

Design and Development of an Enhanced Mobile Automated Transporter (E-MAT) for Material Transfer

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ABSTRACT – At present, the established method and the most practical technique for transporting small to medium objects are using a trolley. However, the problem with regards to the usage of a trolley is its inability to adjust the height and manually movement. Therefore, it is important to propose a mechanism to address this issue. The main objective of this paper is to propose a new innovative product known as an Enhanced Mobile Automated Transporter (E-MAT) that can automatically control the movement of the device. Practically, the adjustable height feature of the product will ease the loading process and reduce the back pain problem of the users. In addition, the layout control mode of the product, helps the user to transport the objects to the designated location automatically. Besides that, E-MAT is also built with Bluetooth control mode, where the user can move freely without restriction. The methodology of this research is conducted. Result shows that developed prototype manage to characterized a payload up to 30kg, lifting speed of 0.025m/s and travel speed of 0.3022m/s.

1. INTRODUCTION

Trolleys were initially formed to facilitate users transport items when they are shopping by putting items inside it. A good example is shopping trolleys and folding shopping trolleys [1]. These products have proven beneficial since they reduce the user's burden of transporting objects and goods around. However, based literatures, each of these items has its own set of limitations. Apart from that, some trolleys are not ergonomically designed since they are too high or too low for the user [2]. As a result, it is unsuitable for some users, particularly older citizens, pregnant women, and the handicapped. Its design makes it difficult for certain users to accomplish specific tasks, such as moving a large trolley, loading, and unloading heavy items from the trolley, and maintaining the trolley. In a workplace like hospitals, hotels, and factories, the worker also uses trolleys during their work hour [3-4]. Owing to the reason, there is a solid reason on why there is a need to design a more advanced version of trolley or material transporter to cater the issue [5]. The objectives of the research work is to design and fabricate an improved version of E-MAT.

2. METHODOLOGY

The process flowchart, design requirement and the isometric overview of an Enhanced Mobile Automated Transporter (E-MAT) is shown in Figure 1. To determine the customer requirements and the problems faced when using normal trolley, feasibility study, task analysis and product design analysis were performed.

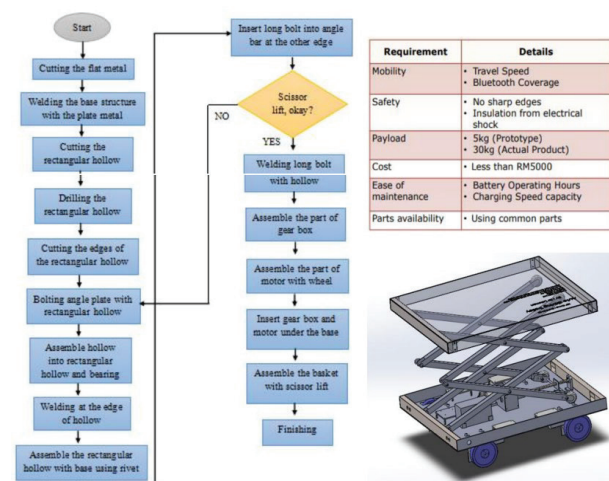


Figure 1 : Process flowchart and overview of E-MAT

3. DESIGN OF THE ENHANCED MOBILE AUTOMATED TRANSPORTER (E-MAT)

E-MAT consists of 3 main modes that will support the functionality of the product. Each sub-system will have its own designed function to tackle the problems associated with the current design of the specimen trolley. The modes that made up an enhanced mobile transporter are Bluetooth control mode, layout mode, and dual control lifting mode. The first mode is Bluetooth control mode. It is design using the Arduino mega board as the main microcontroller connected to other electrical circuit. The functionality design of the product involves Arduino programming and MIT app inventor. When the code is being transferred to the product, user can use their phone to connect with the product. By using the MIT app inventor, the product can be control using phone.

The second design is the layout driving mode

which is employed to transport the object to its target destination. It can also return to its original position. The third mode is the dual control lifting mode. This mode is for adjusting the height of the product which can be controlled by using the MIT app inventor and button.

The mechanical body of the transporter is formed by 3 parts which are the platform, scissor lift, and driving unit that represent the upper, middle and lower parts respectively.

4. RESULT AND DISCUSSION

The performance result of the developed prototype is analyzed using Solidwork software. The analysis involved is mechanical stress-strain analysis as shown in Figure 3. The wheel bracket and the lower base are designed in such way it could manage to withstand up to 100 kg

The other criteria analyzed are maximum height, gear ratio, output torque, travel speed, lifting speed and payload.

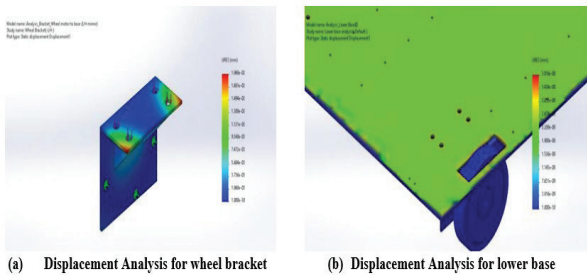


Figure 3: Stress-strain analysis for wheel bracket & lower base

Based on the analysis, the height of the transporter from the wheel until the upper base is around 23cm when fully closed. When the transporter is fully extended, it manages to reach up to 110cm, which has satisfied the requirement determined in the feasibility study of 90-100cm of desired customer requirement.

The lifting mechanism of the transporter is fulfilled by controlling the extension and retraction of the screw thread which involve using a gear down gearbox to reduce the speed and increase the torque. Figure 4 shows the connection of motor to the screw thread and the calculation of gear down ratio and output torque of the lifting mechanism.

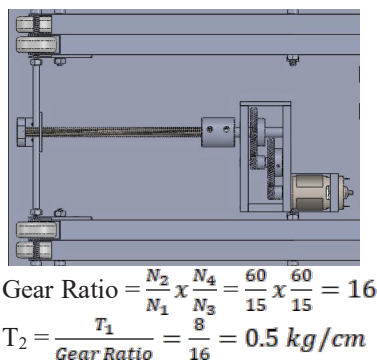


Figure 4: Lifting Mechanism and Gear ratio calculation

Table 1 tabulates all the analysis performed and their result.

Table 1: Analysis Criteria and Result

Analysis Criteria	Result
Maximum Height	110cm
Gear Ratio	0.0625:1
Output Torque	128kg/cm
Travel speed	0.3022m/s
Lifting speed	0.0250m/s
Payload (prototype)	5kg

5. CONCLUSION

In conclusion, by utilizing the flexibility of Bluetooth and microcontroller technology as well as the design analysis using Solidwork software, the purpose of designing an enhanced version of an automated mobile transporter have successfully achieved.

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