th}$ percentile for women and the 95$^{th}$ percentile for men drivers. A micro electric vehicle (MEV) is a vehicle controlled by an electric engine, rather than an inside ignition motor. This project produces packaging design of two passenger MEV according to the Economic Commission of Europe (ECE) regulation and purpose for 3D modeling. There are two software of CAD has been made by using this project which is Solidworks and Catia. The sizing of manikin has used the sizing of United Kingdom to follow the requirement of ECE regulation. Meanwhile, to calculate the posture of manikin is used concept RULA and REBA. The sizing of height structure was added because of the 95$^{th}$ men driver can't enter the car.***

***Keywords: Micro-electric vehicle, Packaging design, ECE regulation, Ergonomic, RULA, and REBA.***

## I. INTRODUCTION

Since the early 21$^{st}$ century, problems due to climate change or global warming have been rigorously discussed by several governments. Large amount of related reports have exposed the adverse effect of climate changes lead by human activities. Due to the worldwide raising civilization and industrialization, a huge amount of fossil fuel burnings in industries have led to the severe problem of air pollution.

A micro electric vehicle (MEV) is a vehicle controlled by an electric engine, rather than an inside ignition motor (ICE), and the engine is run utilizing the power put away in the batteries. The batteries must be charged much of the time by connecting to any 120 V or 240 V supply. With the growing fuel issues, it has become essential for people to use improved forms of energy to fuel their vehicles. This is achieved in the recent days by switching to electric vehicles. These vehicles consume low energy and are known for their efficiency which makes them one of the ecologically friendly automobiles. The idea of using electric cars was imposed by the global fuel shortages. Most people own or rent vehicles in their lifetime and most of the vehicles are powered by the internal combustion engines (ICE). Currently, there are a number of new vehicle types distributed all over the world, like wildfire. They are vehicle-powered by an effective source of energy and not restricted to fossil fuels. These are the new variety of cars usually known as electric cars. Packaging design is essential in the automotive industry.

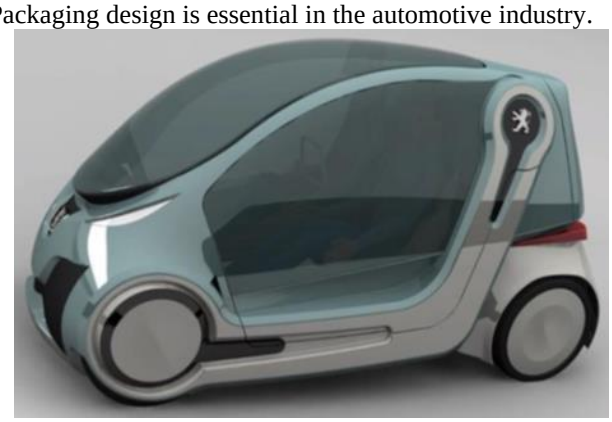

**Fig. 1.Micro electric vehicle**

## II. LITERATURE REVIEW

### A. Packaging design

In automotive industry, packaging describes the activities involved in tracing several systems such as the power-train, climate-control, fuel, and mechanisms including occupants in-vehicle space. (Bhise, V. D. 2016). Packaging refers to the space allocation for various vehicle systems, accommodating people and provide storage places for numerous items that people put in their vehicle.

The term packaging involves the task of package engineering is essentially "bringing in system and components" produced by different suppliers and fitting the item into the vehicle space, so the vehicle function properly to satisfy customer and user of the vehicle.

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The packaging is vital for this research because of making the aspect for vehicle design. The packaging design is one of the main objectives to set up the driver and passenger to comfortable and save at that car. Besides that, to create an envelope around them and use key reference data within their geometries to set up the rest of the vehicle package.

### B. Electric Vehicle

Electric vehicles are broadly considered to have great potential for reducing emissions from transportation. An EV instead of ICE, runs on an electric motor which is powered using the stored batteries (Ding, N., Prasad, K., & Lie, T. T. 2017). Authors state that the EV has a great potential to reduce emission from transport. Using a main power supply, these batteries need to be recharged very often. EV drives the wheels using electric motors. The EVs draw power from large, rechargeable batteries. The range is measure used to measure the distance that an EV can drive between recharges (Louise, B. S. H., David, H. 2018). Different categories of EV include all-electric EV, plug-in hybrid (PHEV), hybrid (HEV), and fuel cell vehicles.

### C. Ergonomic

Ergonomic is not always the car controls and instruments, but it applies to any design that involves people; namely at recreation, sports, workplaces, safety and health. However, this paper focuses on drivers and passenger in the car. Ergonomics improves workplaces and surroundings to reduce the risk of damage or injury. As an when there is a change in technology, we need to confirm that the tools that we make use of at work, play area and recreation are designed satisfying the requirements of the body.

Percentile Humans Anthropometric proportions for each population are ranked by dimensions and defined as percentiles. It is public practice to strategize the 5$^{th}$ percentile (5%) female until the 95$^{th}$ percentile (95%) male. The 5% female value for a particular dimension usually represents the smallest measurement for design in a population. Conversely, the 95% male value may represent the largest dimension for which one is designing. The 5% to 95% range accommodates approximately 90% of the population. To design for a more significant portion of the population, one might use the range from the 1% female to the 99% male.

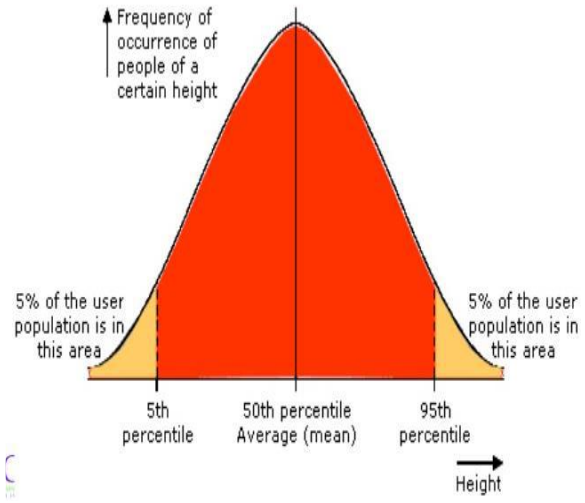


**Fig. 2.Consideration of the population**

## III. METHODOLOGY

### A. Flow chart of this project

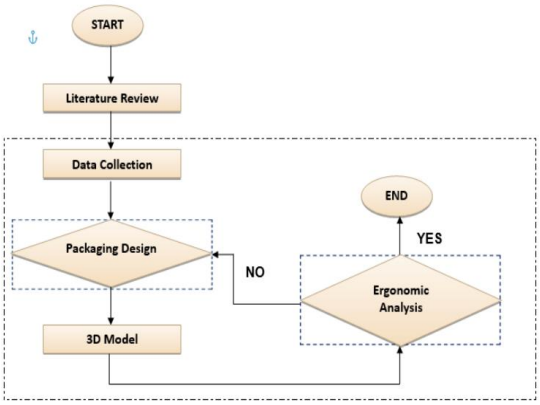


**Fig. 3.Flowchart of the project**

### B. Solidworks and CATIA

The designing process started by overviewing the body of the structure before the other components design. For example, the exterior shell, manikin, front structure, bottom body base, and crumping zone. Then, make an assembly drawing to combine all parts conducted by the group

**Fig. 4.5$^{th}$ and 95$^{th}$ percentile driver**

### C. Anthropometric data

Anthropometric data is the necessary process that should find to make a manikin-based on ECE regulation. United Kingdom people data is chosen for properties of the regulation. It shows the sizing of the body for the 5th percentile for women and the 95th percentile for men.

### D. RULA and REBA

Rapid Upper Limb Assessment or known as RULA, is a posture targeting method to estimate the risks of work-related upper limb disorders. REBA stands for Rapid Entire Body Assessment. To evaluate whole-body postural and risks associated with job tasks the ergonomic evaluation tool uses a systematic process.

Based on the assessments, the score values for each body region is entered in section A for the arm and wrist, centainly, section B is filled up for the neck and trunk. After the data for each area is gathered and recorded, tables on the form are then used to compile the risk factor variables, producing a single score that signifies the level of risk.

RULA worksheet is categorized into two body sections. Table A score section at the vertical side that covers the arm & wrist analysis. Table B score section cover neck, trunk & leg analysis at the horizontal side. RULA covers from wrist to head; meanwhile, REBA covers all positions of the body.

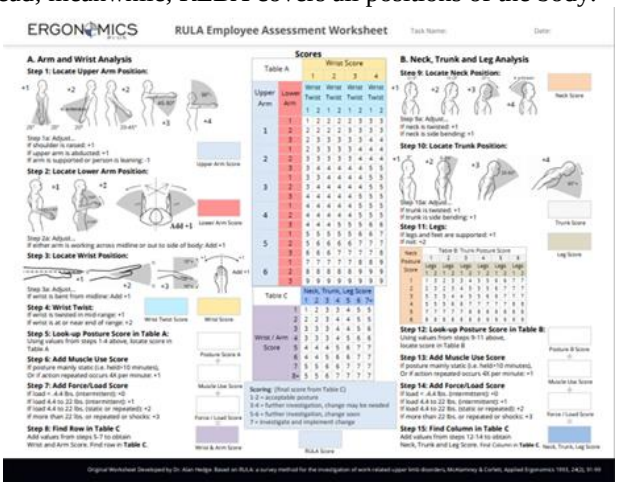


**Fig. 5.RULA employee assessment worksheet**

## IV. RESULT AND DISCUSSION

Based on table 4.2, the score of posture arm and wrist at table A is 4. Which is calculate based on table A. Then to complete the score for arm and wrist analysis is used to find the row on table C be added from step 5 until step 7 which is 5 (4+1+0=5). Based on table 4.4, a score of posture neck, trunk and leg analysis at table B is 2. Which is calculated based on Table 1. Then, to complete the score for the analysis is used to find the row on table C be added from step 12 until step 14, which is 5 (2+1+0=3). The final score for this RULA procedure is 4. The result shows it still needs investigation in further based on table 4.6.

**Table- I: Scores**

| Score | Final Score |
|---|---|
| 1 or 2 | Acceptable |
| 3 or 4 | Investigate further |
| 5 or 6 | Investigate further and change soon |
| 7 | Investigate and change immediately |

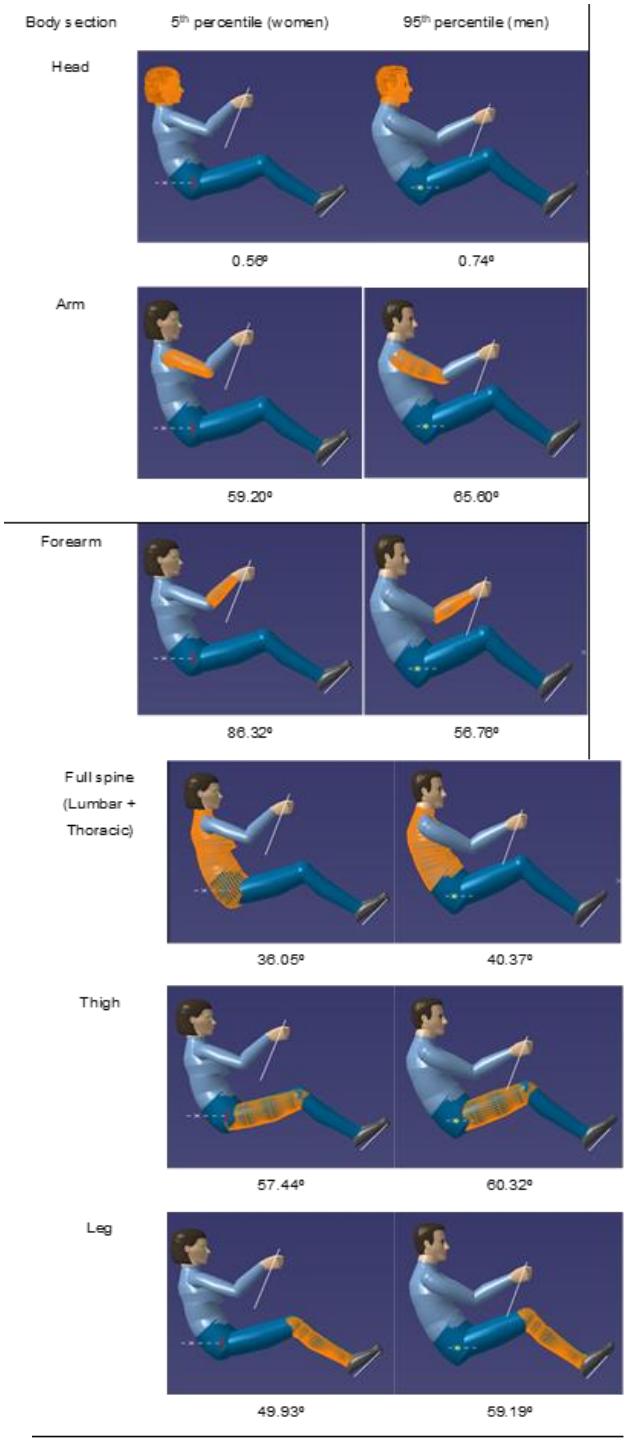


**Fig. 6.The result of posture in degree for the body section**

## V. CONCLUSION

This project has successfully achieved the objective by product packaging design based on ECE regulation which is repaired the structure of the design to insert the driver and passenger into the microcar. Based on the experimental result, the following conclusion can produce a packaging design based on requirement of ECE regulation and optimize the micro vehicle based on result dimension and show the final score for the body assessment is 4.

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