# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

# DEVELOPMENT OF AN AUTOMATIC LIFTER USING ARDUINO

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Robotics and Automation) with Honours.

by

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This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Industrial Automation & Robotics) with Honours. The member of the supervisory is as follow:

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## ABSTRAK

Lifter automatik adalah digunakan untuk mengendalikan beban berat dengan kelajuan pantas, kebolehpercayaan yang tinggi, keselamatan dan ekonomi. Terdapat sebuah syarikat telah membuat pesanan untuk menaik taraf lifter dijadikan sebagai dua fungsi iaitu manual dan automatic. Syarikat ini ingin mengurangkan masa yang diambil untuk menggunakan tenaga kerja demi mencapai waktu target perusahaan mereka. Oleh itu, lifter automatik ini direka untuk bergerak secara automatik dan dikawal oleh IoT menggunakan aplikasi Blynk. Lifter automatik ini mempunyai tiga objektif yang perlu dicapai. Pertama adalah untuk meningkatkan perkembangan lifter automatik menggunakan Arduino. Ia menggunakan Arduino Mega sebagai mikrokontroler kerana keperluan untuk menggunakan banyak port. Seterusnya, objektif kedua adalah untuk mereka bentuk sistem penghalang halangan untuk lifter automatik. Objektif ini akan dilakukan dengan menggunakan sensor jarak analog SHARP. Terakhir, objektif ketiga adalah untuk menganalisis prestasi gerakan alat pengangkat automatik untuk gerakan menegak dan mendatar. Pengangkat ini boleh mencapai kira-kira 66cm untuk ketinggian yang lebih tinggi dan ketinggian yang lebih rendah adalah kira-kira 30cm. Matlamat projek ini adalah untuk menjadikan pengangkat mengendalikan automasi sepenuhnya tanpa panduan manusia. Ia boleh dicapai dengan membangunkan langkah lifter automatik dalam baris berikut yang boleh mengikuti garisan hitam yang ditarik pada permukaan warna yang berbeza. Semua objektif dalam projek ini dapat menunjukkan bahawa lifter telah berkembang secara automatik dan boleh digunakan dalam industri.

## ABSTRACT

Automatic Lifter is a screw scissor lifter that used to handle heavy loads with fast speed, high reliability, safety and economy. There is a company have making an order to upgrade a lifter to become in two ways function which is in manually and automatically where can move in vertical and horizontal. The problem is this company want to decrease the time taken for manpower use the lifter during do the services, so they want to improve the automatic lifter to reach target time of their company. Thus, this automatic lifter is design to move automatically and control by IoT using Blynk application. This automatic lifter have three objectives that need to achieve. First is to improve the development of automatic lifter using Arduino. So that it will use Arduino Mega as the microcontroller because its need to use a lot of port. Next, second objective is to design an obstacle avoidance system for automatic lifter. This objective will done by using SHARP analog distance sensor. Lastly, third objective is to analyse the motion performance of the automatic lifter for vertical and horizontal motion. This lifter can reach about 66cm for higher height and the lower height is about 30cm. This project aim is to make the lifter operate fully automation without human guidance. It can be achieve by develop the automatic lifter move in line following which can follow a black line drawn on the contrasting colour surface. All the objectives in this project can demonstrate that the lifter have been develop automatically and can use in industry.

## ACKNOWLEDGEMENT

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## LIST OF SYMBOLS

| | | |
|---|---|---|
| **cm** | - | Centimetre |
| **kg** | - | Kilogram |
| **rpm** | - | Revolutions per metre |

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

This chapter presents the background, problem statements, objectives and work scope of the project. It focuses on the overview, the objectives to be achieved, the work scope and outcomes of the project.

## 1.2 Background

Screw scissor lifter is one of the simple mechanical device used to lift up component or object to a certain height from ground level to accomplish a particular task with maximum load and minimum effort. Scissors lift is a lift with a lever system that allows the metal platform to move vertically. This device is folding supports in a crisscross pattern with achieved by using of linked, known as a pantograph also called as scissor mechanism (Jeyangel, 2015; Olenin, 2016). The outside of the lowest set of support is applied by pressure in order to create the vertical motion, due to this pressure the crisscross pattern elongates to propel the work platform vertical upwards (Thorat, Chiddarwar and Prasana, 2017). Scissors lift platform with considerable comprehensive space can be used indoors or outdoors. Although, it can be used in the mechanical sectors, automatic manufacturing lines, the basements and physical distribution lines, and so on. Scissors lift is also an integral part of most of the workshops and building objects (Hongyu and Ziyi, 2011; Cabrita, 2016). The scissor lifts can be perform according to energy as hydraulic, pneumatic or mechanical, whereby each of these mechanisms need to study and modify according to its application in industries (Manoharrao and S, 2016).

Next, scissor lift design is ergonomics where is preferred over other heavy lifting devices available in market. Scissor lift are classified as permanent and portable lifts on the basis of the mounting condition ('Design and Fabrication of Mechanical Lift for Transportation', 2016). The scissor lifting platform is an example of a permanent lift and scissor jack. For this project will improve the scissor lift become automatic lifter that can use in industry to lift up heavy loads in higher condition in manually and automatically. These automatic lifter apply to handle heavy loads with fast speed, reliability, safety, economy etc (Miková *et al.*, 2014). These device increase output, improve quality, speed up the deliveries and therefore, decrease the cost of production. The advantage of lifts is to offer the best way to organize a technological and industrial process.

This automatic lifter was control by Arduino Mega as the controller which is control in horizontal and vertical motion. These project with the size 61cm x 46cm can lift up heavy loads about 50kg and the higher height is 66cm. There SHARP analog distance sensor act as IR sensor for obstacle avoidance and limit switch for lower and higher condition limit. This obstacle avoidance system are used for precaution for user which is the lifter will stop when detect any obstacle. Other than that, this automatic lifter are used line maker for based follower that can make the lifter move automatically. Moreover, this automatic lifter was control by Internet of Things (IoT) which is using Blynk application. It is because the IoT is a network of simple devices that interact over the internet to perform a single function in a more intelligent way (Baig *et al.*, 2016) .

## 1.3 Problem Statement

SARAKOM Enterprise, Johor has making an order to upgrade a lifter to become in two ways function which is in manually and automatically where can move in vertical and horizontal. The problem is this company want to decrease the time taken for manpower use the lifter during do the services, so they want to improve the automatic lifter to reach target time of their company. Then, the company request the automatic lifter can detect obstacle, so it will cut course for maintenance and reduce a collision.

## 1.4 Objective

1. To improve the development of automatic lifter using Arduino.
2. To design an obstacle avoidance system for automatic lifter.
3. To analyze the motion performance of the automatic lifter.

## 1.5 Scope

In this project, automatic lifter were designed based on research, ideology and concept of project. This project are focuses on the industrial requirements which is in automation industry. This is an IoT project which is use Blynk application to control the lifter. Arduino Mega are used as the controller for this project and ESPWiFi Shield was attached together with Arduino for Blynk connection. Another electrical component that use is limit switch for higher and lower limit and analog distance sensor for detect obstacle. This lifter can carry load about 50kg and it can lift up until 66cm while the lower limit is about 30cm. This project suitable use for outdoor especially for small workshop. Besides that, the function of each component will discuss in this report.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

This chapter is learning on the previous investigation that interconnected with the project. The purpose of this chapter is to gain more information, to provide present of the knowledge, skill to develop the project and also to findings the concept and outcome related to same field on the automatic lifter.

## 2.2 Automatic Lifter

Scissors elevator is an elevator with a system of hydraulic cylinders on which the metal platform is capable of moving in the vertical plane. The modern in elevator was develop in the 1920s. This scissors elevator has since become an indispensable of equipment in manufacturing and warehousing operation. An elevator design can be categorized into two main types, permanent and portable (Olenin, 2016; Rani, 2018). Figure 2.1 and 2.2 below shows the example of permanent and portable types of elevator.

**Figure 2. 1:** Mobile lifting platform (Georgy Olenin 2016)

**Figure 2. 2:** Launching and unloading platform (Georgy Olenin 2016)

All design concepts are discussed on the basis of the criteria and process developed, and the functionality of the design are modified to further. The consideration made during the design and fabrication is follows as the functionality of the design, manufacturing and economic availability. The most important factor for designing this system is by selection of the material where it depends on a component and tasks that performs. There are several technical characteristics that needs to follow during fabricate this lifter such as loading capacity, height of rise, rise time, lowering time, initial height and power supply. Every mechanism of different parts takes different loads and stresses because of their different functions. (Thorst et al. 2017).

In industry there are many lifting system for example telescopic lifting, articulated maintenance lifts and the most popular is scissor lifting system. Normally, this scissor lifting is use maintenance repair and cleaning. In this case, the system was designed with double scissor on both sides. This scissor was use hollow for rectangular profile with their dimension. Type of material that used is St37 (S235JR) and St50 (E295) steel as pins in this scissor lifting system. In manufacturing industry, these materials are commonly used because it is low cost and easy supply (Görkem Dengiz *et al.*, 2018) .

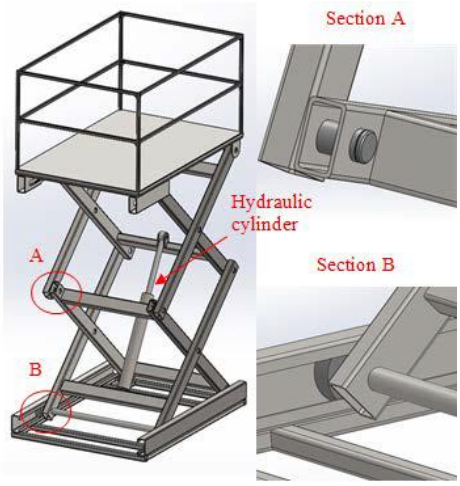


**Figure 2. 3:** Double scissor lifting system (Görkem Dengiz, Can Şenel, Yıldızlı, & Koç, 2018)

Coiled spring pallet lifters is one of the lift system were designed to perform the fully extended position when there are certain low weight present in the top surface of the coiled. Besides, the raising pallets can be effective by coiled spring pallet lifters, which these coiled spring are generally huge, and needs a hydraulic pallet lifter to raise the pallet. The top support surface can manually or mechanically raised and lowered because of the pallet lifter. The raised and lowered of the lifter was happen only a few inches above the floor surface so that a hand pulled pallet mover can easily load the pallet of goods onto the top surface (Jay, 2015).

In order to design any lifting system, certain characteristics must be followed: loading capacity, height of increase, lifting time, reduction time, initial height, total mass and power supply. Nowadays, scissor lift is a fundamental part for workshops and building objects usage (Ubale, Francy and Sherje, 2015). Then, all lifts give probability to change of their installation without use much effort because it is important in the usually changing condition in the production process even it can be the best way to organize a technological and industrial process. Mild steel is one of the type carbon steel that use to fabricate lifter because it is hardness and stiffness. However, mild steel have their disadvantage where it is heavy material so that it not be easy to installing process. Next, the expansion rate in changing temperatures is high and it can cracks and more corrosion.

Moreover, there are many different type of drive to design methodologies of scissor lift. Hydraulic scissor lift is the most popular drive among the lifter because hydraulic system can give high pressure to operate the lifter. The scissor lift can also be used to provide hydraulic drive for standard mechanical mounting in sector (Journal, Technological and Chimote, 2019).

## 2.3 Mechanism of Automatic Lifter

### 2.3.1 Mechanical Lift

Screw scissor lift is one of mechanism that use for lifter system. The lift is connect with a drive controller that can be used to control and provide power to the drive mechanism (Mark T. Hanlon et al. 2106). Figure 2.5 will shows the design of screw scissor lift where a lift support a payload which special significance on the support angle. The scissor arm, helical wire spring, electric motor, and the actuator screw was support by lift base frame. The actuator screw drive the scissor arm while the scissor arms was support the upper platform, which supports the payload. To lift the payload and the travel between an extended and retracted position, a first pair of scissors arms was disposed. Energy will store in energy storage device as the payload is lowered and once the payload is raised, will provide further lift to the payload.

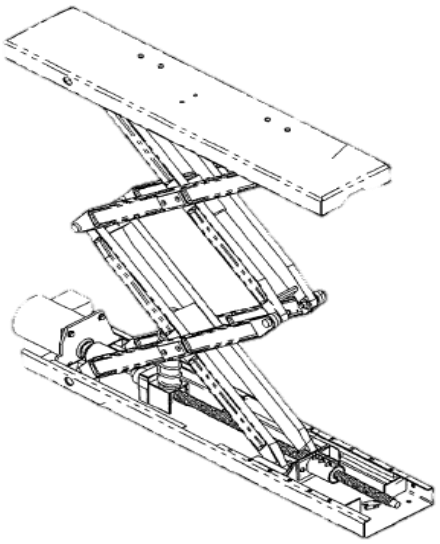

**Figure 2. 4:** Design of screw scissor lift
(Mark T. Hanlon et al. 2106

Another mechanism can be used for scissor lift is powered by gear mechanism. Gear powered scissor lift were consists with several component which is spur gears, scissor arm, platform and one horse power electric motor. All the components are designed and it use Automated Dynamic Analysis of Multi Body Dynamics Simulation Solution to simulate the mechanism. The mechanism can performed a detailed kinematic analysis and also for different length to radius ratio, maximum translator displacement is measured. Varying the number of links can achieve the different lift height (Jeyangel, 2015).

In order to design a spur gear transmission, there some calculation to decide the size of gears. With modern technology, it can be easily determine one of the often-performed mechanical engineering tasks, requires a lot of long and complicated tedious computations. Every model of a spur gear transmission of design procedure are following necessary steps which is selection of gear is based on evaluation parameters and the gear tooth strength, corresponding calculations of the shaft's strength and rigidity for shaft design and last is the calculation lifetime of the beagings. Figure 2.5 show the gear transmission where all calculation are based on the three main distances (Geramitcioski and Trajcevski, 2003).

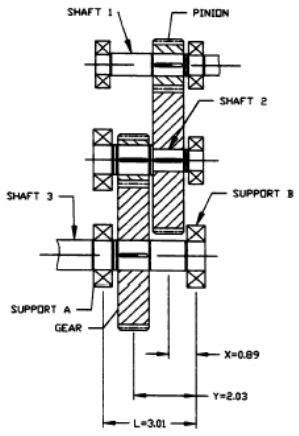


**Figure 2. 5:** Shematics of gear transmission
(Geramitcioski and Trajcevski, 2003)